An Evaluation of the Cost-Effectiveness of Carbon Reducing Policies Related to Electric Utilities in the United States

Putting a Price on Carbon: An Evaluation of the Cost-Effectiveness of Carbon Reducing Policies Related to Electric Utilities in the United States

Kelly S. Earls

A Thesis in the Field of Sustainability

for the Degree of Master of Liberal Arts in Extension Studies

Harvard University

May 2019

Abstract

This thesis examined different types of carbon reducing policies implemented by legislation or administrative laws or rules across all fifty states in the United States and assessed which policies have been the most cost-effective. This is imperative to address a policy need to determine what carbon reducing policies should be implemented.

The policies explored were: 1) implementing a price on carbon, either via a carbon tax or a cap-and-trade system. With either a carbon tax or cap-and-trade, an agency can place a legal limit on the amount of CO_2 a utility can emit per a certain amount of energy output, such as per megawatt (MW). Currently, no states participate in a true carbon tax, but ten states participate in a carbon market via cap-and-trade. 2) Energy efficiency (EE) and demand-side management (DSM) measures– both aimed at reducing the utility's load and ultimate consumption of energy. 3) Increase renewable energy use, through mandates or incentives.

An evaluation of all fifty US states was performed, which looked at three variables: first, the trend of each state in reducing CO_2 emissions from 2007-2016 from electric generation; second, the overall cost of electricity in each state from 2007-2016 to determine how the cost of electricity coincided with the trend in CO_2 emissions; and third, what carbon-reduction policies each state had in place. Data were gathered from several sources, and every state utility regulatory commission was contacted to determine what information was publicly available. An assumption was made that the rising cost of electricity would correlate directly with the states that saw reductions in emissions, as

generally the political deterrent to impose more stringent policies is the argument that policies will dramatically inflate the cost of electricity.

However, analysis showed that these were not as correlated as perhaps many would assume. Therefore, a correlation analysis was performed to test for linear relationships between the change in a state's CO_2 emissions and the change in electricity price. This revealed a correlation of 0.37, indicating a weak correlation with reductions in CO_2 emissions and a rise in electric prices. The percentage of change in electricity prices as a number was then added to the percentage reduction in CO_2 and multiplied by the correlation to create an Index of the Relative Efficiency (IRE). The IRE is a new way to determine the benefit arrived in implementing the CO_2 reduction policies congruently with the overall cost of electricity.

The most substantial and surprising take-away from the research is that over the course of ten years from 2007 to 2016, the states with the biggest reductions in CO_2 emissions did not see an overall large increase in the price of electricity. In fact, the top six states that saw the biggest reduction in CO_2 emissions saw on average only a 6.7% increase in electric prices over the ten-year period, less than the national average increase of 27.7%. More surprising, the six worst states at reducing CO_2 emissions saw on average a 51.2% increase in the overall price of electricity.

Therefore, policy makers should not have the overarching concern that overall electric prices are negatively impacted by CO_2 reduction policies, and therefore cost should not be considered a deterrent by legislators in implementing more stringent CO_2 reducing policies.

Dedication

This thesis is dedicated not to the dreamers, but to the doers. The scientists, lawyers, legislators, and all who see climate change as the greatest challenge of our time, and instead of simply pontificating on the matter, or running in retreat, they are actively making strides at this fulcrum in time towards change.

“UNLESS someone like you cares a whole awful lot. Nothing is going to get better. It’s not.” ~Dr. Seuss

Acknowledgements

I must thank and acknowledge the following, numerous people for their invaluable assistance in getting me here today:

My family: my late father, Howard Earls, for always believing in me. Harvard - can you believe it Dad? Well if anyone could, it would be you – my biggest cheerleader. My mother, Claudia Earls, who saw me through my darkest days and back to life and supported me through my loftiest goal yet! My brothers, for making me a tough girl.

My tribe: Darci, Whitney, Sam, Nene, Stephanie, Alison, Heather, Elizabeth, and others – for helping me laugh along the way.

My mentor, Kay Pashos, who took a chance on me.

My doctors, nurses, physical and speech therapists, who brought me back to life.

Fr. Ryan, Sr. Lucia, and Dr. Seuss, who taught me at an early age that we are the caregivers of this tiny blue dot – it is our responsibility, not our possession.

Dr. Mark Leighton and Jen Palacio, who gave me the keys to actually do this; statistics and math are invaluable – who knew? You two did – thanks for teaching me.

My fellow classmates in the program – from presidents of huge corporations to those in the Peace Corp – you could not find a more eclectic or amazing group of people.

Professor Rick Reibstein, my thesis director, for all of his endless support, redlining, questioning, and encouragement; even when I changed everything, repeatedly!

Most importantly - for my little boy, Jackson Howard Earls, who has the mind of a scientist and the heart of a dreamer; my son who will achieve amazing things for he has been given many gifts; my son, the epicenter of my universe and my reason for wanting a better future; I dedicate all that I am, and all that I ever could be, to you.

Biography

The author, Kelly Earls, is currently a Deputy Attorney General for the State of Indiana. She obtained her Bachelor of Arts from Indiana University in 2006, and her Doctor of Jurisprudence from Indiana University, Robert H. McKinney School of Law, in 2011. This thesis is the culmination of her Master of Liberal Arts, Extension Studies – in the field of environmental management and sustainability – from Harvard University, expected graduation May 30, 2019. Before joining the Indiana Office of the Attorney General, she focused her practice on energy and environmental law and policy. She currently resides in Indianapolis with her son, Jack.

Table of Contents

List of Tables

List of Figures

Definition of Terms

Affordable Clean Energy (ACE) Rule – A Trump administration policy which would establish emission guidelines for states to develop plans to address greenhouse gas emissions from existing coal-fired power plants, first proposed by EPA in August 2018. The ACE rule would replace the 2015 Clean Power Plan (Proposal: Affordable Clean Energy (ACE) Rule, n.d.).

BSER – best system of emission reduction.

Cap-and-trade - Systems whereby a limit is imposed on the amount of greenhouse gas that companies may produce, and by which they are allowed to trade their quota with one another. This should, in theory, ensure that greenhouse gases are reduced at the lowest possible cost, as the cleanest companies will benefit by selling their unused quota to laggards (Financial Times Lexicon, 2018).

Carbon market - A market that is created from the trading of carbon emission allowances to encourage or help countries and companies to limit their carbon dioxide emissions. This is also known as emissions and/or carbon trading (Financial Times Lexicon, 2018).

Clean Power Plan – An Obama administration policy aimed at combating climate change from electric generation, first proposed by the EPA in 2014, and ultimately repealed by the Trump administration (McCabe, n.d.)

Correlation coefficient - a value of between (-1) and (1). A (0) means there is no relationship between the variables at all, while (-1) or (1) means that there is a perfect negative or positive correlation (Correlation Coefficient, 2019).

Distortionary taxes - a tax that is intentionally established to reduce market externalities.

Energy Information Administration (EIA) – The statistical and analytical agency within the U.S. Department of Energy. By law, EIA’s data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government (Analysis and Projections, 2019).

Index of the Relative Efficiency (IRE) – for the purpose of this study, the IRE was calculated by adding the percentage change from the CO_2 reduction with the percentage change in the overall price of electricity, and then multiplying by the correlation.

Pearson Correlation Coefficient - is a measure of the strength of a linear association between two variables and is denoted by r (Pearson Product-Moment Correlation, 2019).

PEST Analysis - PEST is an acronym for political, economic, social and technological. It's a way of understanding how external forces impact decisions. It was created by Harvard professor Francis Aguilar in 1967 (Post, 2018). The PEST analysis of the various emission reductions policies included in this study is included in the Appendix of this paper.

Regional Greenhouse Gas Initiative (RGGI) - RGGI is a cooperative effort among nine states – Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island and Vermont. RGGI develops and maintains a system to report data from emissions sources subject to RGGI, and to track CO_2 allowances; RGGI runs a platform to auction CO_2 allowances and monitors the market related to the auction and trading of CO_2 allowances (RGGI, Inc., 2018).

Renewable portfolio standards (RPS) - mandate that a minimum amount of electricity sold must be generated from a renewable source.

Revenue recycling –Recycling revenue would be to use or earmark the revenues generated from a carbon tax or carbon market for a special purpose; such as: to set up grants for research and development of renewables or efficiency; to use a portion to offset the additional cost to those most effected; or in areas highly dependent on coal – to use some carbon tax revenue to assist the transition of these workers.

Utility regulatory commission- generally used in this paper, it is a public utilities commission in nearly all 50 states, led by commissioners either elected or appointed by the Governor. The commission often regulates electric, natural gas, telecommunications, steam, water and sewer utilities

Chapter I

Introduction

Despite decades of regulation, carbon dioxide (CO_2) emissions in the United States increased roughly seven percent between 1990 and 2013 (Overview of Greenhouse Gases, 2015). While the past few years have seen a decrease in energy-related CO_2 emissions, emissions growth was still 20 million metric tons above trend (U.S. Energy Information Administration, 2018). The United States Environmental Protection Agency (EPA) has determined that electric generation remains the largest single source of carbon emission, and electricity production alone contributed 28.4% of 2016 greenhouse gas emissions (U.S. Energy Information Administration, 2018). Approximately 70% of the United States' electricity comes from burning fossil fuels, mostly coal and natural gas (U.S. Energy Information Administration, 2018).

The EPA has adopted various policies and regulations to attempt to curb this increase and reduce emissions from the largest single source of CO_2 emissions — electric generators (EGUs). Various state legislatures and/or state administrative agencies have enacted these policies. There is an economic cost to utility ratepayers to enact these policies, and while it is indisputable that the United States must reduce its CO_2 emissions from power plants, the question remains which policies have been the most effective, and which policies will be most effective in the future when considering the cost of compliance.

Research Significance and Objectives

This research demonstrated a method of comparative analysis of various policies to determine which policies have been the most cost-effective and successful at reducing carbon dioxide pollution. The three policies examined herein were: (1) a price on carbon, either as a market, via a cap-and-trade system, or as a carbon tax; (2) mandated energy efficiency and demand-side management measures with mandated targets; and/or (3) renewable portfolio standards and incentives.

This research is important and timely as individual states, the United States federal government, and the EPA attempt to find ways to reduce carbon emissions from electricity, while taking costs into consideration. Under the EPA's original Clean Power Plan (CPP), the EPA had projected reducing carbon dioxide by existing electric generation by over thirty percent of the 2005 levels (Environmental Protection Agency, 2015). The EPA noted that it was important to consider a thorough "all of the above approach" and that the most successful plans would incorporate various methods to achieve the CO_2 reduction goals.

However, a wrench was thrown into the energy-regulatory world when President Trump issued an executive order in March 2017 to review EPA regulations that encumber energy production, specifically mentioning coal (Whitehouse.gov, 2017). Even though the CPP has been stopped for now, emissions-reduction is included under the new ACE Rule, using a source-specific approach. Therefore, nearly all power plants and emissions in the United States will continue to be evaluated.

What makes this thesis most timely is that more economists in bipartisan agreement support that a carbon tax is necessary to reduce GHGs and a price on carbon, and that instituting a carbon tax will cost less than combating the effects of climate change (Gleckman, 2018).

There is a definite need to understand the economics between climate change and the cost of compliance with emission reductions. It is imperative to policymakers to weigh the cost and benefits of various policies. There needs to be an understanding of what policies work better at reducing greenhouse gasses, particularly CO_2 as it relates to economic value.

Indeed, the United States remains the second leading contributor of CO_2 emissions (Union of Concerned Scientists, 2018). The United States continues to make the rest of the world question their respective global efforts and the United States' commitment for global solutions (United Nations Climate Action, 2018). The issue of successful and cost-effective emission reduction is one of the most pressing concerns of this decade. The perception amongst legislators is that carbon-reduction policies are costly, and a carbon tax may not gather the political momentum to become reality. While this paper does not address the actual overall cost of climate change, there is strong consensus that it is extraordinary, and action is necessary.

This paper fills a gap in knowledge concerning which states in the U.S. have the most effective policies, while considering the cost. This analysis has broad potential application to environmental, ecological, legislative and regulatory concerns and could help states decide what legislation will work best at reducing greenhouse gases, in developing CO_2 reduction plans, whether required to by federal law, or in developing state or regional goals.

The research objectives were:

- To review various legislation and regulatory policies in all fifty U.S. states.
- Under an assumption that the legislation and regulatory policies of the states had an effect, to measure that overall effect, along with understanding there are other factors in play, such as synergism, lagging customer demand, and utility and customer social responsibility, which may also contribute to a decrease in CO_2 emissions.
- Under an assumption that environmental costs are a large portion of the increase in electricity prices but understanding that transmission and distribution costs also increase electricity prices, to measure the correlation between implementing emission-reduction policies and the overall cost of electricity in various states.
- To model and analyze the relationship between the cost and the effectiveness at reducing carbon.

As shown in the various literature and other methods introduced here, this thesis is not the first to study any of the carbon-reducing measures. However, it may be the first to do a cost-comparison of various carbon-reducing measures for electric utilities in nearly two decades, to compare costs spent among various jurisdictions with the benefits gained. Thus, it may be the first to provide data showing that regulation to reduce carbon emissions has only a minimal effect on electricity prices.

Background

In August of 2015, President Obama announced the Clean Power Plan, the sole focus of which was to reduce carbon pollution from power plants (Environrmental Protection Agency, 2015). The EPA worked with various stakeholders from all across the country in developing the carbon-reduction amounts per state. One of the major objectives of the plan was to "show the world that the United States is committed to leading global efforts to address climate change" (Environmental Protection Agency, 2015).

Indeed, there is a growing consensus that imposing a price on carbon is necessary to combat climate change. This is most notable with the changing views of economist William D. Nordhaus. The Sverigies Riksbank Prize in Economic Sciences in Memory of Alfred Nobel 2018 was awarded to William D. Nordhaus and Paul M. Romer, "for integrating technological innovations into long-run macroeconomic analysis" for their work related to integrating "innovation and climate with economic growth" (The Nobel Prize, 2018). Both men have worked on strategizing economic growth. In particular, Nordhaus has discussed climate change since the 1970s, including constructing various models to describe the interplay between the economy and climate (The Nobel Prize, 2018). Notably, the Royal Swedish Academy of Sciences noted of Nordhaus's work, that his models "examine the consequences of climate policy interventions, for example carbon taxes" (The Nobel Prize, 2018).

The selection of Nordhaus was not without controversy in the climate science community. Eugene Linden, the author of, "Winds of Change: Climate, Weather and the Destruction of Civilizations" argued that Nordhaus is the reason that the United States does not have a carbon tax (Linden, 2018). Nordhaus (1993, p. XX) argued that, "[a] growing body of evidence has pointed to the likelihood that greenhouse warming will have only a modest economic impact in industrial countries, while progress to cut [greenhouse gases] will impose substantial costs." Mr. Linden in his article noted that

Nordhaus estimated in 1992 that a three degree Celsius of global warming would cost an estimated $5.6 trillion globally ($10.2 trillion in today's dollars), however, the Intergovernmental Panel on Climate Change (IPCC) issued a report the same day Nordhaus received the Nobel Prize, and estimated that a two-degree Celsius warming to conservatively cost $69 trillion (Linden, 2018). However, Nordhaus no longer holds that a carbon tax is a bad idea. Nordhaus has created various economic modeling which he argues demonstrates that a carbon tax or carbon market is crucial to combat the effects of climate change and that climate change comes with a large price tag that will be felt the world over (Gleckman, 2018).

A bipartisan group of economists including twenty-seven Nobel laureates, all four former Chairs of the Federal Reserve, and fifteen former Chairs of the Council of Economic Advisors (Climate Leadership Council, 2019), released an agreed statement regarding the best method to combat climate change, urging that, "[a] carbon tax offers the most cost-effective lever to reduce carbon emissions at the scale and speed that is necessary. By correcting a well-known market failure, a carbon tax will send a powerful price signal that harnesses the invisible hand of the marketplace to steer economic actors towards a low-carbon future" (George Akerlof, 2019). As Forbes has noted, "[t]his [a carbon tax] has become the mainstream view among economists." (Gleckman, Nordhaus, The Nobel Prize, Climate Change And Carbon Taxes, 2018).

The Clean Power Plan and Section 111(d)

The Clean Power Plan (CPP) was first proposed in 2014 by the EPA to cut carbon dioxide emissions emitted by electric generation to combat climate change. The CPP fell under section 111(d) of the Clean Air Act. The EPA set out to determine the best system of emissions reduction (BSER) for pollutants and generation sources by examining technologies and measures already being used (The Clean Power Plan - Setting State Goals, 2018). BSER determinations were used in other 111(d) rulemakings, and the EPA considered measures that individual states, and utilities were already using to reduce CO_2 from fossil fuel-fired power plants (Id). The EPA determined in the CPP that the BSER should be comprised of three building blocks:

- Building Block 1 – reducing the carbon intensity of electricity generation by increasing the operational efficiency of existing coal-fired power plants.
- Building Block 2 – reducing the carbon intensity of electricity generation by shifting electricity generation from higher emitting fossil fuel-fired steam power plants (generally coal-fired) to lower emitting natural gas-fired power plants.
- Building Block 3 – reducing the carbon intensity of electricity generation by increasing electricity generation from zero-emitting renewable sources of energy like wind and solar (Environmental Protection Agency, 2018). The goal of the CPP was to reduce CO_2 emissions by 32 percent of 2005 levels, the equivalent of 870 million tons less of carbon pollution (Environmental Protection Agency, 2015). The EPA calculated that the measures to reduce carbon would aid in the reduction of other harmful pollutants from power plants as well, including 90% lower SO_2 levels from 2005 levels, and 72 percent lower NOx emissions (Environmental Protection Agency, 2015). The CPP specifically targeted the 1,000 U.S. fossil-fueled power plants (Environmental Protection Agency, 2015).

With these reduced emissions amounts, the health benefits were calculated at a savings to the American public health and climate of $34 to $54 billion per year starting in 2030, with the cost of such compliance equating to roughly $8.4 billion (Environmental Protection Agency, 2015).

States were required to submit a State Implementation Plan by September 6, 2016 (later with extensions granted to September 18, 2018) (Environmental Protection Agency, 2015). The EPA took into consideration several factors, including that many coal-fired generation plants and oil-fired generation plants are reaching near retirement age. Indeed, under the CPP rule many existing coal plants would have been required to retire slightly earlier than anticipated. Notably, the EPA made several suggestions to individual states on what policies each state should implement to reduce CO_2 emissions from electric power plants. EPA's proposed suggestions to states under the CPP included:

- 50 states have demand-side energy efficiency programs;
- 37 states have renewable portfolio standards or goals;
- 10 states have market-based greenhouse gas emissions programs; and
- 25 states with energy efficiency standards or goals

(Environmental Protection Agency, 2015).

The EPA conducted its own analysis on what environmental policies states should implement to reach the EPA's proposed reduction amounts. There were several economic analyses done on cost and benefits of the CPP. However, as discussed below, there were many who argued that the EPA overestimated the societal benefit of CO_2 reductions, and underestimated the cost of compliance (Lesser, 2016).

Opposition to the Clean Power Plan

The final CPP rule was published in the Federal Register on October 23, 2015. States had until January 21, 2016 to comment on the rule (Walton, 2015). Dozens of states filed various lawsuits to challenge the EPA's regulatory package, in large part because of the cost of compliance. The EPA's regulatory package included: the final rule, the standards for modified sources, and the federal compliance strategy (Walton, 2015). Several other private industries also filed legal challenges as well.

On February 9, 2016, the Supreme Court of the United States stayed the Clean Power Plan (Bade, 2016), and in October of 2018 ruled that no further appeals could be granted that would stop President Trump's administration from repealing the CPP (Hurley, 2018). However, the biggest blow to the CPP came in President Trump's Energy Independence and Economic Incentive Executive Order (Whitehouse.gov, 2017). The Executive Order called for the EPA to reconsider the CPP and all regulations that encumber energy production, and that may harm economic growth (Whitehouse.gov, 2017). The EPA has proposed a new rule to take the place of the CPP, much less stringent and focusing on carbon emission reductions only at coal-fired generation plants (EPA Proposes Affordable Clean Energy (ACE) Rule, 2018). The CPP and the ACE and their respective legality and standards will continue to be debated and may be debated after the period of this thesis.

Because cost has become so central to the national discussion concerning the response to the threat of climate change, an analysis of the cost-effectiveness of relevant policies is needed to help states determine what future methods legislators and regulators should employ, regardless of the ultimate legal status of the CPP or ACE. Indeed, even the states that sued the EPA in 2015 over the Clean Power Plan were working on compliance options, as shown below in Figure 1 (Walton, 2015).

In 2017 the EPA did an avoided cost analysis using 2015 numbers to determine various costs in implementing and repealing the CPP (Shouse, 2018). If instead the EPA had weighed the cost of all previous state and federal regulations related to carbon dioxide emissions, and how effective such measures were, and compared them to the possibility of implementing a streamlined carbon tax, it might have more effectively revealed the best policy choices. This is the analysis performed in this thesis.

Administration changes can change trajectories, but overall many states recognize that carbon-emission reducing policy is likely to happen, and the central question is what is the best way to do it.

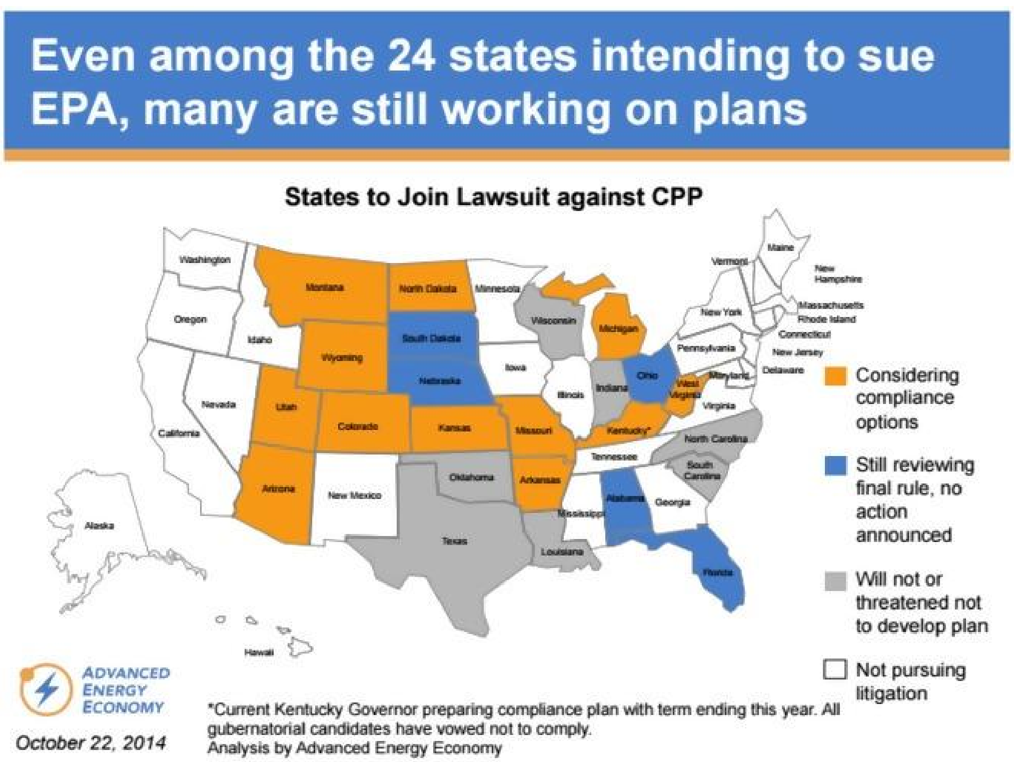

Figure 1. Status of states relative to CPP compliance (Walton, 2015).

Policy Considerations

Overall, there are three major policies that should be considered when determining what policies work best at reducing carbon dioxide emissions.

Putting a Price on Carbon

A price can be set on carbon, and it has been implemented both statewide and globally in two similar, but distinct ways, either by taxing carbon, or implementing cap-and-trade. The first price method, implementing a carbon tax for the electric industry would be a tax on the carbon dioxide emissions based on the carbon content of the fuel being used for electric generation. The carbon content of every fossil fuel is exactly known, as is the weight of CO_2 that is released from burning a fossil fuel (Carbon Tax Center, 2015). Therefore, the calculation of a tax would be easy to quantify based on how much fossil fuel is burned to obtain the energy.

No state in the United States has a carbon tax. Indeed, only a handful of states have even proposed such legislation. Washington State introduced a bill that put carbon tax on the ballot in November 2016 (Carbon Washington, n.d.). The cost of the carbon tax was set at $25 per metric ton on fossil fuels, with annual increases of 3.5% plus inflation. Washington intended to use the tax to reduce the state sales tax and to provide tax relief to 400,000 low-income households (Carbon Washington, n.d.). The measure ultimately failed.

In 2018, again Washington attempted to be the first state with a carbon tax, and again introduced new legislation. Initiative 1631, the Carbon Emissions Fee and Revenue Allocation Initiative, reduced the proposed 2016 fee from $25 per metric ton to $15 per metric ton of carbon emissions, increasing $2 a year until Washington's proposed 2035 emissions target is met (Groom, 2018). Again, the measure failed.

California has been considering a carbon tax, after its cap-and-trade revenue raised only one percent of its expected revenue in 2016-2017 (DeVore, 2017). Some have argued that the cap-and-trade program is actually a tax. For that reason, the cap-and-trade program has been on questionable legal grounds, because a tax must be approved by two-thirds of the California legislature, as opposed to just a fee (Id).

The city of Boulder, Colorado introduced the United States' first carbon tax in 2006. It is only a municipal tax in Boulder, which only effects electricity utility consumption. Currently, the tax varies among different tariff groups (i.e. residential, commercial, industrial), but for a residential customer it is less than $2 a month and has been renewed by voters.

Since a carbon tax has not been implemented statewide in the United States, this thesis cannot use that policy to determine its effectiveness in the United States, or as part of the cost analysis. However, when discussing potential policies that reduce CO_2 emissions, it is impossible to do a thorough review without discussing a carbon tax, as much of the rest of the world is considering it, and economists are now encouraging it.

A review of the literature has shown that several countries have instituted a carbon tax, notably: France, Norway, the U.K., Finland, Japan, Denmark, Ireland, and Canada. (Carbon Tax Center, 2018). Many economists are now in agreement that a carbon tax is the most effective and fastest means of reducing carbon emissions (George Akerlof, 2019). Putting a price on carbon would essentially correct an imbalance in the market (2019). However, there are concerns that are raised with a carbon tax – most notably that in a cost/benefit analysis carbon taxes are seen as regressive, which means that they can disproportionally hurt the poor (Grainger & Kolstad, 2010).

Emission Limits per Unit of Output - Cap-and-Trade

The second way to put a price on carbon is to put an emission limit per unit of output - cap-and-trade. Like a carbon tax, cap-and-trade has the effect of inducing a price on carbon (Grainger & Kolstad, 2010). However, a cap-and-trade system has been implemented and has a track record of success. Cap-and-trade entails a limit – a cap – on total carbon dioxide emissions that all electric generators must comply with, and as with a carbon tax, this introduces a market-based price for carbon. Electric utilities could trade emissions in a market operated by a variety of sources that already trade energy. A cap-and-trade would provide an emissions cap – as environmentalists want; and a market for emissions trading – as economists and others want, but it does not impose a new tax – as politicians want (Avi-Yonah & Uhlmann, 2009).

There are benefits, as aforementioned, with a cap-and-trade system, but there are also negatives. The benefits include a reduced role for government. However, one such negative is that it is a market-based system, which has often been shown to not be effective for environmental sustainability, and the social and economic costs of climate change are enormous (Avi-Yonah & Uhlmann, 2009). It would be imperative that the government would need to take a greater role in steadily reducing the cap to assure participants are striving to lower emissions. A second negative is that markets can be "gamed" and hurt other participants, and energy markets are no exception. Again, the government must oversee cap-and-trade regulation, and could place regulations on the carbon market, much like current regulations in energy markets that set criteria for offer prices and prohibitions on market manipulation generally.

Energy Efficiency and Demand-Side Management Measures

Demand-side management (DSM) is a method for utilities to influence customer uses of electricity in an attempt to reduce load, notably by curtailing demand when demand gets too high (Saini, 2004). Energy efficiency (EE) is an attempt to develop the most efficient use of energy. Nearly all states participate in EE and DSM, however, not all states have a set requirement on how much EE and/or DSM measures should be taken. The United States has continuously increased its spending on energy efficiency and DSM. In the 1990s U.S. electric utilities spent $14.7 billion on DSM programs (Loughran & Kulick, 2004). The EPA has determined that EE and DSM are both likely to be involved in CO_2 reductions at a state level; even though under the initial Clean Power Plan EE and DSM were removed. There are two reasons primarily that EE was removed from the final CPP, the first was to narrow the BSER to supply-side emissions reductions, and EE is demand-side reduction. The EPA essentially had to do this to withstand judicial scrutiny of the CPP because the EPA's authority over emissions sources has long been interpreted to not extend "beyond the plant fence" (Michigan Government, 2015). The EPA still assumed that states would use EE and DSM to meet respective reduction requirements in their respective state implementation plans.

Most states will continue to build on DSM programs as a cheaper method of reducing carbon emissions and the need to build more generation. Even though these programs were not included in the final version of the CPP – and it is debatable whether the EPA can even exert authority over EE and DSM – these programs are examined herein to provide a comparative sense of their effectiveness. One major concern that arises with the ongoing costs of EE measures is the idea that it is harder to build on future energy efficiency measures for the same costs because early EE was cheaper in gathering the "low hanging fruit" (those projects that cost a small amount and reap big rewards).

States like Colorado had proposals to rollback energy efficiency goals arguing that "low-hanging fruit of energy savings, primarily through lighting retrofits," had already been picked (Hardesty, 2014). In 2014 Indiana also terminated their energy efficiency standards (Indianapolis Business Journal, 2014); however, in 2017, the Indiana General Assembly required the five investor-owned utilities to continue to offer energy efficiency programs, but without any set goals or reduction numbers (Indiana Office of Utility Consumer Counselor, 2018). However, many are beginning to see that this perceived "low hanging fruit" continuously grows back, as technological and manufacturing innovations continuously bring efficiency improvements (Goldstein, 2011).

Renewable Portfolio Standards and Renewable Incentives

Around half of the United States have renewable portfolio standards (RPSs). RPSs mandate that a minimum amount of electricity sold must be generated from a renewable source. There are various methods to utilize the RPS: alternative compliance payments, rate caps, cost caps on acquiring a specific resource, and in some instance no cap. Research has been performed in this area to determine the strengths and weakness of various RPS models (Stockmayer, Finch, Komor, & Mignogna, 2012). According to the

National Conference of State Legislatures, half of the growth in U.S. renewable energy generation since 2000 can be attributed to state renewable energy requirements (National Conference of State Legislatures, 2018). This paper examined various state RPS models and determined the benefit and cost-effectiveness of RPS generally.

Policy Options Discussion

Generally speaking, there are three policy options: to maintain the status and do nothing differently, to increase what policies are known to be effective, or to introduce new policies. Each option is discussed below.

Maintain the Status Quo

The policy of simply maintaining the status quo is not only fundamentally flawed, it truly is not cost-effective. First, the UN's Intergovernmental Panel on Climate Change concluded that the world must decrease net carbon dioxide emissions by nearly 50 percent by 2030 and eliminate them by 2050 to maintain much of the planet's livability. (Gleckman, Nordhaus, The Nobel Prize, Climate Change And Carbon Taxes, 2018). The Fourth National Climate Assessment, released November 23, 2018, predicts the U.S. economy will shrink by as much as 10 percent by the end of the century if global warming continues apace (Here's how much climate change could cost the U.S., 2018). Furthermore, just two exacerbated effects of climate change are forest fires, predicted to cost the U.S. $23 billion and in 2017 alone the US spent $265 billion responding to hurricanes in the Atlantic (Here's how much climate change could cost the U.S., 2018). The overall cost is nearly impossible to measure. The IPCC has estimated that a 2-degree

Celsius warming will cost $69 trillion (Linden, 2018). Thus, a status-quo, do-nothing approach is not feasible.

Increase Energy Efficiency

Many policy makers misunderstand what energy efficiency is. It is not simply turning off lights to decrease usage – that is simply conservation; efficiency is employing technology to help avoid or reduce energy waste so that turning on the lights uses less energy (Shinn, 2018). The United States Department of Energy notes that every year, much of the energy the U.S. consumes is wasted through transmission, heat loss, and inefficient technology; which costs money and leads to increased carbon pollution (Energy Efficiency, 2019). Energy efficiency is one of the easiest and cheapest ways overall to combat climate change (Id). The Office of Energy Efficiency and Renewable Energy have set many strategic goals for electric generation, including setting energy efficiency milestones of 25%-50% by 2020-2030, including implementing energy performance standards, improving building energy codes, and supporting weatherization (Strategic Goals, 2019).

Overall, according to the Department of Energy, a third-party evaluation assessed one-third of the Office of Energy Efficiency and Renewable Energy's research and development portfolio and found that an EERE taxpayer investment of $12 billion has already yielded an estimated net economic benefit to the United States of more than $230 billion, with an overall annual return on investment of more than 20% (Department of Energy, 2019). Thanks to efficiency measures, U.S. energy use is about the same now as it was in 2000, despite economic growth of about 30 percent (Shinn, 2018).

Energy efficiency already accounts for more than 2.2 million U.S. jobs—10 times more than oil and gas drilling and 30 times more than coal mining (NRDC, 2017). Many EE measures are simple measures that Americans are already exploring, like switching lightbulbs with efficient LED bulbs that can save consumers national savings of $12.5 billion and use 90% less energy (Shinn, 2018). It has been calculated that residential energy efficiency could have the largest source of CO_2 reduction potential and it is estimated that widespread use of efficient appliances, electronics, equipment and lighting, and weatherization, could cut 550 million metric tons of carbon pollution a year by 2050 (Shahyd, 2017).

With all of the benefits that are clear from energy efficiency and demand side management measures, and a direct link to cost savings to average consumers that outweigh the cost spent, it is surprising that only half the states have specific savings targets. A review of the literature and the review of the policies in comparison with CO_2 reductions supports a recommendation that all states should have energy efficiency standards.

Increase the Amount of Renewables

According to the University of Michigan's Center for Sustainable Systems, only eleven percent of the United States energy is generated from renewable sources (U.S. Renewable Factsheet, 2019). Eighty percent of the energy mix comes from fossil fuels and roughly nine percent is nuclear (Id). However, the potential for renewables to displace fossil fuels exists. U.S. onshore wind resources have the potential to generate almost 11,000 GW of electricity, 123 times more than the current installed capacity of

82.1GW. If wind displaced 11,000 GW of fossil fuels, then 338.25 gigatonnes of CO_2 emissions could be avoided annually (U.S. Renewable Factsheet, 2019).

There is, however, a direct link to the employment of renewables, and the tax credits that are offered, meaning that policies have a direct impact on their implementation. In 2013, the U.S. installed 1.1 GW of wind capacity, a 92% decrease from 2012 (U.S. Renewable Factsheet, 2019) (Wind Industry Annual Market Report, Year Ending 2013, 2014). According to research done by the University of Michigan, this significant drop resulted from the expiration of the federal production tax credit (PTC) in 2013. However, after the PTC was retroactively reinstated with an expiration date of December 31, 2019, 7.017 GW of wind capacity were installed in the U.S. in 2017, a 9% increase in cumulative wind power capacity from 2016. Future estimates range from 80 GW to almost 400 GW by 2050 (U.S. Renewable Factsheet, 2019).

Renewables are also becoming more competitive than fossil fuels. In October of 2018, Northern Indiana Public Service Company (NIPSCO) presented its 2018 Integrated Resource Plan (IRP), in which NIPSCO determined that it could save customers more than $4 billion over 30 years by moving from 65% coal today to 15% coal in 2023 and completely eliminating coal from its generation portfolio by 2028 (Bade, 2018). NIPSCO proposed in its IRP to retire its coal using a portfolio of solar, storage, wind, DSM and some market purchases from its regional transmission operator, MISO (Northern Indiana Public Service Company 2018 Integrated Resource Plan, 2018). This move from coal to renewable energy is in a state that has no renewable portfolio standards and is traditionally pro-coal.

This shows that renewables are making more economic sense generally. However only 3/5ths of the states have mandated renewable targets or renewable portfolio standards. According to the National Conference of State Legislatures, half of the growth in U.S. renewable energy generation since 2000 can be attributed to state renewable energy requirements (State Renewable Portfolio Standards, 2018).

It is with this information in mind that all fifty states should adopt policies regarding renewable energy mandates, including tax credits and renewable portfolio standards. Renewable mandates show that renewables are economically competitive with fossil fuels, renewables provide massive reductions in CO_2 emissions, and lastly, the evidence shows that despite these benefits, there is a resistance to invest in renewables without tax credits. Therefore, policy makers should support that mandatory renewable standards are imperative towards CO_2 reductions from electricity and should support standards and tax credits.

Put a Price on Carbon

One emerging option is to implement a price on carbon – either through a carbon tax or participation in a carbon market. Ten states participate in carbon markets. The Regional Greenhouse Gas Initiative (RGGI) was the first mandatory market-based program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector by 91 million short tons each year. The RGGI CO_2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI states then sell the emission allowances through auctions and recycles the revenue by investing the proceeds in energy efficiency, renewable energy, and other consumer-benefit programs (The RGGI Greenhouse Gas Initiative, 2019).

The only other state that participates in a carbon market is California. The ARB Emissions Trading Program sets a statewide limit on 450 entities that are responsible for 85 percent of California's greenhouse gas emissions and establishes a price signal needed to drive long-term investment in cleaner fuels and more efficient use of energy (ARB Emissions Trading Program, 2019).

Nobel Prize winner William Nordhaus has determined that to reduce CO_2 emissions it is imperative that carbon have a price signal. His ultimate solution is to have countries agree to an international target carbon price. The countries could set the price, which Nordhaus ultimately calculated should be around $33 USD, in any way that the respective countries choose, such as with a tax, a cap-and-trade system, or some combination (Gleckman, Bill Nordhaus, The Nobel Prize, Climate Change And Carbon Taxes, 2018). Any country that refused to set a price on carbon would then have tariffs imposed on them by the participating countries, and ultimately if the participating countries priced the tariff high enough on non-participating countries, most nations would ultimately participate (Gleckman, 2018).

Nordhaus' research shows that imposing a price on carbon, such as through a carbon tax or cap-and-trade, is more effective and efficient than direct government controls on the quantity of emissions, and the high price on carbon will encourage those in the economy to find alternatives and encourage new technologies (Gleckman, Bill Nordhaus, The Nobel Prize, Climate Change And Carbon Taxes, 2018). Indeed, as discussed above, the mainstream view amongst economists is that a carbon tax is necessary to correct the market failure and send a powerful price signal to steer economic actors towards a low-carbon future (George Akerlof, 2019).

Previous Research on Policy Approaches

Herring (2006) concluded that energy efficiency is not an effective policy at reducing national CO_2 emissions. The author argued that improving energy efficiency lowers the implicit price of energy and hence makes its use more affordable, which then leads to more use. Instead, Herring stated that a carbon tax should be considered for future CO_2 reduction legislation. Herring further argues that any revenue collected from such a tax go to subsidization of renewables. However, Herring's study does not consider the cost of compliance, only the ultimate impact of reduction. Further, Herring's prediction for the "rebound" effect – that consumers will use more energy with energy efficiency because the cost becomes reduced – has not stood the test of time, as energy efficiency has greatly reduced the United States' overall consumption of electricity, and technology continues to improve these efficiencies.

Shirmali and Kniefel (2011) studied all 50 state and renewable policies to see which were the most and least effective at deploying renewables. Renewable Portfolio Standards have been proven to reduce carbon dioxide and helps penetrate renewables into the energy market. However, Shirmali and Kniefel found that voluntary renewable portfolio standards are ineffective in increasing the penetration of any type of renewable source. Their study is also interesting, in that other factors that most scholars would consider important contributors in renewable penetration really have little impact – including electricity prices, economic variables and whether the state is traditionally dependent on coal. These studies help determine the best cost-test for renewable deployment and provide context to the success of renewable deployment.

Two decades ago, Parry and Williams III (1999) evaluated various carbon-reducing legislation. They concluded that a carbon tax is not as cost-effective as other methods but concluded that the added cost may be offset by an efficiency gain from a revenue recycling effect (Parry & Williams III, 1999). A revenue recycling effect is important in any pollution tax, as it determines how the revenue can be collected from a pollution tax and used to reduce other tax distortions or offset other welfare costs. Parry and Williams evaluated methods outside of just electric utilities, including transportation. They concluded that carbon tax limits are "significantly" costlier than other policies (Parry & Williams III, 1999). They used a numerical general equilibrium model to compare various carbon-emission reducing policies in a second-best setting with a distortionary tax on labor (Parry & Williams III, 1999). Their analysis of pre-existing tax distortions raised the cost of all policies, and they discussed how these additional taxes affected the rankings of policies. Parry and Williams determined that when the revenues of a carbon tax are used to reduce distortionary taxes, the tax can be positive. In this context a tax is 'distortionary' when it modifies market equilibrium so that the price system no longer equates social marginal costs with social marginal benefits (Baranzini, Goldemberg, & Speck, 2000).

A distortionary tax can be a tax that is intentionally established to reduce market externalities, such as a tax on cigarettes to discourage a consumer from buying cigarettes, and then earmarking that tax revenue to go to smoking cessation efforts. In this instance Perry and Williams (and later others) have argued that the countries that have implemented carbon taxes sometimes introduced them in place of other taxes on energy (Baranzini, Goldemberg, & Speck, 2000), and earmarked the money to go to places such as research and development of renewables. Again, Perry and William's study also explores other energy related emissions, such as from a gasoline tax and other sources of emission.

Parry and Williams (1999) study examined these various policy instruments and analyzed the cost and overall welfare impacts. Perry and Williams have a complex model and explore various primary tax distortions and use various policies as the secondary comparative factor. However, it is important to note that Perry and Williams' study took places two decades ago, and many economists have had emerging ideals about the true cost of climate change, and the importance of placing a price on carbon. As noted by Nordhaus' changing models, and the overall consensus of economists that a carbon tax is necessary, the economic world has shifted its thoughts on carbon taxes.

Over the past two decades, many articles have been written about the feasibility of carbon taxes; one of the earliest studies examined the effectiveness and impacts of carbon taxes (Baranzini, Goldemberg, & Speck, 2000). The authors noted that only six countries at the time implemented such a tax, and they discussed the negative impacts of the tax, and what could be done with the revenues from such a tax. They noted that, "even if carbon taxes are cost-effective instruments to achieve a given abatement target, because of their direct impact on prices, it is fundamental to consider the indirect incentives that may arise from the use of fiscal revenues" (Baranzini, Goldemberg, & Speck, 2000). They also note the redistribution or "recycling" of the revenue so that they will not be part of generalized spending, but can be used in many ways such as: fiscal reform – to decrease other taxes; earmarked - to go to other environmental programs; compensation – to give the revenues to those most negatively impacted, such as abatement costs for corporations, or subsidies to low-income families (Baranzini, Goldemberg, & Speck, 2000). Overall, the authors discuss the environmental impacts, such as the achievement of other environmental goals, not just the reduction of CO_2. These achievements could include using fewer fossil fuels, which will also improve air quality.

However, in the end, the authors conclude that to implement a carbon tax would lead to a reform in the general fiscal system. They advocate first, removing energy subsidies; second, removing non-environmentally friendly tax incentives, such as exemptions for energy consumption or commuting expenses; and third, recycling that revenue, which they have broadly stated could go to a number of things: from corporate tax subsidies, to environmental causes (Id. at p. 410). This is an important study, and even though it is nearly two decades old the authors raise relevant concerns regarding the tax structure and the use of revenues.

Research Question, Hypothesis and Specific Aims

The primary question I examined was: what carbon-reducing policies the United States, either federally or on a state level, should implement in regards to electric generation? To explore this, not only is it necessary to look at states that have cut their CO_2 emissions, it is also necessary to review the cost changes over the same period of emission reductions to determine if the benefit is proportionate to the cost. The primary hypothesis I examined was: states that implemented carbon-reducing policies will experience greater reductions in CO_2 emissions, but also higher cost increases than those states that did not implement policies. A secondary hypothesis tested was: states that have set a price on carbon will have seen the highest CO_2 reductions in the electric power industry.

Specific Aims

To make this determination and explore related issues, the specific aims were:

1. To look at each state's overall change in CO_2 emissions from the electric utility sector from 2007-2016.
2. To examine each state's regulatory or legislative policies that were driving the reduction, or lack thereof in CO_2 emissions, and logging if the state had: renewable energy goals or mandates; if the state had energy efficiency or demand side management mandatory targets; and/or if the state participated in a carbon market.
3. To then evaluate which of these policies were the most effective at achieving carbon-reduction goals.
4. To look at each state's overall change in electric prices over the same period, 2007-2016 to determine if such CO_2 policy emission drivers made a strong impact on the cost of electricity to make it cost-effective.
5. To determine the correlation between the CO_2 reduction policies and the overall price of electricity.
6. To evaluate which policies moving forward would be the best to pursue after evaluating all other factors.

Chapter II

Methods

This methods section addresses the necessary aspects of performing the thesis research and culminates in several spreadsheet analyses for decision-making based on the cost of CO_2 reductions. To determine this, an Index of the Relative Efficiency (IRE) was created.

This is a good model for our times, because as the Supreme Court noted in a recent decision – cost considerations must be measured and can be the ultimate determinant of whether a rule advances (Michigan et al. v. EPA et al., 2015). Even though this model does not measure societal costs, and other qualitative benefits of reducing the greatest amount of carbon, the cost/benefit analysis appears to remain of utmost importance to legislatures, and the Court as currently composed.

Calculating CO_2 Emissions from the Electricity Sector

The overall state electricity emission calculations are based on information provided by the United States Energy Information Administration (EIA). The EIA is the statistical and analytical agency within the U.S. Department of Energy. By law, EIA's data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government (Analysis and Projections, 2019). The EIA collects various data from states, and calculates each states' energy-related CO_2 based on data contained in the State Energy Data System (About SEDS, 2018), and based on energy consumption of various fuels, such as coal, natural gas, or petroleum, used in the electricity sector (Documentation for estimates of state energy-related carbon dioxide emissions, 2018). The EIA calculates and estimates emission data on a state-level from other areas, such as transportation, but for the purpose of this analysis, only the electricity sector information was used.

Through this examination, several spreadsheets were created to showcase the overall change in the cost of electricity in each state over the same ten-year span that was reviewed in the change of CO_2 emissions, namely 2007-2016, with information provided by the EIA. The information is based on the average retail price of electricity to ultimate consumers by end-use sector.

Research Design

To determine the IRE, a review all fifty states' carbon dioxide emissions from electricity from 2007-2016 was performed. Also reviewed was the cost of electricity in each individual state from 2007-2016 with the goal of determining how the cost of electricity coincided with the trend in carbon dioxide emissions.

With this information there was an assumption that the change in the cost of electricity would correlate directly with the states that saw reductions in emissions; as generally the political deterrent to impose more stringent policies is the argument that it will dramatically inflate the cost of electricity. However, the analysis showed that it was not as correlated as assumed. Therefore, to determine the correlation, a covariance matrix was calculated to summarize the linear relationship between the percentage in the change in electric prices and the percentage of CO_2 reduction over the same time period. A correlation analysis was performed, specifically the Pearson Correlation Coefficient to test for linear relationships between the variables.

After the correlation was determined, the percentage of change in electricity prices was added to the percentage reduction in CO_2, and then multiplied by the correlation to create what I defined as an Index of the Relative Efficiency (IRE). Based on this information the states were ranked based on the number that was output – with the lowest numbers providing the greatest benefit achieved when compared with price.

A spreadsheet analysis for decision making was performed to determine which policies state and federal regulatory agencies should consider, independent of what future policies the EPA enacts. The analysis concluded that CO_2 reduction legislation works, and having a price on carbon is the most effective at reducing CO_2; and overall, the cost of electricity does not see a large correlation between implementing CO_2 reduction legislation and rising electric prices; therefore, it should not be considered a deterrent by legislators in implementing more stringent CO_2 reducing policies.

Another assumption when first performing this research was that most investor-owned utilities had to report the utilities' respective costs of compliance with state utility regulatory commissions, including costs of compliance of state and federally mandated environmental policies. This is often done through the utilities' respective integrated resource planning. Utilities also petition their respective utility commissions for cost recovery. Often because of such cost recovery methods, many utilities also report to state public utility commissions the effects of such programs to assure that customers are receiving the benefit of the compliance costs (i.e. installing a new scrubber). The commissions contain electronic docket systems, in which many utility filings are available. However, as more research was performed, and as will be discussed in the section regarding future research, many states have no such requirements. Therefore, it made the research more difficult, and changed the scope of the research. Ultimately, data was collected and analyzed from numerous state utility commissions, the Energy Information Administration, and the Environmental Protection Agency.

Chapter III

Results

The IRE was used to compare the states with the CO_2 reduction policies that were implemented in each state. Not surprisingly, the states with the most CO_2 reductions over the last ten years have energy efficiency targets and state mandated renewable requirements. However, most notable, the top six states at reducing carbon dioxide emissions all participate in a carbon market. Conversely, the six states with the lowest IRE: none of the six participated in a carbon market, none had mandated targets related to energy efficiency, and only one, South Dakota, had a renewable requirement. Also note-worthy, there was not a strong correlation between the overall change in the price of electricity and the carbon-reduction legislation. Indeed, the six states that were best at reducing CO_2, also saw less of an increase in overall electric prices than those states that performed the worst at CO_2 reductions Figure 2 shows actual (not proportional) changes in each state's continued CO_2 emissions.

In performing this study, consideration was given and charted that many states may have seen a decrease in CO_2 emissions as there has been a general increase in using natural gas as a fuel source and a decrease in using coal as a fuel source. Using natural gas as the energy source does reduce CO_2 emissions from the use of coal, but it does not eradicate CO_2 emissions. It is important to see where the increases have occurred.

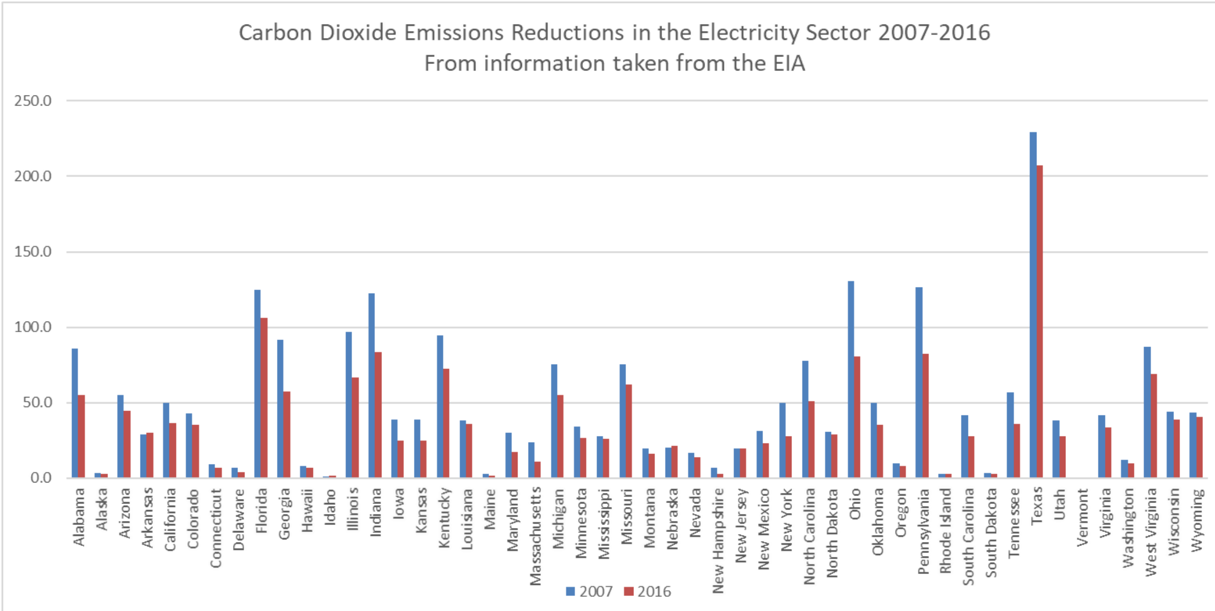

Figure 2. Carbon dioxide emissions from the electricity sector 2007 – 2016, for selected US states (Energy Information Administration, 2019).

According to the EIA, the change in using natural gas instead of coal as the energy source has increased dramatically in recent years. (Natural gas expected to surpass coal in mix of fuel used for U.S. power generation in 2016, 2016). It is important to note that this is in part due to the decreased cost of natural gas, but also the heavier cost of compliance with coal (Id). Many states have seen the switch and other measures reduce CO_2 emissions – for example Alabama has seen a near 36% overall reduction from 2007-2016 (Figure 3).

However, some states saw increased emissions from natural gas, and even though there were reductions in emissions from coal, the overall emissions were greater in 2016 than in 2007. Mississippi is a notable example (Figure 4). This highlights that just a general fossil fuel switch will not solve CO_2 emission concerns, and a close inspection of various emission reduction policies in the states still needs to be examined.

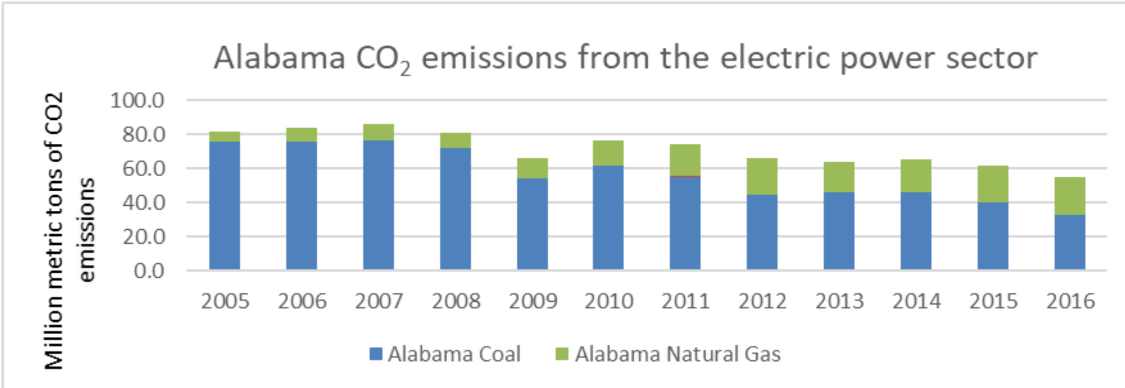

Figure 3. Alabama CO2 emissions from the electric power sector, 2005-2017. Derived from SEDS (U.S. Energy Information Administration, 2019).

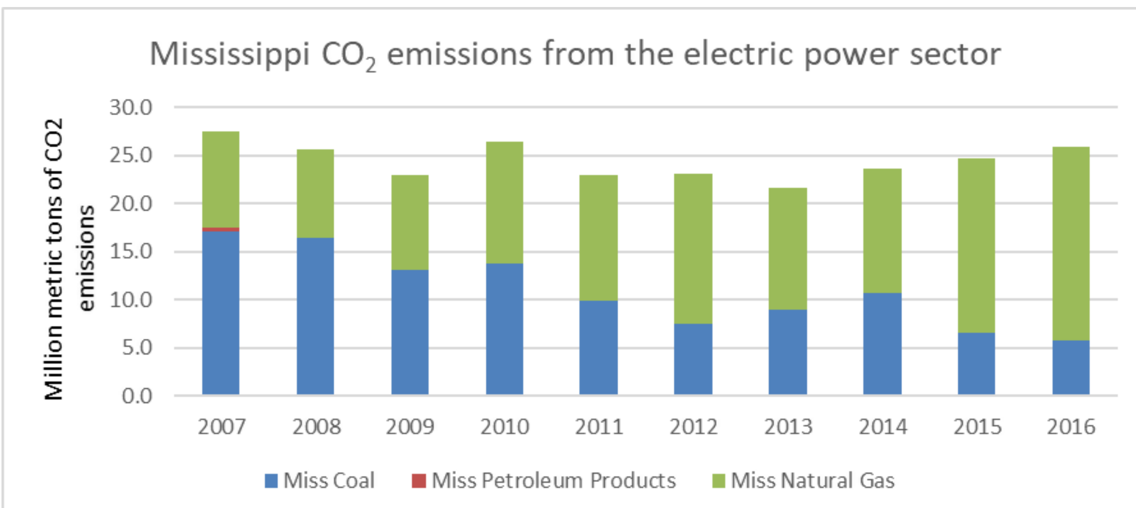

Figure 4. Mississippi CO2 emissions from the electric power sector 2007-2016 (U.S. Energy Information Administration, 2019).

As the charts above indicate, it is imperative to look in depth at policies for states that have seen proportional reductions in these recent ten year periods. Using the data in Figure 2, the states were ranked by their overall percentage of CO_2 reduction (Table 1).

Overall, this needs to be compared with how many million metric tons of CO_2 that states were emitting because of electricity. There are outliers in the chart above, such as Vermont that saw no reduction in emissions because Vermont uses no fossil fuel-based energy. Idaho, which has seen a large increase in its CO_2 emissions from electricity never depended on coal, and instead just saw its natural gas double. It is important to note that the doubling went from CO_2 emissions of .7 million metric tons to 1.3 million metric tons in 2016 (Figure 5). This is a fraction of what many other states emit. Therefore, overall it may not seem an alarming jump as Idaho ranks second lowest after Vermont in CO_2 emissions from electricity. However, it is worth questioning its overall increase as a percentage of change (Figure 5).

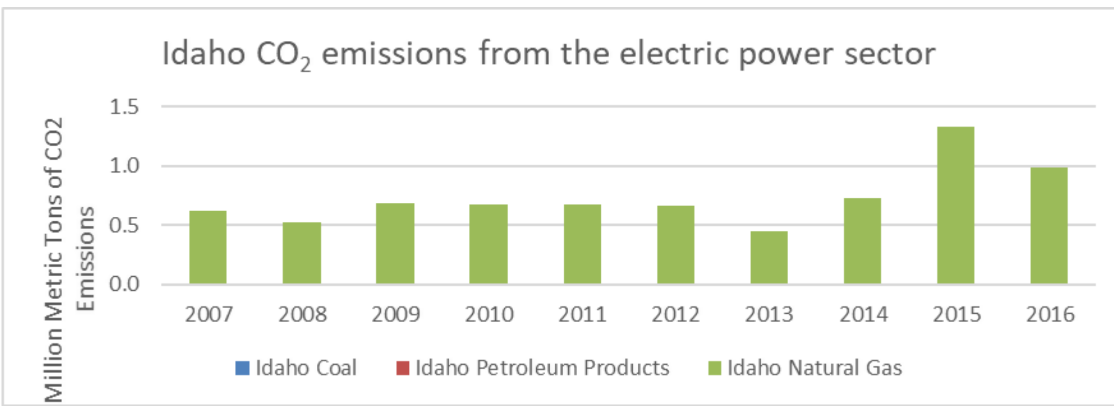

Figure 5. Idaho CO2 emissions from electricity 2007-2016 (State Carbon Dioxide Emissions Data, 2007-2017).

After charting and graphing the CO_2 emission changes from 2007-2016, it was imperative to look at cost of electricity data in each state based on information provided by the EIA to determine if the reduction in carbon dioxide emissions could be seen in an increased cost of electricity to help determine the cost/benefit analysis.

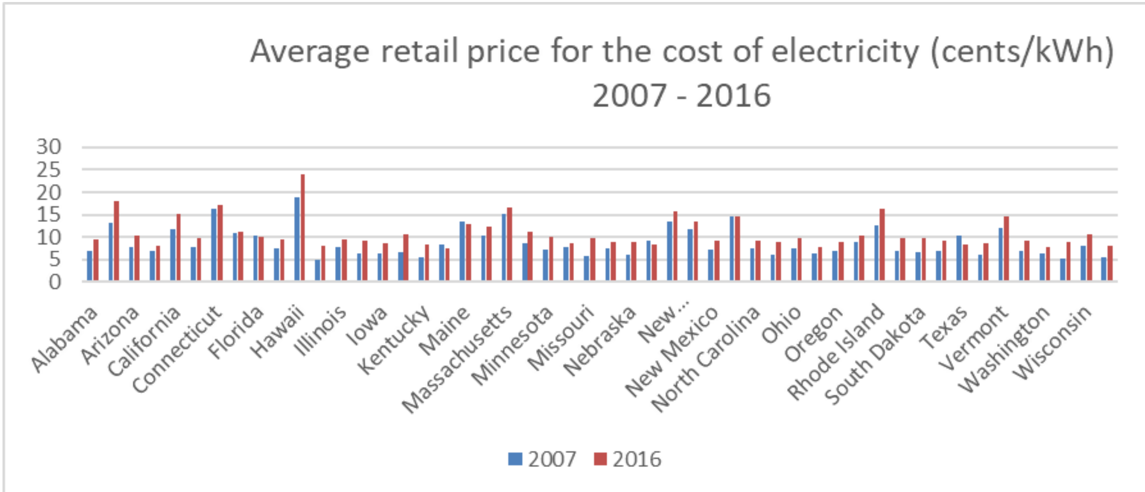

Figure 6. Average retail price for the cost of electricity (cent/kWh) 2007-2016. (U.S. Energy Information Administration, 2019).

Figure 6 showcases the overall change in the average retail price of electricity over the ten year period. Somewhat surprising is that over the course of ten years from 2007 to 2016, those with the biggest reductions in CO_2 emissions, did not see an overall large increase in the price of electricity over those same ten years (Figure 6). In fact, the top six states that saw the biggest reduction in CO_2 emissions saw on average only a 6.68% increase in electric prices over the ten-year period, less than the national average increase of 27.69%. More surprising, the six worst states at reducing CO_2 emissions saw on average a 51.16% increase in the overall price of electricity (Figure 6).

As stated before, many variables go into the overall price of electricity, including transportation and distribution costs, but this should ease some lawmakers concerns that every new emission regulation has an overall end cost to the consumer. States that have seen the reduction in emissions are not financially in a worse place than before more strenuous regulations were enacted to decrease emissions.

Correlation between Change in Price of Electricity and CO_2 Emissions

Table 1 and Table 2 showcase the top six states at reducing CO_2 emissions, and the six states that were the worst performing at reducing carbon emissions. Notably the top six states, New Hampshire, Massachusetts, Maryland, Delaware, New York and Maine, saw substantial reductions, but overall minimal cost increases (Table 1).

Table 1. Top six states at reducing CO_2.

State	Electric price change 2007-2016	CO_2 change 2007-2016
New Hampshire	15.23%	-64.18
Massachusetts	8.92%	-57.8
Maryland	18.77%	-54.85
Delaware	2.40%	-46.27
New York	-0.48%	-44.15
Maine	-4.76%	-42.31
Top 6 mean	6.68%	-51.59

Table 2. Bottom six states at reducing CO2.

State	Electric price change 2007-2016	CO2 change 2007-2016
Nebraska	49.83%	4.43
Arkansas	17.48%	5.3
Wyoming	52.51%	7.36
South Dakota	47.15%	13.33
West Virginia	75.73%	23.04
Idaho	64.56%	85.71
Bottom 6 mean	51.21%	23.195

With the inverse on the worst performers at reducing overall CO_2 emissions from electricity: Nebraska, Wyoming, South Dakota, West Virginia, and Idaho have seen their respective CO_2 emissions from electricity increase, while seeing significant electric price increases over the same ten-year period (Table 2).

Overall, all of the states' performances at reducing CO_2 and the change in electric prices are shown in Table 3.

Table 3. CO_2 emission changes as shown with cost of electricity from each state. (U.S. Energy Information Administration, 2019).

State	Electric price change 2007-2016	CO_2 change 2007-2016
New Hampshire	15.23%	-64.18
Massachusetts	8.92%	-57.8
Maryland	18.77%	-54.85
Delaware	2.40%	-46.27
New York	-0.48%	-44.15
Maine	-4.76%	-42.31
Ohio	29.30%	-38.28
Georgia	27.90%	-37.09
Iowa	31.74%	-36.66
Tennessee	32.80%	-36.57
Alabama	36.18%	-35.74
Kansas	60.15%	-35.58
Pennsylvania	14.88%	-34.94
North Carolina	21.21%	-34.54

South Carolina	43.13%	-34.21
Indiana	45.89%	-31.5
Illinois	21.34%	-31.4
Oklahoma	21.20%	-28.82
Utah	44.37%	-27.82
Michigan	29.09%	-26.83
California	28.95%	-26.8
New Mexico	29.18%	-26.04
Kentucky	54.78%	-23
Minnesota	40.11%	-22.74
Connecticut	5.05%	-20.5
Washington	20.00%	-20.17
Arizona	33.99%	-19.75
Montana	18.98%	-19.7
Virginia	32.70%	-19.62
Oregon	27.97%	-18.75
Hawaii	27.44%	-18.52
Alaska	37.08%	-18.18
Missouri	66.50%	-18.17
Nevada	9.59%	-17.76
Colorado	25.70%	-17.71

Florida	-2.75%	-14.94
Wisconsin	32.22%	-12.1
Texas	-17.43%	-9.59
Rhode Island	28.19%	-7.4
North Dakota	44.66%	-5.86
Mississippi	13.63%	-5.82
Louisiana	-11.75%	-5.25
Vermont	20.10%	0
New Jersey	12.91%	1.55
Nebraska	49.83%	4.43
Arkansas	17.48%	5.3
Wyoming	52.51%	7.36
South Dakota	47.15%	13.33
West Virginia	75.73%	23.04
Idaho	64.56%	85.71

Using the information provided by the U.S. Energy Information Administration and the State Energy Data System, a Pearson Correlation Coefficient was calculated to test for linear relationships between the change in CO_2 and the change in electric price, which revealed a correlation of 0.37 (Figure 7). This correlation shows that there is a slight positive correlation, meaning that there is some correlation with reductions in CO_2 emissions and a rise in electric prices, but it is not very strong.

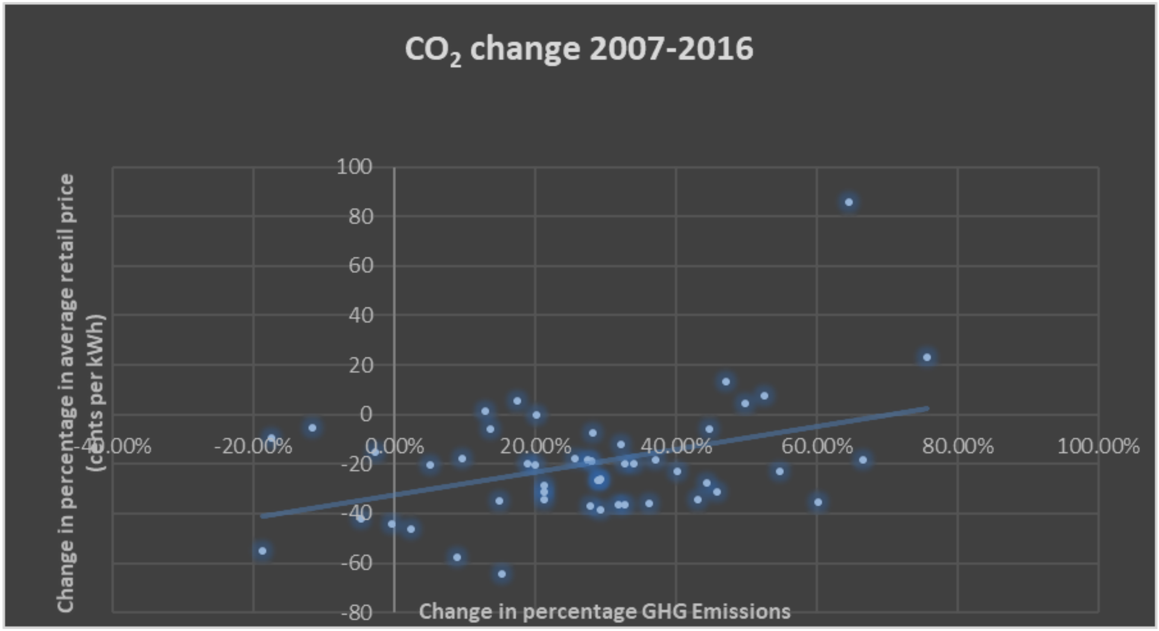

Figure 7. Correlation of change in electric price with change in CO2.

The Index of the Relative Efficiency (IRE)

After determining the correlation, the percentage of change in electricity prices was added to the percentage reduction in CO_2 and multiplied by the correlation to create the Index of the Relative Efficiency (IRE). The states were then ranked based on the number that was output, with the lowest numbers providing the greatest benefit achieved when compared with price (Table 3).

Spreadsheet Analysis for Policy Consideration

After these numbers were logged and calculated, the IRE was reviewed in comparison to the CO_2 reduction policies that were implemented in each state. Not surprisingly, the states with the most GHG reductions over the last ten years have energy efficiency targets and state mandated renewable requirements (Table 3). However, most notably, the top six states at reducing carbon dioxide emissions all participate in a carbon market.

Conversely, concerning the six states with the lowest IRE: none of the six participated in a carbon market, none had mandated targets related to energy efficiency, and only one, South Dakota, had a renewable requirement. The states that were the best at reducing CO_2 from electricity also saw less of a cost increase in the overall price of electricity as compared to the bottom six states (Table 3).

Table 1. Spreadsheet analysis showcasing CO2, overall change in price, the correlation to determine the IRE, then compared with legislation from the respective states.

State	Electric price change 2007-2016	CO2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
New Hampshire	15.23 %	-64.18	-23.7466	25% by 2025	25.2% by 2025	Yes, RGGI
Massachusetts	8.92%	-57.8	-21.386	Incremental savings of 2.93%	15% by 2020 and 1% each year after	Yes, RGGI
Maryland	18.77 %	-54.85	-20.2945	Yes, 15% per capita use reduction by 2015	25% by 2020	Yes, RGGI
Delaware	2.40%	-46.27	-17.1199	Government grants to commercial and industrial EE.	Yes, 25% by 2025	Yes, RGGI

State	Electric price change 2007-2016	CO_2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
New York	-0.48%	-44.15	-16.3355	Yes, incremental 1%	50% by 2030	Yes, RGGI
Maine	-4.76%	-42.31	-15.6547	Yes, 20% by 2020 with incremental savings targets of 1.6% - 2.4%	Yes, 40% by 2017	Yes, RGGI
Ohio	29.30%	-38.28	-14.1636	Yes, brief freeze in 2017, but incremental targets of 1% in 2014 and ramping up to 2% in 2021	12.5% in 2026	No
Georgia	27.90%	-37.09	-13.7233	No	No	No
Iowa	31.74%	-36.66	-13.5642	Yes, between 1.77 until 2021 to 3.05 in 2030	Yes, 105 MW	No
Tennessee	32.80%	-36.57	-13.5309	No	No	No
Alabama	36.18%	-35.74	-13.2238	No	No	No
Kansas	60.15%	-35.58	-13.1646	No	Yes, 30% by 2020	No
Pennsylvania	14.88%	-34.94	-12.9278	.8% incremental savings 2016-2020	18% by 2021	No
North Carolina	21.21%	-34.54	-12.7798	Yes, high targets of 6% by 2015, then getting up to 40% in 2021	12.5% by 2021	No

State	Electric price change 2007-2016	CO2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
South Carolina	43.13 %	-34.21	-12.6577	No	2% by 2021	No
Indiana	45.89 %	-31.5	-11.655	No set targets, but each IOU has EE	No – state has goals, but not mandates 10% by 2025	No
Illinois	21.34 %	-31.4	-11.618	No	Yes, 25% by 2025	No
Oklahoma	21.20 %	-28.82	-10.6634	No	15% by 2015	No
Utah	44.37 %	-27.82	-10.2934	No	20% by 2025	No
Michigan	29.09 %	-26.83	-9.9271	1% incremental savings through 2021	25% by 2021, 35% by 2025	No
California	28.95 %	-26.8	-9.916	Yes - 1.15 target	Yes 33% by 2020 50% by 2030	Yes. WCI.
New Mexico	29.18 %	-26.04	-9.6348	5% of 2005 numbers by 2014 and 8% by 2020	20% by 2020	No
Kentucky	54.78 %	-23	-8.51	No	No	No
Minnesota	40.11 %	-22.74	-8.4138	1.5% incremental savings in 2010 and each year thereafter	26.5% by 2025	No

State	Electric price change 2007-2016	CO2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
Connecticut	5.05%	-20.5	-7.585	Yes, 1.15 and utilities must pursue all cost-effective EE resources	Yes, 28% by 2020	Yes, RGGIRGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector.
Washington	20.00 %	-20.17	-7.4629	2.5% per year through 2030	15% by 2020	No
Arizona	33.99 %	-19.75	-7.3075	Yes -2.5% target	15% by 2025	No
Montana	18.98 %	-19.7	-7.289	No	15% by 2015	No
Virginia	32.70 %	-19.62	-7.2594	No	Voluntary goals of 15% by 2025	No
Oregon	27.97 %	-18.75	-6.9375	1.3% annually 2015-2019	25% by 2025	No

State	Electric price change 2007-2016	CO2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
Hawaii	27.44 %	-18.52	-6.8524	Yes, 2.4 incremental	Yes, 30% by 2020, 40% by 2030, 70% by 2040 and 100% by 2045	No
Alaska	37.08 %	-18.18	-6.7266	Yes	Yes	No
Missouri	66.50 %	-18.17	-6.7229	No	15% by 2021	No
Nevada	9.59%	-17.76	-6.5712	Goal of 20-25% of retail sales including a quarter of that met by EE, phased out by 2025	No	No
Colorado	25.70 %	-17.71	-6.5527	Yes	Yes 30% by 2020, 20% for coops and muni	No
Florida	-2.75%	-14.94	-5.5278	No	No	No
Wisconsin	32.22 %	-12.1	-4.477	.81% of sales	10% by 2015	No
Texas	-17.43 %	-9.59	-3.5483	Yes, .1% annual savings, .4%compared to previous year	10,000MW by 2025	No
Rhode Island	28.19 %	-7.4	-2.738	Incremental 2.6%	Yes, 14.5% by 2019, increasing 1.5%	Yes, RGGI

State	Electric price change 2007-2016	CO2 change 2007-2016	IRE	EE/DSM	RPS	Carbon Markets/Cap-and-trade
					yearly until 38.5% by 2035	
North Dakota	44.66 %	-5.86	-2.1682	No	10%	No
Mississippi	13.63 %	-5.82	-2.1534	No	No	No
Louisiana	-11.75 %	-5.25	-1.9425	No	No	No
Vermont	20.10 %	0	0	2.1% per year	55% by 2017 and 25% by 2032	Yes, RGGI
New Jersey	12.91 %	1.55	0.5735	No	50% by 2030	No
Nebraska	49.83 %	4.43	1.6391	No	No	No
Arkansas	17.48 %	5.3	1.961	No set target, but IOU participates	No	No
Wyoming	52.51 %	7.36	2.7232	No	No	No
South Dakota	47.15 %	13.33	4.9321	No	Yes, 10% by 2015	No
West Virginia	75.73 %	23.04	8.5248	No	No - Repealed Goals	No
Idaho	64.56 %	85.71	31.7127	No	No	No

A spreadsheet analysis for decision making was performed to determine which policies state and federal regulatory agencies should consider, independent of what future policies the EPA enacts. This analysis concluded that CO_2 reduction legislation works and having a price on carbon is the best indicator at reducing CO_2, but synergism overall is the best indicator are CO_2 reductions.

Further, this research determined that overall, the cost of electricity does not see a large correlation between implementing CO_2 reduction legislation and rising electric prices; therefore, it should not be considered a deterrent by legislators in implementing more stringent CO_2 reducing policies.

Chapter IV

Discussion

The original research contained herein showed that synergy amongst the various legislation is best at achieving CO_2 reductions, with participation in a carbon market the best indicator at overall reduction goals. The research also demonstrated that reduction legislation/regulation has a minimal impact on the overall retail price of electricity. A PEST analysis was performed to illustrate the various policy considerations (Table 4).

Table 4. PEST analysis on carbon emission reduction policies.

Criteria	P Political Feasibility	E Economic Cost Effectiveness	S Social Environmental Impact	T Technological Administrative Feasibility
Do Nothing/ Status Quo	Strong Negative Unlikely that there will be no future CO_2 reduction legislation	Strong Negative There are economic consequences to climate change Any CO_2 reduction policy should be seen as mitigating or hedging cost of climate change	Strong Negative Strong environmental impact if no further CO_2 policies are implemented	Strong Positive No technological or administrative barriers to do nothing
Impleme nt a Price on Carbon	Positive Likely – nine states already participate in a carbon market Many countries have adopted a carbon market	Strong Positive Economists believe a price on carbon is effective Cost to consumers can be higher, but	Strong Positive Arguably the fastest policy at swift CO_2 reductions, which would lead to several environmental	Neutral Would require looking at science to set price to determine the correct price deterrent

Criteria	P Political Feasibility	E Economic Cost Effectiveness	S Social Environmental Impact	T Technological Administrative Feasibility
		revenue can be recycled	benefits – less CO_2emissions, less incentive to use fossil fuels, therefore, cleaner air	Would require overhaul of tax scheme Would require policy changes
Mandate Energy Efficiency and Demand Side Management Targets in all 50 states	Positive Likely at a state level, easy to set targets Unlikely at a federal level currently – questionable law regarding jurisdiction concerns over demand-side reductions with EPA	Strong Positive Cost-effective, often EE and DSM measures more than pay for themselves with the benefit exceeding the cost	Strong Positive Consumers like energy efficiency and demand side management – benefits outweigh costs, and average consumer sees a reduction in energy bill	Strong Positive Many states have EE and DSM programs at the utility level, easier feasibility to increase targets
Mandate Stronger Renewable Portfolio Standards in all 50 states	Positive More states are implementing renewables with and without the production tax credits and RPS.	Strong Positive States are finding that renewable generation is becoming competitive with fossil fuel generation	Strong Positive Reducing dependency on fossil fuels will drastically cut or CO_2 emissions from electricity	Neutral Many states have renewable targets or goals Technology is catching up, but still would require grid changes and potential storage options for full deployment of renewables

Research Limitations

Some research limitations included the following:

- There are various different tax regimes which may affect any of the policy costs.
- There can be policy overlap, such as the same policies limiting carbon, or compliance measure such as SO2 compliance, may overlap, so trying to carve out if the policy has dual goals – how much it costs to solely comply with the CO_2 reduction.
- Any government costs to create markets, or implementation of other measures, independent of utility costs.
- The best use of any revenue from any proposed tax.

Conclusions

As previously noted, the UN's Intergovernmental Panel on Climate Change concluded that the world must decrease net carbon dioxide emissions by nearly 50 percent by 2030 – and eliminate carbon dioxide emissions by 2050 – to maintain much of the planet's livability (Gleckman, 2014; Nordhaus, 1993; The Nobel Prize, 2018). The United States needs more stringent policies to reduce carbon dioxide emissions. All policy changes will influence the average consumer, and politicians are not fans of creating new taxes. However, more Americans understand the negative effects of climate change. According to a recent survey from the Yale Program on Climate Change in November and December 2018, 73% of Americans said that global warming was happening, up ten percent from three years ago, and 72% said that global warming was personally important to them (Schwartz, 2019).

The United States should implement mandatory energy efficiency and demand side management programs in all fifty states; each state should have a mandatory renewable generation requirement; and lastly, the EPA or states should place a statutory cap on carbon emissions based on energy output, and have states participate in a regional market - or alternatively a carbon market by developing a carbon tax. Based on a literature review, the revenue collected from a carbon tax can be recycled to benefit many. After implementing a tax on carbon of $33 USD per ton of CO_2, the money collected can be put into research and development funds to find fuel alternatives, battery storage technology, and various efficiency measures, as this research shows that these programs are working in the states that have implemented them. Many economic and tax policy experts have identified various ways in which the tax could be imposed and collected. A streamlined policy that makes the most sense as it relates to the electric world is if the government implements a tax on the carbon content of the fuel being burned, rather than the emissions themselves (Gleckman, 2014). *Forbes*, economists, and many agree that under the Trump Administration, it is unlikely that a carbon tax will come to fruition in the near future. However, implementing a new tax that helps decrease the deficit, and helps remediate climate change, would be highly efficient policy, accomplishing multiple policy goals at once. Gleckman, 2014; Nordhaus, 1993; The Nobel Prize, 2018).

Many of the economic policy discussions around a carbon tax do not show how complementary these other carbon reduction policies are to each other. Overall, these policies are showing that they are working to reduce CO_2 emissions from electric generation, but it is not enough. As the ICC has noted, the United States needs more CO_2 reductions, and the states could counter the regressivity of such a tax by recycling the revenues of a carbon tax to benefit the whole. In particular states could use the revenue to benefit those most effected by the tax, such as providing training and resources to coal miners out of work; or to implore better technology. As stated above such revenue could also be used to help assist in these other emission-reduction policies that have been shown to work. A price on carbon shows the world that the United States will be involved in the world's reduction goals, which will provide motivation. Economists have now come out in large numbers to say that the United States and the world need carbon taxes, but often they have not noted that it should be used as a complement to these other programs, we should not abandon programs that are working for a streamlined approach. The world reduction goals will take synergism.

In conclusion, whatever policies move forward, this paper should encourage decision makers that carbon-reduction policies work and overall have a minimal effect on the overall cost of electricity.

Appendix 1

Carbon Dioxide Emissions from the Electricity Sector in each U.S. State

Table 5. Carbon dioxide emissions from the electric power sector for each U.S. state, by fossil fuel type (million metric tons).

		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Alabama	Coal	75.5	75.6	76.2	72.0	54.0	61.4	55.3	44.8	46.1	46.1	40.1	32.6
	Petroleum Products	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.0
	Natural Gas	5.7	7.9	9.6	9.0	12.3	15.2	18.5	21.6	18.0	18.8	21.8	22.6
	Total	81.3	83.6	85.9	81.0	66.4	76.7	74.0	66.5	64.2	65.1	61.9	55.2
Alaska	Coal	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.9	1.0	0.9
	Petroleum Products	0.6	0.6	0.5	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3
	Natural Gas	2.1	2.3	2.2	2.3	2.0	2.1	2.2	2.1	1.8	1.7	1.6	1.5
	Total	3.2	3.5	3.3	3.3	3.2	3.0	3.2	3.1	2.6	2.9	2.9	2.7
Arizona	Coal	39.0	39.3	40.0	42.1	38.2	42.2	42.5	38.9	42.5	41.8	35.9	30.2
	Petroleum Products	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	11.8	13.4	15.2	15.5	14.2	12.1	9.8	12.4	12.1	11.2	13.7	14.0
	Total	50.8	52.7	55.2	57.6	52.5	54.4	52.3	51.3	54.7	53.1	49.6	44.3
Arkansas	Coal	22.5	23.4	25.0	25.4	24.2	27.0	28.4	27.5	30.4	31.5	21.0	22.8
	Petroleum Products	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	2.7	3.9	3.5	3.5	4.5	5.2	5.8	7.0	5.1	3.9	6.0	7.4
	Total	25.3	27.4	28.6	29.0	28.8	32.3	34.2	34.6	35.5	35.5	27.0	30.2
California	Coal	2.0	2.1	2.2	2.2	2.0	2.1	1.9	1.2	0.6	0.6	0.0	0.0
	Petroleum Products	2.4	2.2	2.2	1.9	1.8	1.3	1.1	0.2	0.1	0.1	0.0	0.0
	Natural Gas	37.6	42.2	45.7	46.8	44.1	40.1	33.4	46.5	45.1	45.6	44.2	36.5
	Total	41.9	46.5	50.0	50.9	47.8	43.4	36.4	48.0	45.7	46.3	44.3	36.6
Colorado	Coal	35.6	36.5	36.2	35.2	32.2	34.9	34.2	34.3	33.6	32.3	31.4	29.7
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	5.0	5.0	6.7	5.8	6.2	5.0	4.6	4.7	4.9	5.3	5.2	5.5
	Total	40.6	41.6	42.9	41.0	38.4	39.9	38.9	39.1	38.5	37.7	36.6	35.3
Connecticut	Coal	4.0	4.3	3.8	4.3	2.5	2.7	0.6	0.9	0.7	0.9	0.6	0.2
	Petroleum Products	2.6	1.1	1.1	0.5	0.3	0.4	0.1	0.1	0.2	0.4	0.3	0.1
	Natural Gas	3.4	4.1	4.0	3.2	3.8	4.6	5.9	6.2	5.8	5.5	6.5	6.7
	Total	10.0	9.5	8.8	7.9	6.5	7.7	6.6	7.2	6.8	6.7	7.4	7.0
Delaware	Coal	5.1	5.1	5.8	5.5	3.2	2.9	1.7	1.6	1.7	1.0	0.7	0.6
	Petroleum Products	0.6	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Natural Gas	0.7	0.5	0.7	0.6	0.6	1.3	2.1	2.9	2.3	2.6	2.5	3.0
	Total	6.4	5.7	6.7	6.2	3.8	4.2	3.8	4.6	4.1	3.6	3.3	3.6
Florida	Coal	60.9	63.0	65.4	62.9	52.6	58.1	51.0	44.4	46.3	51.2	42.6	39.0
	Petroleum Products	31.4	19.8	17.0	10.7	8.2	8.3	3.2	1.3	2.6	1.9	2.2	2.8
	Natural Gas	34.6	40.5	42.2	43.5	49.6	53.0	56.2	61.3	55.7	56.1	62.8	64.1
	Total	126.9	123.4	124.5	117.1	110.5	119.5	110.4	107.0	104.6	109.2	107.6	105.9
Georgia	Coal	80.9	80.5	84.6	80.2	65.8	69.5	57.2	39.1	38.5	43.6	36.1	36.7
	Petroleum Products	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
	Natural Gas	4.0	5.3	6.7	5.3	7.8	9.5	10.6	16.6	15.1	15.7	19.4	20.7
	Total	85.1	85.8	91.4	85.6	73.7	79.1	67.8	55.7	53.6	59.5	55.7	57.5
Hawaii	Coal	1.4	1.4	1.4	1.5	1.4	1.5	1.4	1.5	1.3	1.5	1.4	1.5
	Petroleum Products	6.7	6.7	6.6	6.4	6.3	6.1	6.0	5.6	5.4	5.2	5.2	5.1
	Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	8.1	8.1	8.1	7.9	7.7	7.6	7.4	7.1	6.8	6.7	6.6	6.6
Idaho	Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.6	0.5	0.7	0.7	0.7	0.7	0.4	0.7	1.3	1.0	1.5	1.3
	Total	0.6	0.5	0.7	0.7	0.7	0.7	0.4	0.7	1.3	1.0	1.5	1.3
Illinois	Coal	89.9	89.4	93.3	94.7	88.5	91.5	88.6	80.5	86.2	85.5	71.9	58.5
	Petroleum Products	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1
	Natural Gas	3.1	2.3	3.4	1.8	1.8	2.4	2.5	4.7	2.8	2.3	4.5	7.8
	Total	93.3	91.9	96.8	96.7	90.4	94.1	91.2	85.3	89.0	87.9	76.4	66.4
Indiana	Coal	120.1	120.6	120.0	120.6	107.0	110.9	103.1	91.9	93.0	97.6	79.0	73.5
	Petroleum Products	0.2	0.1	0.1	0.1	0.1	0.1	1.0	0.7	1.1	1.2	1.2	0.5
	Natural Gas	1.9	1.5	2.0	1.8	2.0	3.3	4.6	6.2	4.4	4.5	7.1	9.7
	Total	122.2	122.2	122.2	122.5	109.1	114.3	108.6	98.8	98.4	103.3	87.3	83.7
Iowa	Coal	34.4	34.7	37.5	39.8	36.4	39.8	36.6	33.4	31.5	31.9	27.6	23.6
	Petroleum Products	0.2	0.2	0.3	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.1
	Natural Gas	1.0	0.9	1.2	0.9	0.5	0.6	0.5	0.8	0.6	0.5	0.8	1.1
	Total	35.5	35.8	39.0	40.8	37.0	40.6	37.2	34.3	32.1	32.5	28.4	24.7
Kansas	Coal	35.4	33.9	36.9	34.7	33.4	33.7	32.5	28.9	30.7	29.6	25.6	23.7
	Petroleum Products	0.9	0.1	0.3	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.8	1.2	1.4	1.4	1.7	1.5	1.6	1.8	1.3	1.0	0.8	1.1
	Total	37.1	35.1	38.5	36.4	35.3	35.4	34.2	30.7	32.0	30.7	26.4	24.8
Kentucky	Coal	87.0	90.5	90.1	91.2	84.3	90.5	90.8	83.1	83.7	83.7	72.7	67.6
	Petroleum Products	4.3	3.9	3.2	3.3	2.3	2.5	1.9	1.7	1.6	1.3	1.2	1.4
	Natural Gas	0.9	0.7	1.1	0.5	0.5	1.0	0.8	1.7	0.8	1.5	2.8	3.6
	Total	92.2	95.1	94.3	95.0	87.0	94.1	93.5	86.5	86.1	86.4	76.7	72.6
Louisiana	Coal	23.8	24.9	23.4	24.6	23.8	24.5	25.4	22.3	21.3	19.6	16.1	12.9
	Petroleum Products	3.5	2.1	2.4	2.3	1.7	3.3	4.9	3.2	5.0	5.2	4.4	5.2
	Natural Gas	15.6	10.8	12.3	12.9	12.2	14.7	15.9	17.4	14.5	14.5	18.7	18.1
	Total	42.9	37.8	38.1	39.8	37.7	42.4	46.2	42.9	40.8	39.3	39.2	36.1
Maine	Coal	0.4	0.4	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
	Petroleum Products	0.8	0.1	0.4	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.4	0.1
	Natural Gas	2.7	2.3	1.9	2.1	2.0	2.2	1.9	1.6	1.1	1.3	1.0	1.2
	Total	3.8	2.7	2.6	2.5	2.4	2.6	2.1	1.7	1.4	1.7	1.6	1.5
Maryland	Coal	27.9	27.7	28.1	26.4	23.0	22.9	20.7	16.2	15.8	17.5	14.3	14.2
	Petroleum Products	3.1	0.5	0.8	0.4	0.3	0.3	0.2	0.1	0.2	0.4	0.2	0.2
	Natural Gas	1.1	1.2	1.3	1.1	1.0	1.7	1.1	2.7	1.4	1.1	2.2	2.8
	Total	32.2	29.4	30.2	27.9	24.3	24.9	22.0	19.0	17.4	19.0	16.7	17.2
Massachusetts	Coal	11.0	10.4	11.1	9.9	8.6	7.8	3.9	2.1	3.8	2.7	2.2	1.9
	Petroleum Products	5.3	2.0	2.5	1.8	0.7	0.2	0.2	0.1	0.3	0.7	0.6	0.3
	Natural Gas	8.4	9.3	10.1	8.5	8.2	10.2	10.2	9.9	8.5	7.4	8.6	8.5
	Total	24.6	21.6	23.7	20.1	17.5	18.2	14.3	12.1	12.6	10.8	11.3	10.7
Michigan	Coal	67.8	65.5	68.1	67.3	64.5	64.0	58.6	52.9	55.6	52.3	52.4	40.8
	Petroleum Products	0.8	0.4	0.5	0.4	0.3	0.3	0.3	0.2	0.5	1.2	1.0	0.9
	Natural Gas	7.0	5.9	6.7	5.0	4.5	6.1	6.1	9.8	6.0	6.1	9.1	13.4
	Total	75.7	71.7	75.3	72.7	69.3	70.4	64.9	62.9	62.1	59.6	62.4	55.1
Minnesota	Coal	33.3	32.6	32.0	31.4	28.8	27.4	27.4	22.3	23.0	27.4	24.0	22.8
	Petroleum Products	0.8	0.5	0.4	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	1.4	1.3	1.9	1.3	1.3	1.9	1.5	3.1	2.7	1.7	3.0	3.6
	Total	35.5	34.4	34.3	32.9	30.2	29.3	28.9	25.4	25.7	29.1	27.0	26.5
Miss	Coal	16.4	17.6	17.1	16.4	13.1	13.8	9.9	7.5	9.0	10.8	6.5	5.8
	Petroleum Products	1.2	0.3	0.4	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	7.4	7.7	10.0	9.1	9.9	12.6	13.0	15.6	12.6	12.9	18.1	20.1
	Total	25.0	25.6	27.5	25.6	23.0	26.4	23.0	23.2	21.6	23.7	24.7	25.9
Missouri	Coal	76.2	75.5	73.1	72.3	70.3	73.7	76.5	70.2	73.7	71.2	63.6	58.8
	Petroleum Products	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Natural Gas	1.7	1.8	2.2	2.3	1.6	2.2	2.0	2.8	2.0	1.9	2.1	2.9
	Total	78.1	77.4	75.4	74.7	72.0	76.0	78.6	73.0	75.8	73.2	65.8	61.7
Montana	Coal	18.5	18.0	19.0	19.0	16.2	19.1	15.5	14.4	15.3	16.1	16.4	14.8
	Petroleum Products	0.7	0.8	0.7	0.7	0.8	0.7	0.8	0.8	0.8	0.7	0.9	0.8
	Natural Gas	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.3	0.4	0.3	0.4	0.3
	Total	19.2	18.8	19.8	19.8	17.0	19.8	16.5	15.5	16.4	17.1	17.6	15.9
Nebraska	Coal	20.8	20.7	19.7	21.4	22.9	22.8	25.2	24.0	25.7	24.0	23.2	20.8
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.4	0.4	0.6	0.4	0.2	0.2	0.2	0.4	0.3	0.2	0.2	0.3
	Total	21.3	21.1	20.3	21.8	23.1	23.1	25.4	24.4	26.0	24.3	23.4	21.2
Nevada	Coal	18.2	7.5	7.4	8.0	7.6	7.2	5.7	4.3	5.4	6.8	2.8	2.3
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	8.1	9.1	9.4	10.0	10.5	9.6	8.8	10.3	9.9	9.2	11.6	11.6

	Total	26.4	16.6	16.8	18.0	18.1	16.8	14.5	14.7	15.4	16.0	14.4	13.9
New Hampshire	Coal	4.2	4.2	4.2	3.8	3.1	3.2	2.3	1.3	1.6	1.4	1.0	0.5
	Petroleum Products	1.1	0.3	0.3	0.1	0.1	0.1	0.1	0.0	0.1	0.2	0.1	0.0
	Natural Gas	2.5	2.3	2.2	2.7	2.1	2.1	2.6	2.8	1.6	1.7	2.3	1.8
	Total	7.8	6.8	6.7	6.6	5.3	5.4	5.0	4.1	3.3	3.3	3.5	2.4
NJ	Coal	11.8	10.9	10.6	9.2	5.6	6.8	4.7	2.4	2.4	2.9	2.2	1.6
	Petroleum Products	0.6	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.0
	Natural Gas	6.9	7.2	8.6	9.3	9.0	10.8	10.9	12.4	11.9	13.7	15.6	18.0
	Total	19.3	18.3	19.4	18.7	14.6	17.7	15.6	14.8	14.4	16.7	17.9	19.7
NM	Coal	29.8	29.7	27.8	26.7	28.8	25.2	26.8	24.8	24.1	20.2	20.2	18.4
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	Natural Gas	2.2	3.0	3.3	3.7	3.8	3.8	4.0	4.1	4.1	4.2	4.3	4.5
	Total	32.1	32.7	31.1	30.5	32.6	29.0	30.8	28.9	28.2	24.5	24.6	23.0
NY	Coal	20.1	20.4	20.8	18.5	12.5	13.4	9.4	4.6	4.5	4.3	2.1	1.5
	Petroleum Products	19.4	5.6	6.7	3.0	2.1	1.7	0.9	0.4	0.6	1.5	1.3	0.5
	Natural Gas	16.5	21.0	22.1	21.6	19.9	23.0	23.5	27.3	24.9	24.7	25.8	25.8
	Total	56.0	47.0	49.6	43.1	34.5	38.1	33.8	32.2	30.0	30.5	29.2	27.7
NC	Coal	72.8	70.1	75.2	71.8	61.4	68.1	56.7	48.6	44.6	45.5	36.6	34.4
	Petroleum Products	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.4	0.3	0.2
	Natural Gas	1.5	1.5	2.2	1.9	2.1	3.9	4.8	8.1	10.8	11.1	14.8	16.1
	Total	74.5	71.9	77.6	73.9	63.8	72.2	61.7	56.8	55.5	57.0	51.7	50.8
ND	Coal	31.6	30.0	30.6	31.3	31.0	29.5	28.4	29.4	28.7	28.8	29.4	28.3
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.6
	Total	31.6	30.0	30.7	31.3	31.0	29.5	28.4	29.4	28.7	28.9	29.8	28.9
OH	Coal	129.7	126.3	127.5	124.9	110.5	116.2	104.1	83.2	91.0	86.6	69.3	67.2
	Petroleum Products	1.4	1.3	1.1	1.3	1.2	1.4	1.4	1.6	1.7	1.5	1.6	1.4
	Natural Gas	1.5	1.3	2.0	1.3	2.1	3.2	5.1	9.3	8.8	9.7	11.7	gvbg
	Total	132.6	128.9	130.6	127.5	113.8	120.7	110.6	94.1	101.5	97.7	82.6	80.6
OK	Coal	36.1	34.9	33.8	35.6	34.1	31.5	34.6	29.8	30.6	30.5	25.4	19.9
	Petroleum Products	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	13.2	15.2	15.6	15.5	15.6	15.9	14.5	17.3	13.6	11.5	14.2	15.4
	Total	49.3	50.1	49.6	51.1	49.7	47.4	49.1	47.1	44.2	42.0	39.6	35.3
OR	Coal	3.3	2.3	4.1	3.8	2.9	3.8	3.1	2.5	3.5	3.0	2.3	1.8
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	4.8	4.1	5.6	6.3	5.9	5.9	3.3	4.4	5.5	4.9	6.3	5.9
	Total	8.1	6.4	9.6	10.1	8.8	9.8	6.4	6.9	9.0	7.9	8.6	7.8
Pennsylvania	Coal	115.7	117.4	117.3	112.2	101.1	105.7	97.1	85.4	85.5	76.9	63.2	54.2
	Petroleum Products	4.4	0.9	1.1	0.8	0.7	0.5	0.4	0.3	0.3	0.5	0.4	0.2
	Natural Gas	4.4	5.5	7.9	7.7	11.5	13.4	16.7	21.6	20.1	21.5	24.2	27.6
	Total	124.5	123.8	126.2	120.7	113.4	119.6	114.2	107.3	105.9	98.9	87.8	82.1
RI	Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Natural Gas	2.4	2.3	2.8	2.9	3.0	3.1	3.5	3.3	2.5	2.4	2.7	2.6
	Total	2.4	2.3	2.8	2.9	3.0	3.1	3.5	3.3	2.6	2.5	2.8	2.6
SC	Coal	37.0	37.1	38.8	39.2	32.9	36.0	32.4	27.0	23.0	27.5	21.7	20.2
	Petroleum Products	0.4	0.1	0.2	0.1	0.5	0.1	0.1	0.1	0.1	0.2	0.1	0.1
	Natural Gas	2.5	2.8	2.8	2.5	4.1	4.8	5.5	6.3	5.1	4.7	7.4	7.3
	Total	39.9	40.0	41.8	41.9	37.5	40.9	37.9	33.4	28.2	32.5	29.3	27.5
SD	Coal	3.1	3.3	2.7	3.7	3.3	3.4	2.7	3.0	2.9	2.8	1.5	2.2
	Petroleum Products	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.2	0.2	0.2	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.3	0.4
	Total	3.3	3.5	3.0	3.9	3.4	3.5	2.8	3.2	3.1	3.0	1.9	2.6
TN	Coal	54.3	56.5	56.0	53.3	38.7	41.9	39.0	33.8	31.5	34.5	29.7	31.1
	Petroleum Products	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.2	0.1	0.1
	Natural Gas	0.3	0.4	0.4	0.2	0.2	1.2	1.4	3.4	2.0	2.4	3.7	4.7
	Total	54.8	56.9	56.6	53.7	39.0	43.3	40.5	37.3	33.6	37.1	33.5	35.9
TX	Coal	147.1	145.4	148.1	147.9	139.8	146.8	158.2	139.6	148.8	147.2	124.6	123.6
	Petroleum Products	1.7	1.8	1.3	1.2	1.5	0.6	0.8	0.2	0.2	0.1	0.1	0.1
	Natural Gas	80.0	79.7	80.0	78.1	75.1	73.0	78.7	82.3	77.2	77.6	88.9	83.8
	Total	228.8	226.9	229.5	227.2	216.5	220.4	237.7	222.1	226.2	224.8	213.6	207.5
Utah	Coal	35.1	34.6	35.0	35.5	32.9	32.1	31.4	29.1	32.2	31.2	29.7	24.2
	Petroleum Products	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.7	1.6	3.1	3.1	2.7	2.7	2.2	2.6	2.7	3.2	3.1	3.3
	Total	35.8	36.2	38.1	38.6	35.7	34.8	33.6	31.8	34.9	34.4	32.9	27.5
Vermont	Coal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Virginia	Coal	34.8	33.3	35.3	31.3	25.3	25.6	20.4	14.5	21.2	20.6	17.3	16.7
	Petroleum Products	3.3	0.6	1.5	0.9	0.8	1.0	0.4	0.3	0.2	0.9	0.9	0.4
	Natural Gas	3.7	3.3	4.9	4.2	5.2	7.7	7.8	10.4	9.4	8.8	13.6	16.5
	Total	41.8	37.2	41.8	36.5	31.3	34.3	28.5	25.2	30.9	30.3	31.8	33.6
Washington	Coal	10.5	6.3	8.7	8.7	7.6	8.7	5.2	3.8	6.9	7.0	5.3	4.9
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	3.6	3.2	3.1	4.1	5.0	4.3	2.1	2.3	4.8	4.7	5.5	4.7
	Total	14.0	9.6	11.9	12.7	12.6	13.1	7.4	6.2	11.7	11.7	10.8	9.5
West Virginia	Coal	84.8	85.2	86.5	84.2	65.7	74.1	71.7	66.7	68.4	72.9	65.2	68.1
	Petroleum Products	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Natural Gas	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.7	0.6
	Total	85.1	85.5	86.8	84.4	65.9	74.3	72.0	66.9	68.7	73.4	66.0	68.8
Wisconsin	Coal	44.9	39.9	40.0	41.3	36.7	39.7	38.8	32.2	39.9	36.3	35.9	31.9
	Petroleum Products	0.6	0.8	0.9	0.8	0.6	0.6	0.5	0.1	0.1	0.2	0.1	0.2
	Natural Gas	3.1	2.4	2.9	2.2	2.2	2.3	2.6	4.7	3.3	3.3	5.5	6.5
	Total	48.7	43.1	43.8	44.4	39.5	42.6	41.8	37.1	43.3	39.7	41.5	38.5
Wyoming	Coal	43.3	43.0	43.4	43.9	41.8	42.7	41.0	43.3	46.2	43.2	43.2	40.1
	Petroleum Products	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	Total	43.3	43.1	43.5	44.0	41.9	42.8	41.1	43.4	46.2	43.2	43.3	40.3

Appendix 2

Retail Price of Electricity for U.S. States

Table 2. Average retail price of electricity to ultimate customers by end-use, all sectors, (Price is cents per kWh) (U.S. Energy Information Administration, 2019).

Electricity Costs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Percentage change
Alabama	7.02	8.42	8.95	8.88	9.17	9.24	9.13	9.89	9.73	9.56	36.18% increase
Alaska	13.08	14.57	15.08	14.71	15.89	16.46	16.40	19.08	19.68	17.93	37.08% increase
Arizona	7.71	9.21	9.67	9.85	9.89	9.94	10.29	10.75	11.08	10.33	33.99% increase
Arkansas	6.92	7.76	7.95	7.39	7.52	7.64	7.87	8.31	7.77	8.13	17.48% increase
California	11.81	13.05	13.78	13.16	13.99	13.67	14.66	16.16	16.80	15.23	28.95% increase
Colorado	7.82	8.74	8.25	9.31	9.45	9.42	9.83	10.04	10.02	9.83	25.7% increase
Connecticut	16.41	16.92	17.5	17.44	16.34	15.54	15.64	17.55	18.43	17.24	5.05% increase

Delaware	10.83	12.25	12.21	11.98	11.66	11.04	10.95	10.93	10.59	11.09	2.4% increase
Florida	10.19	10.67	11.52	10.51	10.78	10.42	10.30	10.41	10.37	9.91	2.75% decrease
Georgia	7.42	9.01	8.99	9	9.81	9.46	9.62	9.93	9.66	9.59	27.9% increase
Hawaii	18.73	29.14	20.47	24.92	31.01	34.21	33.23	25.74	28.86	23.87	27.44% increase
Idaho	4.91	5.63	6.45	6.58	6.54	6.93	7.57	8.26	8.24	8.08	64.56% increase
Illinois	7.73	9.13	9.23	9.23	9.06	8.46	8.04	9.50	9.46	9.38	21.34% increase
Indiana	6.32	7	7.61	7.58	8.04	8.30	8.63	9.77	9.58	9.22	45.89% increase
Iowa	6.49	7.05	7.6	7.78	7.71	7.79	8.20	8.90	9.35	8.55	31.74% increase
Kansas	6.55	7.7	8.29	8.41	9	9.39	9.64	10.68	10.67	10.49	60.15% increase
Kentucky	5.44	6.19	6.63	6.69	7.18	7.28	7.51	8.57	8.42	8.42	54.78% increase

Louisiana	8.34	9.48	7.41	7.88	7.84	6.89	8.07	7.84	7.67	7.46	11.75% decrease
Maine	13.44	13.68	13	12.83	12.66	11.74	11.79	12.97	12.97	12.8	4.76% decrease
Maryland	10.28	12.98	13.29	12.86	12.19	11.32	11.63	12.03	11.58	12.21	18.77% increase
Massachusetts	15.13	16.09	15.71	14.36	14.33	13.82	14.25	17.10	18.32	16.48	8.92% increase
Michigan	8.56	9.14	9.74	9.99	10.42	10.97	11.30	11.30	11.57	11.05	29.09% increase
Minnesota	7.13	7.86	8.25	8.45	8.81	8.90	9.58	10.40	10.65	9.99	40.11% increase
Mississippi	7.63	8.82	8.88	8.64	8.85	8.62	9.17	9.12	9.32	8.67	13.63% increase
Missouri	5.77	6.97	7.47	7.91	8.56	8.69	9.15	10.21	9.97	9.74	66.5% increase
Montana	7.43	7.47	7.27	7.84	8.25	8.23	8.58	8.91	8.99	8.84	18.98% increase
Nebraska	6.08	6.6	7.27	7.64	7.97	8.49	8.81	9.18	9.17	9.05	49.83% increase

Nevada	9.28	10.04	10.45	10.04	9.23	9.11	9.12	8.83	8.86	8.39	9.59% increase
New Hampshire	13.59	14.47	15.37	14.77	14.8	14.19	14.28	16.08	16.87	15.66	15.23% increase
New Jersey	11.85	15.12	15.03	14.88	14.53	13.77	13.79	13.43	13.33	13.38	12.91% increase
New Mexico	7.06	8.42	8.26	8.55	8.71	8.91	9.32	9.70	9.49	9.12	29.18% increase
New York	14.54	17.16	16.08	16.57	16.16	15.25	15.83	14.91	15.07	14.47	0.48% decrease
North Carolina	7.59	8.07	8.6	8.75	8.69	9.20	9.19	9.12	9.41	9.2	21.21% increase
North Dakota	6.18	6.64	6.79	7.1	7.47	7.85	8.24	8.86	9.20	8.94	44.66% increase
Ohio	7.61	8.39	9.11	9.17	9.09	9.10	9.18	9.84	9.80	9.84	29.3% increase
Oklahoma	6.46	8.11	7.33	7.67	7.94	7.63	7.92	8.29	8.10	7.83	21.2% increase
Oregon	6.9	7.25	7.55	7.53	8.03	8.19	8.34	8.79	9.01	8.83	27.97% increase

Pennsylvania	8.87	9.37	9.65	10.36	10.56	9.90	9.83	10.13	10.09	10.19	14.88% increase
Rhode Island	12.7	15.89	14.07	14.23	13.38	12.72	13.43	16.30	17.83	16.28	28.19% increase
South Carolina	6.84	7.86	8.39	8.51	8.88	9.09	9.13	10.01	9.71	9.79	43.13% increase
South Dakota	6.68	7.07	7.29	7.83	8.08	8.52	8.88	10.06	9.99	9.83	47.15% increase
Tennessee	6.95	7.71	8.66	8.47	9.18	9.25	9.27	9.43	9.57	9.23	32.8% increase
Texas	10.21	11.06	10.34	9.46	9.28	8.59	8.80	8.43	8.73	8.43	17.43% decrease
Utah	6.04	6.6	6.93	7.09	7.13	7.92	8.28	8.73	8.41	8.72	44.37% increase
Vermont	12.04	12.3	12.79	13.16	13.75	14.15	14.42	14.60	15.05	14.46	20.1% increase
Virginia	6.85	7.87	9.08	8.74	8.85	9.12	9.02	9.20	9.58	9.09	32.7% increase
Washington	6.4	6.64	6.89	6.59	6.73	6.92	7.01	7.89	7.97	7.68	20.0% increase
West Virginia	5.11	5.53	6.55	7.38	7.82	8.12	7.94	9.00	8.83	8.98	75.73% increase

Wisconsin	8.07	9.01	9.49	9.81	10.26	10.33	10.69	10.77	10.93	10.67	32.22% increase
Wyoming	5.37	5.66	6.05	6.2	6.5	7.18	7.54	8.30	8.14	8.19	52.51% increase

All Information taken from Electric Power Monthly, a monthly report prepared by the U.S. Energy Information Administration (EIA), the statistical and analytical agency within the U.S. Department of Energy. By law, EIA's data, analyses, and forecasts are independent of approval by any other officer or employee of the United States Government.

December 2015, with Data from 2014 and 2015 (Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date – all sectors YTD) at p. 126 of 237.
https://www.eia.gov/electricity/monthly/archive/december2015.pdf

December 2013, with data from 2012 and 2013 (Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date – all sectors YTD) at p. 124 of 214.
https://www.eia.gov/electricity/monthly/archive/december2013.pdf

December 2011, with data from 2010 and 2011 (Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date– all sectors YTD) at p. 118 of 189.
https://www.eia.gov/electricity/monthly/archive/December2011.pdf
December 2009, with data from 2008 and 2009 (Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date– all sectors YTD) at p. 110 of 170.
https://www.eia.gov/electricity/monthly/archive/pdf/02260912.pdf
Information for 2007

Table 3. Overall electric price increases by state, ranked.

Overall electric prices			
	2007	2016	Change
Texas	10.21	8.43	-17.43%
Louisiana	8.34	7.46	-11.75%
Maine	13.44	12.8	-4.76%
Florida	10.19	9.91	-2.75%
New York	14.54	14.47	-0.48%
Delaware	10.83	11.09	2.40%
Connecticut	16.41	17.24	5.05%
Massachusetts	15.13	16.48	8.92%
Nevada	9.28	8.39	9.59%
New Jersey	11.85	13.38	12.91%
Mississippi	7.63	8.67	13.63%
Pennsylvania	8.87	10.19	14.88%
New Hampshire	13.59	15.66	15.23%
Arkansas	6.92	8.13	17.48%
Maryland	10.28	12.21	18.77%
Montana	7.43	8.84	18.98%
Washington	6.4	7.68	20.00%

Vermont	12.04	14.46	20.10%
Oklahoma	6.46	7.83	21.20%
North Carolina	7.59	9.2	21.21%
Illinois	7.73	9.38	21.34%
Colorado	7.82	9.83	25.70%
Hawaii	18.73	23.87	27.44%
Georgia	7.42	9.59	27.90%
Oregon	6.9	8.83	27.97%
Rhode Island	12.7	16.28	28.19%
California	11.81	15.23	28.95%
Michigan	8.56	11.05	29.09%
New Mexico	7.06	9.12	29.18%
Ohio	7.61	9.84	29.30%
Iowa	6.49	8.55	31.74%
Wisconsin	8.07	10.67	32.22%
Virginia	6.85	9.09	32.70%
Tennessee	6.95	9.23	32.80%
Arizona	7.71	10.33	33.99%
Alabama	7.02	9.56	36.18%
Alaska	13.08	17.93	37.08%
Minnesota	7.13	9.99	40.11%
South Carolina	6.84	9.79	43.13%
Utah	6.04	8.72	44.37%

North Dakota	6.18	8.94	44.66%
Indiana	6.32	9.22	45.89%
South Dakota	6.68	9.83	47.15%
Nebraska	6.08	9.05	49.83%
Wyoming	5.37	8.19	52.51%
Kentucky	5.44	8.42	54.78%
Kansas	6.55	10.49	60.15%
Idaho	4.91	8.08	64.56%
Missouri	5.77	9.74	66.50%
West Virginia	5.11	8.98	75.73%

References

American Wind Energy Association. (2014). *Wind Industry Annual Market Report, Year Ending* Retrieved from: https://www.awea.org/resources/publications-and-reports/market-reports/2018-u-s-wind-industry-market-reports

Avi-Yonah, R. S., & Uhlmann, D. M. (2009). Combating global climate change: Why a carbon tax Is a better response to global warming than cap-and-trade. *Stanford Environmental Law Journal, 28*, 1-50.

Bade, G. (2018, October 25). Even in Indiana, new renewables are cheaper than existing coal plants. Retrieved from Utility Dive: https://www.utilitydive.com/news/even-in-indiana-new-renewables-are-cheaper-than-existing-coal-plants/540242/

Baranzini, A., Goldemberg, J., & Speck, S. (2000). A future for carbon taxes. *Ecological Economics*, 395-412.

California Environmental Protection Agency Air Resource Board. (2019). *ARB Emissions Trading Program*. Retrieved from: https://www.arb.ca.gov/cc/capandtrade/guidance/cap_trade_overview.pdf

Cama, T. (2016, November 4). EPA moves forward with optional cap-and-trade system for climate rule. Retrieved from The Hill: https://thehill.com/policy/energy-environment/304301-epa-moves-forward-with-optional-cap-and-trade-system-for-climate

Carbon Tax Center. (2015). What is a carbon tax? Retrieved from: http://www.carbontax.org/whats-a-carbon-tax/

Carbon Tax Center. (2018). Where Carbon Is Taxed. Retrieved from: https://www.carbontax.org/where-carbon-is-taxed/

Carbon Washington. (n.d.). Carbon Washington: A revenue-neutral carbon tax campaign. Retrieved from: http://carbonwa.org/policy/

Center for Climate and Energy Solutions. (2018). *California Cap and Trade*. Retrieved from: https://www.c2es.org/content/california-cap-and-trade/

Climate Leadership Council. (2019). *Consensus on Climate Solution*. Retrieved from: https://www.clcouncil.org/?mod=article_inline

DeVore, C. (2017, March 2). California lurches for a carbon tax after consecutive greenhouse gas auction failures. Retrieved from Forbes: https://www.forbes.com/sites/chuckdevore/2017/03/02/california-lurches-for-a-carbon-tax-after-consecutive-greenhouse-gas-auction-failures/#21bb07d132e1

Environmental Defense Fund. (2018). *How Cap and Trade Works*. Retrieved from: https://www.edf.org/climate/how-cap-and-trade-works

Financial Times. (2018). *Financial Times Lexicon*. Retrieved from Financial Times: http://lexicon.ft.com/Term?term=carbon-market

George Akerlof, e. a. (2019, January 16). *Economists' Statement on Carbon Dividends.* Retrieved from Wall Street Journal: https://www.wsj.com/articles/economists-statement-on-carbon-dividends-11547682910

Gleckman, H. (2014, May 27). *Turning Carbon Tax Theory Into Reality*. Retrieved from Tax Policy Center: https://www.taxpolicycenter.org/taxvox/turning-carbon-tax-theory-reality

Gleckman, H. (2018, October 10). *Bill Nordhaus, The Nobel Prize, Climate Change And Carbon Taxes.* Retrieved from Forbes: https://www.forbes.com/sites/howardgleckman/2018/10/10/bill-nordhaus-the-nobel-prize-climate-change-and-carbon-taxes/#1793454d6a03

Grainger, C. A., & Kolstad, C. D. (2010). Who pays a price on carbon? *Environmental and Resource Economics: The Official Journal of the European Association of Environmental and Resource Economists, 46(3)*, 360-378.

Groom, N. (2018, November 7). Washington state carbon tax poised to fail after Big Oil campaign. Retrieved from Reuters: https://www.reuters.com/article/us-usa-election-carbon/washington-state-carbon-tax-poised-to-fail-after-big-oil-campaign-idUSKCN1NC1A9?feedType=RSS&feedName=environmentNews

Hardesty, L. (2014, April 22). Is the low hanging fruit of energy efficiency gone? Retrieved from Energy Manager Today: https://www.energymanagertoday.com/is-the-low-hanging-fruit-of-energy-efficiency-gone-0100458/

Herring, H. (2006). Energy efficiency - a criticcal review. *The Second Biennial International Workshop "Advances in Energy Studies"*, 10-20.

Hurley, L. (2018, October 9). U.S. top court rebuffs appeal of Kavanaugh ruling nixing climate rule. Retrieved from Reuters: https://www.reuters.com/article/us-usa-court-environment/u-s-top-court-rebuffs-appeal-of-kavanaugh-ruling-nixing-climate-rule-idUSKCN1MJ1OC

Indiana Office of Utility Consumer Counselor. (2018). *Electric Energy Efficiency Programs.* Retrieved from: https://www.in.gov/oucc/2612.htm

Indiana Utility Regulatory Commission. (2018). *Northern Indiana Public Service Company 2018 Integrated Resource Plan.* (2018, October 31). Retrieved from: https://www.in.gov/iurc/files/2018%20NIPSCO%20IRP.pdf

Indianapolis Business Journal. (2014). Pence lets bill ending Energize Indiana become law. Retrieved from: https://www.ibj.com/articles/46897-pence-lets-bill-ending-energize-indiana-become-law

Laerd Statistics. (2019). *Pearson Product-Moment Correlation*. Retrieved from: https://statistics.laerd.com/statistical-guides/pearson-correlation-coefficient-statistical-guide.php

Lesser, J. (2016, June). *Missing Benefits Hidden Costs, The Cloudy Numbers in the EPA's Proposed Clean Power Plan.* Retrieved from: https://www.manhattan-institute.org/download/8988/article.pdf

Linden, E. (2018, October 25). The economics Nobel went to a guy who enabled climate change denial and delay. Los Angeles, California, United States.

Lombardi, P. (2018). Noble Prize winner recommends tax On carbon emissions. *Monday Business Briefing, Oct 17, 2018*.

Loughran, D. S., & Kulick, J. (2004). Demand-side management and energy efficiency in the United States. *The Energy Journal*, 19-43.

McCabe, J. (n.d.). *Update on EPA's Clean Power Plan Model Rules - Archived*. Retrieved from Environmental Protection Agency: https://blog.epa.gov/tag/clean-power-plan/

Michigan et al. v. EPA et al., 14-46 (Supremee Court of the United States June 29, 2015).Michigan Government. (2015). *Overview of the Final Clean Power Plan Rule - EPA CAA 111(d).* Retrieved from: https://www.michigan.gov/documents/mpsc/Overview_of_the_Clean_Power_Plan_2015_10_20_503553_7.pdf

National Conference of State Legislatures. (2018). *State Renewable Portfolio Standards*.

Retrieved from: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx

National Resource Defense Council. (2017). *NRDC and Energy Efficiency: Building the Clean Energy Future*. Retrieved from: https://www.nrdc.org/resources/nrdc-and-energy-efficiency-building-clean-energy-future

Nordhaus, W. (1993). Rolling the 'DICE': An optimal transition path for controlling greenhouse gases. *Resource and Energy Economics, 15*, 27.

Office of Energy Efficiency and Renewable Energy - Department of Energy. (2019). *Strategic Goals*. Retrieved from: https://www.energy.gov/eere/about-office-energy-efficiency-and-renewable-energy

Parry, W., & Williams III, R. C. (1999). A second-best evaluation of eight policy instruments to reduce carbon emissions. *Resource and Energy Economics*, 347-373.

Post, J. (2018, September 21). What is a PEST analysis. Retrieved from Business News Daily: https://www.businessnewsdaily.com/5512-pest-analysis-definition-examples-templates.html

Saini, S. (2004). Conservation v. generation: The significance of Demand-Side Management (DSM), its tools and techniques. *Refocus*, 52-54.

Schwartz, J. (2019, January 22). Global warming concerns rise among Americans in new poll. Retrieved from The New York TImes: https://www.nytimes.com/2019/01/22/climate/americans-global-warming-poll.html

Science News. (2018). *Here's how much climate change could cost the U.S.* Retrieved from: https://www.sciencenews.org/article/climate-change-economic-cost-united-states

Shahyd, K. (2017, October 5). *Residential Energy Efficiency is Largest Source of CO2 Reduction Potential*. Retrieved from NRDC: https://www.nrdc.org/experts/khalil-shahyd/residential-energy-efficiency-largest-source-co2-reduction-potential

Shinn, L. (2018, August 14). *Energy Efficiency: The Clean Facts*. Retrieved from National Resources Defense Council: https://www.nrdc.org/stories/energy-efficiency-clean-facts

Shirmali, G., & Kniefel, J. (2011). Are government policies effective in promoting deployment of renewable electricity resources? *Energy Policy*, 4726-4741.

Shouse, K. C. (2018, February 28). *EPA's Proposal to Repeal the Clean Power Plan: Benefits and Costs.* Retrieved from Congresssional Research Service: https://fas.org/sgp/crs/misc/R45119.pdf

Smith, P. (2018, October). Public Utility Analyst Manager at the Alabama PUC. (K. Earls, Interviewer).

Statistics How To. (2019). *Correlation Coefficient*. Retrieved from: https://www.statisticshowto.datasciencecentral.com/probability-and-statistics/correlation-coefficient-formula/

Stockmayer, G., Finch, V., Komor, P., & Mignogna, R. (2012). Limiting the costs of renewable portfolio standards: A review and critique of current methods. *Energy Policy, Valume 42*, 155-163.

The Nobel Prize. (2018). *Prize in Economic Sciences 2018.* Retrieved from: https://www.nobelprize.org/prizes/economic-sciences/2018/press-release/

The Regional Greenhouse Gas Initiative. (2018). Retrieved from https://www.rggi.org

The Regional Greenhouse Gas Initiative. (2018). Retrieved from: https://www.rggi.org/rggi-inc/contact

The Regional Greenhouse Gas Initiative. (2019). Retrieved fromI: https://www.rggi.org/

Union of Concerned Scientists. (2018). *Each Country's Share of CO2 Emissions.* Retrieved from https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html#.XEpI3FxKhPY

United Nations. (2018). *United Nations Climate Action*. Retrieved from: https://www.un.org/sustainabledevelopment/climate-change-2/

University of Michigan - Center for Sustainable Systems. *(2019). U.S. Renewable Factsheet*. Retrieved from: http://css.umich.edu/factsheets/us-renewable-energy-factsheet

U.S. Department of Energy. (2019). *Energy Efficiency*. Retrieved from: https://www.energy.gov/science-innovation/energy-efficiency

U.S. Energy Information Administration. (n.d.). *Electric Power Monthly - (Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date – all sectors YTD).* Retrieved from: https://www.eia.gov

U.S. Energy Information Administration. (2018). *Electricity Explained*. Retrieved from: https://www.eia.gov/energyexplained/index.php?page=electricity_in_the_united_states

U.S. Energy Information Administration. (2018). *Documentation for estimates of state energy-related carbon dioxide emissions*. Retrieved from: https://www.eia.gov/environment/emissions/state/pdf/statemethod.pdf

U.S. Energy Information Administration. (2019). *Table 5.6.B, Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State, Year-to-Date– all sectors YTD.* (2007-2017). Retrieved from: https://www.eia.gov/electricity/monthly/

U.S. Energy Information Administration. *(2019). State Carbon Dioxide Emissions Data.* (2007-2017). Retrieved from: https://www.eia.gov/environment/emissions/state/

U.S. Energy Information Administration. (2016). *Natural gas expected to surpass coal in mix of fuel used for U.S. power generation in 2016*. Retrieved from: https://www.eia.gov/todayinenergy/detail.php?id=25392

U.S. Energy Information Administration. (2018). *U.S. Energy-Related Carbon Dioxide Emissions.* Retrieved from: https://www.eia.gov/environment/emissions/carbon/

U.S. Energy Information Administration (2018). *About SEDS*. Retrieved from: https://www.eia.gov/state/seds/

U.S. Energy Information Administration (2019). *Analysis and Projections*. Retrieved from: https://www.eia.gov/analysis/

U.S. Environmental Protection Agency. (2018). *EPA Proposes Affordable Clean Energy (ACE) Rule*. Retrieved from: https://www.epa.gov/newsreleases/epa-proposes-affordable-clean-energy-ace-rule

U.S. Environmental Protection Agency. (2015). *Cutting Carbon Pollution from Power Plants*. Retrieved from: http://www.epa.gov/cleanpowerplan/fact-sheet-clean-power-plan-numbers

U.S. Environmental Protection Agency. (n.d.). *Overview of Greenhouse Gases*. Retrieved from: http://www3.epa.gov/climatechange/ghgemissions/gases/co2.html

U. S. Environmental Protection Agency (2018). *Sources of Greenhouse Gas Emissions*. Retrieved from: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

U.S. Environmental Protection Agency. (2015). *Clean Power Plan for Existing Power Plants*. (2015). Retrieved from: http://www.epa.gov/cleanpowerplan/clean-power-plan-existing-power-plants

U.S. Environmental Protection Agency (2018). *Complying with President Trump's Executive Order on Energy Independence*. Retrieved from: https://www.epa.gov/energy-independence

U.S. Environmental Protection Agency. (2017). *Proposal to Repeal the Clean Power Plan*. Retrieved from: https://www.epa.gov/stationary-sources-air-pollution/electric-utility-generating-units-repealing-clean-power-plan

U.S. Environmental Protection Agency (n.d.). *Proposal: Affordable Clean Energy (ACE) Rule*. Retrieved from: https://www.epa.gov/stationary-sources-air-pollution/proposal-affordable-clean-energy-ace-rule

U.S. Environmental Protection Agency. (2018). *The Clean Power Plan - Setting State Goals.* Retrieved from The: https://archive.epa.gov/epa/cleanpowerplan/fact-sheet-components-clean-power-plan.html

Walton, R. (2015, October 23). *Final Clean Power Plan rule published; 24 states sue EPA* . Retrieved from Utility Dive: http://www.utilitydive.com/news/final-clean-power-plan-rule-published-24-states-sue-epa/407869/

Whitehouse.gov. (2017, March 28). Retrieved from The White House: www.whithouse.gov/presidential-actions/presidential-executive-order-promoting-energy-independence-economic-growth/

Ancillary Appendix 1

Communications with Various State Commissions

Table 8. Discussions with individual state public utility commissions.

Note that each Commission was contacted to discuss CO_2 reduction policies, and where information regarding policies and cost of compliance could be found. Blank responses indicate that the Commission provided no response to inquiry.

State	PUC Name	Website	Point of contact	What they said
Alabama	Alabama PUC	www.psc.state.al.us	Patricia W. Smith, CPM Public Utility Analyst Manager Electricity Policy Division AL Public Service Commission 100 N. Union Street, Suite 931 Montgomery, AL 36104 Office: (334) 242-9848 Fax: (334) 242-2041 Patricia.smith@psc.alabama.gov	In October 2004, under Docket Nos. 18117 and 18416, the Commission approved a modification to Rate CNP to include Part C (Certificated New Plant – Environmental Compliance Plan). Rate CNP, Part C's primary purpose is to recover costs associated with the compliance of environmental laws. As part of the reporting requirements, the Company must file, in accordance with Rate CNP, Part C, a preliminary version of the Environmental Compliance Plan by November 1 of each year and a final version, including the Rate CNP environmental factors, in December of each year. The plan must include details of the Company's environmental compliance strategy for the succeeding five-year period along with a discussion of the pertinent environmental legislation and regulations. I have attached a copy of the most recent filing of the Environmental Compliance Plan, filed December 12, 2017, under docket numbers 18117 and 18416. Additionally, I am providing the steps to locate the annual filing on the Commission's website, if you wish to check for this filing in other years. See below. http://www.psc.alabama.gov/index.htm 1. In the Business Information Center section, click the down arrow under "How Do I:" (to get the options in the drop down box). 2. Click "View PSC Calendar". 3. Scroll down and click on, "Click Here to Search". 4. In the Date Filed Between section, input December 1, 2017 and December 31, 2017. (this is the most recent filing) 5. Next to Tracking number, type - TR1730680 6. Scroll down and Click "Search". 7. See the most recent filed "Final Environmental Compliance Plan for Rate CNP for Alabama Power Company" (date filed 12/12/2017). 8. Click on the icon (looks like a lined sheet of paper). 9. Click on "Final Environmental Compliance Plan for Rate CNP for Alabama Power Company". 10. Click Open to view the document.
Alaska	Regulatory Commi	rca.alaska.gov		

	ssion of Alaska			
Arizona	Arizona Corporation Commission	www.azcc.gov/divisions/utilities/electric.asp	CChidebell-Emordi@azcc.gov	Dr. Nonso Chidebell-Emordi, an Electric Regulatory Engineer at the ACC and your inquiry was passed along to me. The ACC does not have GHG emissions mandates. However, the Obama-era proposed Clean Power Plan (CPP) required states to meet GHG emission limits. Compliance efforts led by the Arizona Department of Environmental Quality (ADEQ) included economic parameters as part of the data under consideration. ADEQ worked with the AZ EPA, Lawrence Berkeley National Labs (LBNL), National Renewable Energy Labs (NREL), the Western Energy Interstate Board (WEIB) as well as other private consulting groups (Brattle Group, etc.) to develop compliance options for Arizona's power plants. This is the contact information I have , I am unsure as to how current some of it is: ADEQ: Steve Burr (Burr.Steven@adeq.gov) WEIB: Alaine Ginocchio (702-897-4554) LBNL: Steve Schiller (srschiller@lbl.gov)
Arkansas	Arkansas Public Service Commission	www.arkansas.gov/psc	Katie Pritchett, BEP Cost Allocation & Rate Design Rate Case Analyst Arkansas Public Service Commissio 501-682-5824 kpritchett@psc.state.ar.us	Our Energy Efficiency Rules can be located here http://www.apscservices.info/Rules/energy_conservation_rules_06-004-R.pdf And our net metering rules are here: http://www.apscservices.info/Rules/net_metering_rules.pdf This is a link to our research by docket: http://www.apscservices.info/efilings/docket_search.asp you will find docket numbers listed in the rules. Each utility is required to file an annual report and have approved projects for energy efficiency.
California	California Public Utilities Commission	cpuc.ca.gov		

Colorado	Colorado Public Utilities Commission	https://www.colorado.gov/pacific/dora/divs		The Commission generally receives information on the reductions in CO2 emissions achieved by Colorado's two IOU electric utilities in the context of their Electric Resource Plan (ERP) proceedings. These proceedings have just concluded for the most recent four-year cycle: Xcel Energy (Public Service Company of Colorado) Proceeding No. 16A-0396ECommission approved early retirement of two coal units and their replacement with renewables, storage, and gas-fired generation. Assigning a cost to C02 emissions was a contested issue. Black Hills Energy (Black Hills/Colorado Electric, Inc.)Proceeding No. 16A-0436ECommission approved acquisition of 60MW wind generation that will reduce natural gas fuel burn. (Black Hills is small; 94,000 customers only.)Assigning a cost to C02 emissions was a contested issue. The public filings in these proceedings are available through the Commission's E-Filings system. Within the case files are references to the IOUs' earlier proceedings in which emission reductions was a prominent factor. We will shortly be entering a rulemaking to modify the ERP Rules. A delay in the next ERP filings is likely (possibly until sometime in 2020). Tomorrow's election also will bring us a new governor and may potentially bring control of the General Assembly to his party. This change could have a big impact on renewable energy and emission reduction policies as well.
Connecticut	Connecticut Public Utilities Regulatory Authority	https://www.ct.gov/pura		
Delaware	Delaware Public Service Commission	https://depsc.delaware.gov		
Florida	The Florida Public Service Commission	http://www.psc.state.fl.us	contact@psc.state.fl.us	The FPSC regulates investor-owned electric and natural gas utilities throughout the state, and investor-owned water and wastewater utilities in those counties which have opted to transfer jurisdiction to the FPSC. In the telephone industry, the Commission's authority includes the Lifeline Assistance Program, Florida Relay Service, and pay telephone service. From the information you provided, this matter appears outside of our jurisdiction. The agency that may be able to assist you would be the Florida Department of Environmental Protection. You can reach this agency at: Department of Environmental Protection Citizen Services 3900 Commonwealth Boulevard M.S. 49z Tallahassee, Florida 32399 850-245-2118 (phone); 850-245-2128 (fax) http://www.dep.state.fl.us
Georgia	Georgia Public Service	http://www.psc.state.ga.us/	gapsc@psc.state.ga.us	

	Commission			
Hawaii	Public Utilities Commission - Hawaii	Public Utilities Commission - Hawaii	puc@hawaii.gov	
Idaho	Idaho Public Utilities Commission	Idaho Public Utilities Commission	Karl.klein@puc.idaho.gov	I forwarded you email to the Idaho PUC's engineering supervisor. He asked me to send you his response. In sum, he relayed that Idaho retail customers do not incur "direct" costs due to greenhouse gas regulations at either the federal or Idaho state level. With the Clean Power Plan DOA and no Idaho RPS or any other type of Idaho GHG regulations, Idaho utility rates are devoid of any direct costs, such as allowances or credits needed to cover greenhouse gas emissions. He also noted that, with that said, Idaho utilities have service territories that cover States that do have regulations in the form of renewable portfolio standards and emission performance standards for power plants located in each of their respective states, primarily in Washington, Oregon, and California. Because each of these utilities plan and operate as a "system," yet are required to meet state specific requirements, Idaho can incur indirect costs if the resources that were selected operate at a higher cost than resources that would have been selected had those requirements not existed. These indirect costs are difficult to estimate since they are based on comparisons done on a counter-factual basis. The only documents that he knows exist that could possibly provide that type of information would be contained in the Utility's IRPs. These can be obtained on the following websites: https://www.pacificorp.com/es/irp.html https://www.idahopower.com/energy/planning/integrated-resource-plan/ https://www.myavista.com/about-us/our-company/integrated-resource-planning
Illinois	Illinois Commerce Commission	Illinois Commerce Commission	jean.gibson@illinois.gov	I am looking into your question and will let you know when I find out more information! If you have any more details or specific questions you would like answered, please reach out to me and I will do my best. Thank you and happy Friday, Shea Felde Market Associate, Office of Retail Market DevelopmentIllinois Commerce Commission160 North LaSalle, Suite C-800Chicago, IL 60601Phone: 312-814-3075Shea.Felde@illinois.gov https://www.icc.illinois.gov/ormd

Indiana	Indiana Utility Regulatory Commission	https://www.in.gov/iurc/		Author has familiarity with IURC and where information is located, so no specific request for information was given to the Commission.
Iowa	Iowa Utilities Board		iub@iub.iowa.gov	
Kansas	Kansas Corporation Commission		fcip@kcc.ks.gov	It is my understanding the information is provided by way of various rate related filings, and no concise or compiled report is available, but you may want to search the online docket source and our legislative reports on the website. http://kcc.ks.gov/ The legislative reports can be located on our website under the "Commission Activity" tab found in the blue banner across the top of the page and then scroll down to "Reports to the Legislature". The reports cover 2014 to 2018. Then you can go to the Utilities report for each year.
Kentucky	Kentucky Public Service Commission		psc.info@ky.govAndrew Melnykovych Director of Communications Kentucky Public Service Commission 502-782-2564 (direct) or 502-564-3940 (switchboard) 502-330-5981 (cell) Andrew.Melnykovych@ky.gov	We do not receive that information
Louisiana	Louisiana Public Service Commission		arnold.chauviere@la.gov	
Maine	Maine Public Utilities Commission	https://www.maine.gov/mpuc/	https://www.maine.gov/mpuc/about/contactform.shtml	
Maryland	Maryland Public Service Commission		Daniel.Hurley@maryland.gov	
Massachusetts	Department of Public Utilities		DPU.Legal@state.ma.us	

Michigan	MPSC - MI Public Service Commission	https://www.michigan.gov/mpsc/	proudfootp@michigan.gov	
Minnesota	Public Utilities Commission	https://mn.gov/puc/	Janet.Gonzalez@state.mn.us Sean Stalpes Rates Analyst | Economic Analysis Minnesota Public Utilities Commission 121 7th Place E, Suite 350 Saint Paul, MN 55101-2147 O: 651-201-2252 sean.stalpes@state.mn.us	Janet Gonzalez forwarded me your question regarding utility regulations and the cost related to achieving greenhouse gas (GHG) emissions in Minnesota, and I work on resource planning and environmental cost dockets here at the Commission. Generally, there are several state statutes and Commission proceedings that evaluate the costs related to achieving greenhouse gas emissions reductions, in particular: · The integrated resource planning (IRP) statute (Minn. Stat. 216B.2422); · The Commission's resource planning rules (Minn. Rule. 7843); and · The CO2 Values statute (Minn. Stat. 216H.06). These are all interrelated, and the CO2 values are employed in IRP modeling. Note that we also consider environmental externalities, which is an estimate of the social damage of various pollutants. Your question asked about the cost of compliance (e.g. carbon taxes, cap-and-trade), which is why I listed the CO2 Values statute above. Environmental externalities are required by the IRP statute (see subdivision 3). Please let me know if you have follow-up questions, and I could perhaps set aside some time for a phone call (or email if you prefer).
Mississippi	Mississippi Public Service Commission	http://www.psc.state.ms.us/	frank.farmer@psc.state.ms.us	
Missouri	Missouri Public Service Commission	https://psc.mo.gov/	pscinfo@psc.mo.gov	
Montana	Montana Public Service Commission	http://psc.mt.gov/	jkraske@mt.gov	
Nebraska	Nebraska Public Service Commission | NPSC	http://www.psc.nebraska.gov/	mike.hybl@nebraska.gov	The Nebraska Public Service Commission does not regulate electric utility providers in the State of Nebraska- Nebraska is a 100% public power state, and the utility are overseen by elected boards or local government officials. There is a coordinating body for public power- the Nebraska Power Review Board- which is an independent agency the PRB web address is powerreview@nebraska.gov.

Nevada	Public Utilities Commissionof Nevada	http://puc.nv.gov/	amcuneo@puc.nv.gov	We don't track the cost of carbon. While the cost of carbon is included in calculating 20-year and 30-year PWRRs (Present Worth of Revenue Requirements) for resource planning purposes, they are not actual costs. They are hypothetical costs. Thank you, Peter
New Hampshire	New Hampshire Public Utilities Commission	http://www.puc.state.nh.us/	puc@puc.nh.gov; Amanda O. Noonan Director, Consumer Services and External Affairs New Hampshire Public Utilities Commission 21 South Fruit Street, Suite 10 Concord NH 03301 603.271.1164 voice/603.271.3878 fax amanda.noonan@puc.nh.gov	Thank you for your email regarding greenhouse gas emissions. New Hampshire and the other New England states participate in the Regional Greenhouse Gas Initiative, or RGGI, a regional cap and trade market for CO2 allowances. The cost of RGGI is embedded in energy prices in the regional wholesale electricity market. New Hampshire's electric distribution companies purchase energy service for their customers through a competitive bidding process, and the pass-through energy price includes, among other costs, the cost of RGGI. Just as no breakdown is provided for other components, like risk premiums and profit margins, in the per kWh energy price, the cost of RGGI is not identified separately. New Hampshire entered into RGGI in 2008 through legislation. Information about the history of RGGI and NH's legislative activity is available on our website http://puc.nh.gov/Sustainable%20Energy/GHGERF.htm The most recent report on RGGI is also available on our website. http://puc.nh.gov/Sustainable%20Energy/GHGERF/RGGI%20Annual%20Reports/20181023-SE-RGG-2018-Annual-Report-To-Legislature.pdf
New Jersey	New Jersey Board of Public Utilities		stacy.peterson@bpu.nj.gov	Thank you for contacting our office. The most recent information regarding your inquiry can be found in case number EW-2012-0065, available for viewing in EFIS (Electronic Filing and Information System). You may access this via our website here: https://psc.mo.gov/General/Look%20Up%20Docket%20Files Simply click on the "Docket Sheet" link, then enter EW-2012-0065 in the Case No. field. Here you may view all documents filed in the case.
New Mexico	New Mexico Public Regulation Commission	http://www.nmprc.state.nm.us/	milo.chavez@state.nm.us	
New York	New York State Department of Public Service	https://www.dps.ny.gov/	james.denn@dps.ny.gov	
North Carolina	North Carolina	https://www.ncuc.net/	swatson@ncuc.net	

	Utilities Commission			
North Dakota	Public Service Commission, North Dakota	https://www.psc.nd.gov/	ndpsc@nd.gov	Our IOUs are not required to report either emissions reductions or costs to comply with emissions reductions. A few of them have had rate riders in the past to allow them to recover investments in environmental controls on powerplants. If you search our online docketing system they were referred to as environmental cost recovery. Keep in mind the expenses recovered there were only a small portion of total costs to comply with all federal emissions standards.
Ohio	Public Utilities Commission of Ohio	https://www.puco.ohio.gov/	stuart.siegfried@puc.state.oh.us	
Oklahoma	Oklahoma Corporation Commission	http://www.occeweb.com/	bwreath@occemail.com	The Oklahoma Corporation Commission does not monitor Greenhouse Gas (GHG) emissions. We do receive annual reports including reduced emissions and water consumption for Demand Portfolios during Demand Program periods. However, these do not include costs for GHG reductions. The IOUs in Oklahoma are required to submit air emissions to the Oklahoma Department of Environmental Quality (ODEQ). You may reach the ODEQ at (405)-702-0100 or you may use their contact information at www.deq.state.ok.us. Perhaps you can start your search there. As for IOUs in Oklahoma that are operating power plants, there are only three companies: Oklahoma Gas and Electric (OG&E), Public Service Company of Oklahoma (PSO), and Empire District Electric Company (EDE a.k.a. Liberty Utilities). We do know that each of the IOUs have performed some tasks in recent years for air quality. I have provided information below for you to contact them directly to request the information you may want. OG&E – Jill Butson (405)-553-3285 Email: butsonja@oge.com PSO – Emily Shuart (405)-841-1311 Email: ecshuart@aep.com EDE/Liberty Utilities – Jill Schwartz (417)-625-5941 Email: jill.schwartz@libertyutilities.com
Oregon	Public Utility Commission of Oregon	https://www.puc.state.or.us/	puc.commission@state.or.us	Through SB 101 (2009), we biannually report to the legislature the rate impact of two actions: meeting the state goal of reducing emissions by 10 percent from 1990 levels by 2020; · Reducing emissions 15 percent below 2005 levels by 2020. This second goal is not an adopted statewide goal. Attached a report that shows ghg goals met!
Pennsylvania	Pennsylvania PUC	http://www.puc.state.pa.us/	maosborne@pa.gov; tihunt@pa.gov	
Rhode Island	Rhode Island Public Utilities Commission	http://www.ripuc.org/	teads@psc.state.wv.us	

South Carolina	Public Service Commission South Carolina	https://www.psc.sc.gov/	wmorgan@regstaff.sc.gov	
South Dakota	South Dakota Public Utilities Commission	https://puc.sd.gov/	leah.mohr@state.sd.us	South Dakota does not have mandated greenhouse gas emission limits or reduction targets. Therefore, utilities do not provide reports to the SD PUC that document the cost of compliance for achieving greenhouse gas emissions reductions. South Dakota did have a Renewable, Recycled, and Conserved Energy Objective, which was a voluntary objective for utilities to obtain 10 percent of all electricity sold at retail within South Dakota from renewable and/or recycled energy sources by 2015. If this information would be of interest to you, can find it on the PUC's website at the following link: http://puc.sd.gov/energy/reo/reo.aspx.
Tennessee	Tennessee Public Utility Commission	https://www.tn.gov/tpuc.html	monica.smith-ashford@tn.gov	The Tennessee Commission does not regulate transmission or generation of electricity, so the IOUs do not provide specific information regarding emission reductions or costs to comply. I believe this information would be handled at the federal level by the Tennessee Valley Authority. I do not know who you would contact there.
Texas	Public Utility Commission of Texas	https://www.puc.texas.gov/	pam.whittington@puc.texas.gov	
Utah	Public Service Commission - Utah	https://psc.utah.gov/	psc@utah.gov	The following dockets on our website psc.utah.gov: for Electric check docket no. 17-035-16
Vermont	Vermont Public Utility Commission	https://puc.vermont.gov/	john.cotter@vermont.gov	
Virginia	Virginia State Corporation Commission (SCC) - Division of Public Utility Regulation	https://www.scc.virginia.gov/pur/complaint.aspx	David.Eichenlaub@scc.virginia.gov	
Washington	Washington Utilities and Transportation Commission		jball@utc.wa.gov;deborah.reynolds@utc.wa.gov	You need to look for integrated resource plans. That will be the best source of such information. You can find PSE's on their website at www.pse.com

West Virginia	Public Service Commission of West Virginia	http://www.psc.state.wv.us/	Teads@psc.state.wv.us	
Wisconsin	Wisconsin Public Service Commission	https://psc.wi.gov/	Adam.Ingwell@wisconsin.gov	Go to this part of our web page, and you'll see the boxes that say quick single docket search. Type in docket 5-ES-108. This will bring you to something our Commission prepares every other year called the Strategic Energy Assessment. The most recent one is docket 5-ES-109. The 5-ES-108 may have a bit more information about what you're looking for, but both will help I think. If you like, you can simply keep going back in numbers, 109, 108, 107, etc. to see previous SEA's. The page is http://apps.psc.wi.gov/
Wyoming	Wyoming Public Service Commission	http://psc.state.wy.us/	wyoming_psc@wyo.gov	

Ancillary Appendix 2

Carbon Reduction Policies and Legislation

Table 9. Carbon reduction policies or legislation.

States	Program	Legislation or Regulation
Alabama	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	No
Alaska	EE/DSM	Energy Efficiency Rules can be located here http://www.apscservices.info/Rules/energy_conservation_rules_06-004-R.pdf
	Carbon tax	No
	Cap and trade	no - was an observer in WCI 2007-2011
	RPS	Enabling Statute, Code or Order: In the 2009-2010 legislative session, the Alaska legislature enacted House Bill 306 with the goal that "the state receive 50 percent of its electrical generation from renewable energy sources by 2025." This language does not appear in codified statutes.
Arizona	EE/DSM	Incremental savings targets began at 1.25% of sales in 2011, ramping up to 2.5% in 2016 through 2020 for cumulative electricity savings of 22% of retail sales, of which 2% may come from peak demand reductions.8 Co-ops must meet 75% of targets. Docket No. RE-00000C-09-0427, Decision 71436 Docket No. RE-00000C-09-0427, Decision 71819
	Carbon tax	No
	Cap and trade	no longer - WCI 2007-2011
	RPS	Title: Renewable Energy Standard. Established: 2006. Requirement: 15 percent by 2025. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: None. Details: Distributed Generation: 30 percent of annual requirement in 2012 and thereafter. The state has several credit multipliers for different technologies. Enabling Statute, Code or Order: Ariz. Admin. Code §14-2-1801 et seq.

Arkansas	EE/DSM	Energy Efficiency Rules can be located here http://www.apscservices.info/Rules/energy_conservation_rules_06-004-R.pdf, Each utility is required to file an annual report and have approved projects for energy efficiency.
	Carbon tax	No
	Cap and trade	No
	RPS	No
California	EE/DSM	Average incremental savings targets average about 1.15% of retail sales electricity. In October 2015, California enacted SB 350, calling on state agencies and utilities to work together to double cumulative efficiency savings achieved by 2030. The CEC's SB 350 energy efficiency target setting efforts are anticipated to be completed in late 2017. Utilities must pursue all cost-effective efficiency resources. CPUC Decision 04-09-060 CPUC Decision 08-07-047 CPUC Decision 14-10-046 CPUC Decision 15-10-028 AB 995 SB 350 (10/7/15) AB 802 (10/8/15
	Carbon tax	No.
	Cap and trade	Yes, WCI, participates with Canadian provinces
	RPS	Title: Renewables Portfolio Standard. Established: 2002. Requirement: 33 percent by 2020; 40 percent by 2024; 45 percent by 2027; 50 percent by 2030. Applicable Sectors: Investor-owned utility, municipal utilities. Cost Cap: Determined by the California Public Utilities Commission. Details: A 2013 amendment allows the California Public Utilities Commission to adopt additional requirements. Enabling Statute, Code or Order: Cal. Public Utilities Code §399.11 et seq.; Cal. Public Resources Code §25740 et seq.; CA A 327 (2013); CA S 350 (2015).
Colorado	EE/DSM	Black Hills follows PSCo incremental savings targets of 0.8% of sales in 2011, increasing to 1.35% of sales in 2015. For the period 2015-2020, PSCo must achieve incremental savings of at least 400 GWh per year. Colorado Revised Statutes 40-3.2-101, et seq. ; Docket No. 12A-100E Dec. R12-0900; Docket 10A-554EG Docket No. 13A-0686EG Dec. C14-0731
	Carbon tax	No
	Cap and trade	No

	RPS	Title: Renewable Energy Standard. Established: 2004. Requirement: 30 percent by 2020 (IOUs); 10 percent or 20 percent for municipalities and electric cooperatives depending on size. Applicable Sectors: Investor owned utility, municipal utilities, cooperative utilities. Cost Cap: 2.0 percent. Details: Distributed Generation: 3 percent of IOU retail sales by 2020, 1 percent of cooperative retail sales by 2020 (for those providing service to 10,000 or more meters) or 0.75 percent of cooperative retail sales by 2020 (for those providing service to less than 10,000 meters). The state has several credit multipliers for different technologies. Enabling Statute, Code or Order: Colo. Rev. Stat. §40-2-124; CO S 252 (2013).
Connecticut	EE/DSM	Average incremental savings of 1.51% of sales from 2016 through 2018. Utilities must pursue all cost-effective efficiency resources. Public Act No. 07-242 Public Act No. 13-298 2016-2018 Electric and Natural Gas Conservation and Load Management Plan
	Carbon tax	No
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.

	RPS	Title: Renewables Portfolio Standard. Established: 1998. Requirement: 28 percent by 2020. Applicable Sectors: Investor-owned utility, local government, retail supplier. Cost Cap: 5.8 percent. Details: Class I renewable energy sources (including distributed generation): 20 percent by 2020. Class I or II (biomass, waste-to-energy and certain hydropower projects): 3 percent by 2010. Class III (combined heat and power, waste heat recovery and conservation): 4 percent by 2010. Enabling Statute, Code or Order: Conn. Gen. Stat. §16-245a et seq.; Conn. Gen. Stat. §16-1.
Delaware	EE/DSM	No
	Carbon tax	No
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewables Energy Portfolio Standard. Established: 2005. Requirement: 25 percent by 2025-2026. Applicable Sectors: Investor-owned utility, local government, retail supplier. Cost Cap: 3 percent; 1 percent (PV). Details: Photovoltaics: 3.5 percent requirement by 2025-2026. The state has multiple credit multipliers that apply to different technologies. Enabling Statute, Code or Order: Del. Code Ann. 26 §351 et seq..
Florida	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	No
Georgia	EE/DSM	No
	Carbon tax	No

	Cap and trade	No
	RPS	No
Hawaii	EE/DSM	In 2009, Hawaii transitioned away from a combined RPS-EERS to a standalone EEPS goal to reduce electricity consumption by 4,300 GWh by 2030 (equal to ~30% of forecast electricity sales, or 1.4% incremental savings per year). HRS §269-91, 92, 96 HI PUC Order, Docket 2010-0037
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Renewable Portfolio Standard. Established: 2001. Requirement: 30 percent by 2020; 40 percent by 2030; 70 percent by 2040; 100 percent by 2045. Applicable Sectors: Investor-owned utility. Cost Cap: None. Enabling Statute, Code or Order: Hawaii Rev. Stat. §269-91 et seq.; House Bill 623 (2015).
Idaho	EE/DSM	No
	Carbon tax	no
	Cap and trade	no
	RPS	no
Illinois	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Renewable Portfolio Standard. Established: 2001 (voluntary target); 2007 (standard). Requirement: 25 percent by 2025-2026. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 1.3 percent. Details: Distributed Generation: 1 percent of annual requirement beginning in 2015 for IOUs. Wind: 75 percent of annual requirement for IOUs, 60 percent of annual requirement for alternative retail electric suppliers. Photovoltaics: 6 percent of annual requirement beginning in 2015-2016. Enabling Statute, Code or Order: Ill. Rev. Stat. ch. 20 §688 (2001); Ill. Rev. Stat. ch. 20 §3855/1-75 (2007); Senate Bill 2814 (2016).
Indiana	EE/DSM	No. There are not mandates, or specific targets that the utilities must meet, however, each of the investor owned utilities participates in energy efficiency measures.
	Carbon tax	No
	Cap and trade	No

	RPS	Title: Clean Energy Portfolio Goal. Established: 2011. Requirement: 10 percent by 2025. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities, retail supplier. Cost Cap: None. Details: 30 percent of the goal may be met with clean coal technology, nuclear energy, combined heat and power systems, natural gas that displaces electricity from coal and other alternative fuels. Enabling Statute, Code or Order: Ind. Code §8-1-37. Note that this is not mandated to power companies – these are only goals.
Iowa	EE/DSM	Incremental savings targets vary by utility, averaging 1.77% of sales from 2018 to 2021, 2.08% from 2022 to 2025, and 2.05% from 2026 to 2030. SB 2814 also sets a rate cap of 4%, allowing targets to be adjusted downward should utilities reach spending limits. S.B. 1918 Public Act 96-0033 § 220 ILCS 5/8-103 Case No. 13-0495 Case No. 13-0498 S.B. 2814
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Alternative Energy Law. Established: 1983. Requirement: 105 MW of generating capacity for IOUs. Applicable Sectors: Investor-owned utility. Cost Cap: None. Enabling Statute, Code or Order: Iowa Code §476.41 et seq.
Kansas	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Renewable Energy Goal. Established: 2009 (standard); 2015 (goal). Requirement: 15 percent by 2015-2019; 20 percent by 2020. Applicable Sectors: Investor-owned utility. Cost Cap: Caps gross RPS procurement costs. Details: 20 percent requirement for peak demand capacity. Enabling Statute, Code or Order: Kan Stat. Ann. §66-1256 et seq.; Goal: Senate Bill 91.
Kentucky	EE/DSM	no
	Carbon tax	No
	Cap and trade	no
	RPS	no
Louisiana	EE/DSM	no
	Carbon tax	no

	Cap and trade	no
	RPS	no
Maine	EE/DSM	Electric savings of 20% by 2020, with incremental savings targets of ~ 1.6% per year for 2014-2016 and ~2.4% per year for 2017-2019. Efficiency Maine operates under an all cost-effective mandate. Efficiency Maine Triennial Plan (20142016) Efficiency Maine Triennial Plan (20172019) H.P. 1128 – L.D. 1559
	Carbon tax	no
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewables Portfolio Standard. Established: 1999. Requirement: 40 percent by 2017. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 5.4 percent. Details: Includes a 10 percent requirement by 2022 for Class I (new) sources. The state also has separate goals for wind energy: 2,000 MW of installed capacity by 2015; 3,000 MW of installed capacity by 2020, including offshore and coastal; and 8,000 MW of installed capacity by 2030, including 5,000 MW from offshore and coastal. The state has a credit multiplier for community-based renewable energy. Enabling Statute, Code or Order: Me. Rev. Stat. Ann. 35-A §3210 et seq.; Me. Rev. Stat. Ann. 35-A §3401 et seq. (wind energy).
Maryland	EE/DSM	15% per-capita electricity use reduction goal by 2015 (10% by utilities, 5% achieved independently). 15% reduction in per capita peak demand by 2015, compared to 2007. After 2015, targets vary by utility, ramping up by 0.2% per year to reach 2% incremental savings. Md. Public Utility Companies Code § 7211 MD PSC Dockets 9153-9157 Order No. 87082
	Carbon tax	no

	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewable Energy Portfolio Standard. Established: 2004. Requirement: 25 percent by 2020. Applicable Sectors: Investor-owned utility, local government, retail supplier. Cost Cap: 7.6 percent. Details: Solar: 2.5 percent by 2020. Offshore wind: 2.5 percent maximum by 2017. Enabling Statute, Code or Order: Md. Public Utilities Code Ann. §7-701 et seq.; Senate Bill 921; House Bill 1106 (2016 enrolled, 2017 veto override).
Massachusetts	EE/DSM	Average incremental savings of 2.93% percent of electric sales for 2016-2018. All cost-effective efficiency requirement. D.P.U. 15-160 through D.P.U. 15-169 (MA Joint Statewide Three-Year Electric and Gas Energy Efficiency Plan 20162018) M.G.L. ch. 25, § 21;
	Carbon tax	no

	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewable Portfolio Standard. Established: 1997. Requirement: Class I: 15 percent by 2020 and an additional 1 percent each year after. Class II: 6.19 percent by 2019. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 19.2 percent. Details: Photovoltaic: 1,600 MW required by 2020. Class I resources are new sources. Class II (resources in operation by 1997) requirement includes 2.69 percent renewable energy and 3.5 percent waste-to-energy. Enabling Statute, Code or Order: Mass. Gen. Laws Ann. ch. 25A §11F.
Michigan	EE/DSM	1.0% incremental savings through 2021. Act 295 of 2008 S.B. 438
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable Energy Standard. Established: 2008; 2016. Requirement: 15 percent by 2021 (standard), 35 percent by 2025 (goal, including energy efficiency and demand reduction). Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities, retail supplier. Cost Cap: 2.5 percent. Details: The state has several credit multipliers for different technologies. Enabling Statute, Code or Order: Mich. Comp. Laws §460.1001 et seq.; Senate Bill 438 (2016).
Minnesota	EE/DSM	1.5% incremental savings in 2010 and each year thereafter. Minn. Stat. § 216B.241
	Carbon tax	no
	Cap and trade	no

	RPS	Title: Renewables Energy Standard. Established: 2007. Requirement: 26.5 percent by 2025 (IOUs), 25 percent by 2025 (other utilities). Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Cost Cap: None. Details: Xcel Energy has a separate requirement of 31.5 percent by 2020; 25 percent must be from wind or solar. Solar: 1.5 percent by 2020 (other IOUs); Statewide goal of 10 percent by 2030. Enabling Statute, Code or Order: Minn. Stat. §216B.1691.
Miss	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	no
Missouri	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable Electricity Standard. Established: 2007. Requirement: 15 percent by 2021 (IOUs). Applicable Sectors: Investor-owned utility. Cost Cap: 1 percent. Details: Solar-Electric: 2 percent carve-out. Enabling Statute, Code or Order: Mo. Rev. Stat. §393.1020 et seq.
Montana	EE/DSM	no
	Carbon tax	no
	Cap and trade	no longer - WCI 2008-2011
	RPS	Title: Renewable Resource Standard. Established: 2005. Requirement: 15 percent by 2015. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 0.1 percent. Enabling Statute, Code or Order: Mont. Code Ann. §69-3-2001 et seq.
Nebraska	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	no

Nevada	EE/DSM	20% of retail electricity sales to be met by renewables and energy efficiency by 2015, and 25% by 2025. Energy efficiency may meet a quarter of the standard through 2014, but is phased out of the RPS by 2025. NRS 704.7801 et seq. NRS 704.7801 as amended
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Energy Portfolio Standard. Established: 1997. Requirement: 25 percent by 2025. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: None. Details: Solar: 6 percent for 2016-2025 (1.5 percent of total sales in 2025). The state has a credit multiplier for photovoltaics and on peak energy savings. Enabling Statute, Code or Order: Nev. Rev. Stat. §704.7801 et seq.
New Hampshire	EE/DSM	5% reduction from 2005 total retail electricity sales by 2014, and an 8% reduction by 2020. N.M. Stat. § 62-17-1 et seq
	Carbon tax	no
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Electric Renewable Portfolio Standard. Established: 2007. Requirement: 25.2 percent by 2025. Applicable Sectors: Investor-owned utility, cooperative utilities, retail supplier. Cost Cap: 6.6 percent. Details: Solar: 0.7 percent new solar in 2020 and after. Requires at least 15 percent of requirement to be met with new renewables. Enabling Statute, Code or Order: N.H. Rev. Stat. Ann. §362-F.
NJ	EE/DSM	no

	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewables Portfolio Standard. Established: 1991. Requirement: 50 percent by 2030. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 9.9 percent. Details: 50 percent Class I renewables by 2030. 2.5 percent Class II renewables each year. 5.1 percent solar-electric by 2021, then gradually reduced to 1.1 percent by 2031. Offshore wind: 3,500 MW. Enabling Statute, Code or Order: N.J. Rev. Stat. §48:3-49 et seq.
NM	EE/DSM	5% reduction from 2005 total retail electricity sales by 2014, and an 8% reduction by 2020. N.M. Stat. § 62-17-1 et seq.
	Carbon tax	no
	Cap and trade	no longer - WCI 2007-2011
	RPS	Title: Renewables Portfolio Standard. Established: 2002. Requirement: 20 percent by 2020 (IOUs); 10 percent by 2020 (co-ops). Applicable Sectors: Investor-owned utility, cooperative utilities. Cost Cap: 3.5 percent. Details: Solar: 20 percent by 2020 (IOUs). Wind: 30 percent by 2020 (IOUs). Other renewables including geothermal, biomass and certain hydro facilities: 5 percent by 2020 (IOUs). Distributed Generation: 3 percent by 2020 (IOUs). The state has a credit multiplier for solar energy that was operational before 2012. Enabling Statute, Code or Order: N.M. Stat. Ann. §62-15; N.M. Stat. Ann. §62-16.

NY	EE/DSM	Under current Reforming the Energy Vision (REV) proceedings, utilities have filed efficiency transition implementation plans (ETIPS) with incremental targets varying from 0.4% to 0.9% for the period 2016– 2018. In January, the PSC authorized NYSERDA's Clean Energy Fund (CEF) framework, which outlines a minimum 10-year energy efficiency goal of 10.6 million MWh measured in cumulative first year savings. The PSC issued a REV II Track Order in May prescribing that the Clean Energy Advisory Council also propose utility targets supplemental to ETIPS by October 2016. In response, the Council generated a report in November describing options for energy efficiency target setting, but did not yet offer a consensus recommendation. Some degree of overlap of program savings is anticipated between utility targets and NYSERDA CEF goals. NY PSC Order, Case 07-M-0548 NY PSC Case 14-M-0101 NY PSC Case 14-M-0252 2015 New York State Energy Plan NY PSC Order Authorizing the Clean Energy Fund Framework Energy Efficiency Metrics and Target Options Report (November 2016)
	Carbon tax	no
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewable Portfolio Standard; Reforming the Energy Vision (REV). Established: 2004. Requirement: 50 percent by 2030. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities, retail supplier. Cost Cap: None. Details: Offshore wind: goal of 2,400 MW by 2030. Enabling Statute, Code or Order: NY PSC Order Case 03-E-0188; 2015 New York State Energy Plan.

NC	EE/DSM	Renewable Energy and Energy Efficiency Portfolio Standard (REPS) requires renewable generation and/or energy savings of 6% by 2015, 10% by 2018, and 12.5% by 2021 and thereafter. Energy efficiency is capped at 25% of target, increasing to 40% in 2021 and thereafter. N.C. Gen. Stat. § 62-133.8 04 NCAC 11 R08-64, et seq.
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable Energy and Energy Efficiency Portfolio Standard. Established: 2007. Requirement: 12.5 percent by 2021 (IOUs); 10 percent by 2018 (munis and coops). Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Cost Cap: 1.3 percent. Details: Solar: 0.2 percent by 2018. Swine Waste: 0.2 percent by 2018. Poultry Waste: 900,000 MWh by 2015. The state offers credit multipliers for biomass facilities located in cleanfields renewable energy demonstration parks. Enabling Statute, Code or Order: N.C. Gen. Stat. §62-133.8.
ND	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable and Recycled Energy Objective. Established: 2007. Requirement: 10 percent by 2015. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Enabling Statute, Code or Order: N.D. Cent. Code §49-02-24 et seq.
OH	EE/DSM	Beginning in 2009, incremental savings of 0.3% per year, ramping up to 1% in 2014 and 2% in 2021. Savings targets resumed in 2017 following a “freeze” (S.B. 310) in 2015-2016 that allowed utilities that had achieved 4.2% cumulative savings to reduce or eliminate program offerings. ORC 4928.66 et seq. S.B. 221 S.B. 310
	Carbon tax	no
	Cap and trade	no

	RPS	Title: Alternative Energy Resource Standard. Established: 2008. Requirement: 12.5 percent by 2026. Senate Bill 310 (2014) created a two-year freeze on the state's standard while a panel studied the costs and benefits of the requirement. The freeze was not extended in 2016. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 1.8 percent. Details: Solar: 0.5 percent. Enabling Statute, Code or Order: Ohio Rev. Code Ann. §4928.64 et seq.
OK	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable Energy Goal. Established: 2010. Requirement: 15 percent by 2015. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Enabling Statute, Code or Order: Okla. Stat. tit. 17 §801.1 et seq.
OR	EE/DSM	Incremental targets average ~1.3% of sales annually for the period 2015-2019. Energy Trust of Oregon 2015-2019 Strategic Plan Grant Agreement between Energy Trust of Oregon and OR PUC
	Carbon tax	no
	Cap and trade	no longer - WCI 2007-2011
	RPS	Title: Renewable Portfolio Standard. Established: 2007. Requirement: 25 percent by 2025 (utilities with 3 percent or more of the state’s load); 50 percent by 2040 (utilities with 3 percent or more of the state’s load); 10 percent by 2025 (utilities with 1.5–3 percent of the state's load); 5 percent by 2025 (utilities with less than 1.5 percent of the state’s load). Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities, retail supplier. Cost Cap: 4 percent. Details: Photovoltaics: 20 MW by 2020 (IOUs). The state has a credit multiplier for photovoltaics installed before 2016. The state's two investor-owned utilities must phase out coal generation by 2035. By 2025 at least 8 percent of aggregate electrical capacity must come from small-scale community renewable energy projects with a capacity of 20 megawatts (MW) or less. Enabling Statute, Code or Order: Or. Rev. Stat. §469a; Senate Bill 1547 (2016).

Pennsylvania	EE/DSM	Varying targets have been set for IOUs amounting to yearly statewide incremental savings of 0.8% savings for 2016-2020. EERS includes peak demand targets. Energy efficiency measures may not exceed an established cost-cap. 66 Pa C.S. § 2806.1; PUC Order Docket No. M-20082069887; PUC Implementation Order Docket M2012-2289411 PUC Final Implementation Order Docket M-2014-2424864
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Alternative Energy Portfolio Standard. Established: 2004. Requirement: 18 percent by 2020-2021. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: None. Details: Tier I: 8 percent by 2020-2021 (includes photovoltaic). Tier II (includes waste coal, distributed generation, large-scale hydropower and municipal solid waste, among other technologies): 10 percent by 2020-2021. Photovoltaic: 0.5 percent by 2020-2021. Enabling Statute, Code or Order: Pa. Cons. Stat. tit. 66 §2814.
RI	EE/DSM	Incremental savings of 2.5% in 2015 2.55% in 2016, and 2.6% in 2017. EERS includes demand response targets. Utilities must acquire all cost-effective energy efficiency. R.I.G.L § 39-1-27.7 Docket No. 4443
	Carbon tax	no
	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.

	RPS	Title: Renewable Energy Standard. Established: 2004. Requirement: 14.5 percent by 2019, with increases of 1.5 percent each year until 38.5 percent by 2035. Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 12 percent. Details: The state has a separate long-term contracting standard for renewable energy, which requires electric distribution companies to establish long-term contracts with new renewable energy facilities. Enabling Statute, Code or Order: R.I. Gen. Laws §39-26-1 et seq.; R.I. Gen. Laws §39-26.1 et seq. (contracting standard); House Bill 7413a (2016).
SC	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewables Portfolio Standard. Established: 2014. Requirement: 2 percent by 2021. Applicable Sectors: Investor-owned utility. Cost Cap: None. Details: Systems less than 1 MW: 1 percent of aggregate generation capacity, including at least 0.25 percent of total generation from systems less than 20kW. 1 – 10 MW facilities: 1 percent of aggregate generation capacity. Enabling Statute, Code or Order: House Bill 1189.
SD	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable, Recycled and Conserved Energy Objective. Established: 2008. Requirement: 10 percent by 2015. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Enabling Statute, Code or Order: S.D. Codified Laws Ann. §49-34A-94; S.D. Codified Laws Ann. §49-34A-101 et seq.
TN	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	no

TX	EE/DSM	20% incremental load growth in 2011 (equivalent to ~0.10% annual savings); 25% in 2012, 30% in 2013 onward. Peak demand reduction targets of 0.4% compared to previous year. Energy efficiency measures may not exceed an established cost cap. Senate Bill 7; House Bill 3693; Substantive Rule § 25.181 Senate Bill 1125
	Carbon tax	no
	Cap and trade	no
	RPS	Title: Renewable Generation Requirement. Established: 1999. Requirement: 5,880 MW by 2015. 10,000 MW by 2025 (goal; achieved). Applicable Sectors: Investor-owned utility, retail supplier. Cost Cap: 3.1 percent. Details: Non-wind: 500 MW (goal). Enabling Statute, Code or Order: Tex. Utilities Code Ann. §39.904.
Utah	EE/DSM	no
	Carbon tax	no
	Cap and trade	no longer - WCI 2007-2011
	RPS	Title: Renewables Portfolio Goal. Established: 2008. Requirement: 20 percent by 2025. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Enabling Statute, Code or Order: Utah Code Ann. §54-17-101 et seq.; Utah Code Ann. §10-19-101 et seq.
Vermont	EE/DSM	Average incremental electricity savings of about 2.1% per year from 2015 – 2017. EERS includes demand response targets. Energy efficiency utilities must set budgets at a level that would realize all cost effective energy efficiency. 30 V.S.A. § 209; VT PSB Docket EEU-2010-06 Efficiency Vermont Triennial Plan 201517 (2016 Update)
	Carbon tax	No

	Cap and trade	Yes, RGGI. RGGI states implemented a new 2014 RGGI cap of 91 million short tons. The RGGI CO2 cap then declines 2.5 percent each year from 2015 to 2020. The RGGI CO2 cap represents a regional budget for CO2 emissions from the power sector. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in energy efficiency, renewable energy, and other consumer benefit programs.
	RPS	Title: Renewable Energy Standard. Established: 2005 (voluntary garget); 2015 (standard). Requirement: 55 percent by 2017; 75 percent by 2032. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities, retail supplier. Cost Cap: None. Details: Distributed Generation: 10 percent by 2032. Energy Transformation: 12 percent by 2032 (includes weatherization, thermal energy efficiency and heat pumps). Enabling Statute, Code or Order: Vt. Stat. Ann. tit. 30 §8001 et seq.; Standard: House Bill 40.
Virginia	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Voluntary Renewable Energy Portfolio Goal. Established: 2007. Requirement: 15 percent by 2025. Applicable Sectors: Investor-owned utility. Details: The state has several credit multipliers for different technologies. Enabling Statute, Code or Order: Va. Code §56-585.2.
Washington	EE/DSM	Biennial and Ten-Year Goals vary by utility. Law requires savings targets to be based on the Northwest Power Plan, which estimates potential incremental savings of about 1.5% per year through 2030 for Washington utilities. All cost-effective conservation requirement. Ballot Initiative I-937 Energy Independence Act, Chapter 19.285.040 WAC 480-109-100 WAC 194-37 Seventh Northwest Power Plan (adopted 2/10/16)
	Carbon tax	No
	Cap and trade	No

	RPS	Title: Renewable Energy Standard. Established: 2006. Requirement: 15 percent by 2020. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Cost Cap: 4 percent. Details: Standard is applicable to all utilities that serve more than 25,000 customers. Requirement also includes all cost-effective conservation. The state has a credit multiplier for distributed generation. Enabling Statute, Code or Order: Wash. Rev. Code §19.285; Wash. Admin. Code §480-109; Wash Admin. Code §194-37.
West Virginia	EE/DSM	No
	Carbon tax	No
	Cap and trade	No
	RPS	Title: Alternative and Renewable Energy Portfolio Standard- REPEALED. Established: 2009; Repealed 2015. Requirement: 10 percent from 2015-2019, 15 percent from 2020-2024, 25 percent by 2025. Details: Goal is applicable to IOUs that serve more than 30,000 residential customers. Goal includes alternative energy sources, including coal technology, coal bed methane, natural gas, combined cycle technologies, waste coal and pumped storage hydroelectric projects. Enabling Statute, Code or Order: W. Va. Code §24-2F; Repeal: H.B. 2001.
Wisconsin	EE/DSM	Focus on Energy targets include incremental electricity savings of ~0.81% of sales per year in 2015-2018. Energy efficiency measures may not exceed an established cost-cap. Order, Docket 5-FE-100: Focus on Energy Revised Goals and Renewable Loan Fund (10/15) Program Administrator Contract, Docket 9501-FE-120, Amendment 2 (3/16) 2005 Wisconsin Act 141
	Carbon tax	No
	Cap and trade	No

	RPS	Title: Renewable Portfolio Standard. Established: 1998. Requirement: 10 percent by 2015. Applicable Sectors: Investor-owned utility, municipal utilities, cooperative utilities. Cost Cap: None. Details: Standard varies by utility. 2011-2014: utilities may not decrease its renewable energy percentage below 2010 percentages. 2015: utilities must increase renewable energy percentages by at least 6 percent above their 2001-2003 average. Utilities may not decrease their renewable energy percentage after 2015. Enabling Statute, Code or Order: Wisc. Stat. §196.378.
Wyoming	EE/DSM	no
	Carbon tax	no
	Cap and trade	no
	RPS	no