The Porter Hypothesis in the World of Energy: Renewable Portfolio Standards and Their Effects on Returns for Investor-Owned Utilities

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Abstract

Renewable portfolio standards (RPS) are policies enacted at the state level which mandate certain energy loads be met with renewable sources. These RPS policies aspire to spur greater investment in renewable energy technologies, and significantly vary in stringency among the 38 states that have enacted them. The pressure of this stringency falls directly on investor owned utilities (IOUs), privately owned energy companies that operate as regulated monopolies whose rates and profit margins are determined through legal proceedings called rate cases. Those who oppose RPS policy adoption, and environmental policy in general, commonly cite negative impact on business as evidence of their undesireabilty. Research conducted and inspired by Harvard Business School professor and economist, Michael Porter, however, argues properly designed environmental regulations have the ability “spur innovation that may partially or fully offset the costs of complying with them”. There is no general consensus on the validity of Porter’s hypothesis, but it is clear that the relationship between environmental policy and financial success is not as black and white as political narratives make it seem. This study conducts an anaylsis of 13 IOUs across 8 states with RPS policies of varying stringency. To discern the impact of RPS policy on company profitability, we analyze stock returns and isolate the effect of the policy itself through the use of the cumulative abnormal return equation (CAR). Our analysis shows very little discernable effect of RPS policy on stock market performance, and suggests that the Porter hypothesis holds merit within the IOU industry.

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1. Introduction:

During his 2020 Presidential campaign, Donald Trump took the stage to condemn the environmentally ambitious Green New Deal, calling it “So crazy” and forewarning that its pursuit would result in “Our country (becoming) a Ninth World country, not a Third World country — a Ninth World country!” (whitehouse.gov). Through the behavior and rhetoric of former administrations, like President Trump’s, and their constituents, it is clear that the fear of environmental policy coming at the expense of business is significant. Environmentalists and politicians, however, have done a poor job promoting the fact that this prioritization is unnecessary, as history has shown environmental policy does not have to come at the expense of our economy and the financial well being of the citizenry.

While the costs of environmental policy may seem intuitive, which contributes to the growing partisan divide when it comes to the environment (Kim, Urpelainen, 2017), historical evidence suggests a more nuanced relationship between policy, profitability, and subsequently, the environment. The aforementioned contention certainly remains present, especially in recent memory, but societal concern about climate change has still slightly outweighed preventative skepticism, which has resulted in the social pressure to create “sharp increases of environmental regulations throughout the world at various institutional levels”, especially over the past 30-40 years (Rugman, Verberke, 1998). This sharp increase in regulation has allowed for a wide array of business responses that scholars have studied, resulting in a comprehensive and extensive library of literature available on the topic. Throughout this literature, scholars have found the expected relationship of policy hindering financial success in some instances, but have also observed a significant number of corporations that have improved their financial output in the presence of increased pressure from regulations, a counterintuitive idea, but one that has serious evidence and support (Lanoi et al, 2008) .

In the year 1991, Harvard Business School economist and strategy professor, Michael Porter, developed a hypothesis that aims to disprove any sort of mutually exclusive relationship between economic growth and increased stringency in environmental policy. Until Porter's research, the unanimous view of economists was that requiring companies to reduce an externality like pollution would necessarily decrease their profits because of an inherent decrease in options (Ambec et. al, 2011). If it were profitable to reduce pollution to the specified levels, would firms looking to maximize their profits not already pursue such reductions? Environmental regulations may come in the form of environmental taxes, increasing technological standards, or tradable emissions permits, all of which, by description, seem to harm the profitability of a business (Amber et. al, 2011). Porter and his colleagues, however, would argue that market-based, properly designed environmental regulations limit pollution, which saves resources, and show the ability to "spur innovation that may partially or fully offset the costs of complying with them" (Porter and van der Linde, 1995). Porter and his associates note that the world does not fit the idealist notion of default optimization, arguing that this would only exist in a world where "information is perfect" which, of course, it is not (Porter and van der Linde, 1995). There is no evidence to suggest that industries have realized their optimal operational and organizational frameworks. The real nature of business and competition is constant evolution and technological innovation, the directions for these innovations are numerous, and market based environmental regulations have aided in shedding light on these opportunities (Porter and van der Linde).

While the Porter Hypothesis has not been unequivocally proven, or disproven, there have been several empirical studies conducted that both support and refute the integrity of Porter's proposal, indicating the intense intricacy involving environmental policy. There is no black and white relationship with policy and corporate response, the Porter Hypothesis should be analyzed on a case by case basis to clarify *which* environmental policies result in innovative increases in efficiency (Palmer, Oates, Portney, 1995). A large amount of empirical analysis is typically conducted in the United States, and has displayed such variance especially when taking into account changes in time. As summarized by Ambec, Cohen, Elgie, and Lanoie, older explorations of the Porter Hypothesis such as those conducted by Gollop and Roberts (1983) and Jaffe et al. (1995) found negative correlation between environmental regulations and corporate productivity, with Gollop and Roberts, for instance, finding that SO_2 regulations in the United States slowed growth by 43% in the 1970s (Ambec et. al, 2011). More recent studies conducted by Berman and Bui (2001) and Alplay et al. (2002), conclude that there is a neutral or positive relationship between regulations and productivity, in the refinery and Mexican food processing industries, respectively (Ambec et. al, 2011). It is unclear whether these recently observed trends of success can be attributed to better designed policy or industries reacting with greater frames of reference, but there is significant evidence that more stringent environmental policy can result in indifference or improvements in the world of business production and outputs.

2. Research Question and Literature Review

Given that the Porter Hypothesis is only legitimately proven or disproven on a case by case basis, due to a plethora of confounding variables and variations in policy, it is beneficial for the purposes of this paper to focus on one industry and one type of policy, and analyze the Porter Hypothesis using a more defined framework.This paper will exclusively study the private utility industry, as it is one with exceptional environmental applicability, and renewable portfolio standards (RPS), whose variance allows for an intuitive and digestable analysis of the Porter Hypothesis. Through our analysis, we attempt to answer the following questions: What effect does RPS policy stringency have on returns for investor owned utilities (IOUs)? And do these results support or challenge the Porter hypothesis?

The utility industry is a unique one. Energy and electricity are almost perfectly inelastic products, and the fact that the service of providing these necessities falls within the hands of corporations raises some just concerns. Given the inelasticity of the demand in the industry, and the enhanced privatization of its distribution in the early 1900s (Hirsh, 1999), governmental regulation is highly synonymous with the business proceedings of the utility industry. The nature of this business goes back to the year 1898, when Samuel Insull, a British American business magnate, delivered a speech to the National Electric Light Association (NELA), a trade association of which he was president (Kreis, 2021). Insull made the suggestion in favor of increased regulation, advocating for state governments to be able to determine the amount that private utilities can charge for their service. In exchange for this stark increase in government oversight, Insul advocated that utilities be granted the right to have sole discretion in designated service territories as opposed to going from community to community lobbying for support with countless other competing firms and factors (Kreis). As a result, the utility industry is a nationwide monopoly for hundreds of companies; a regulated monopoly, but a monopoly nonetheless.

As a result of Insull and the NELA's decision to pursue his strategy, most of the country deals with only one utility, which can be a public operation, a private corporation, or a subsidiary branch of a larger firm like Exelon, NextEra, American Electric, etc. In Chicago, it's Commonwealth Edison (COMED), in New York city, confusingly enough, it's Consolidated Edison (CONED), it's upstate New York, it's National Grid, in the majority of Michigan, it's DTE, so on and so forth. Without the motivation of competitors, there is no implicit incentive to keep costs manageable, and profits reasonable. This is where rate cases come into play, which essentially put firms up against themselves, competing to maximize their internal efficiency in hopes to fully realize their maximum potential return on investment. This form of business makes utilities one of the most unique, albeit complicated, industries in the world.

Per Insul's suggestion, the rates that utilities are allowed to charge are determined through rate cases: legal proceedings with representatives from private utilities and often public utility commissions (PUCs). Most states have a PUC which typically serves as the ruling body throughout rate cases, regulatory entities that serve as a judicial-like role in the proceedings of determining rates (Cory, Swezy, 2007). These rate cases, which typically occur on a yearly basis, set a price which allows the utility to recover all of their costs and profit on an allowed rate of return on investment (Myers, 1972). The rate of return on investment is calculated by multiplying the rate base, which is essentially the advisable capital investment of the utility as determined by the regulatory authority for that particular service territory, with the allowed rate of return, which is also predetermined to protect customers from increased costs while allowing the utility to also make a reasonable profit (Myers). Take for example a utility that has a rate base of $20 Million, meaning that their assets total to $20 Million, its total costs are $15 Million, which includes all taxes (Myers), the allowed rate of return on investment is 14.49% (which, according to data collected by NYU, is a strong estimate for the average ROE in today's market (NYU)), also assume that the utility in question is producing 1 billion units of electricity per year. Given these variables, which would be determined through rate cases in this hypothetical scenario, rates would be determined using the following equation (accessed through the Myers study).

$$Price\ Per\ Unit\ Electricity\ = \frac{Revenue\ Requirements}{Number\ of\ Units\ Sold}$$

$$\downarrow$$

$$Price\ Per\ Unit\ Electricity\ = \frac{15{,}000{,}000 + .1449(20{,}000{,}000)}{1B}$$

$$\downarrow$$

$$Price\ Per\ Unit\ Electricity\ = \ \$.017898$$

In the example provided above, the utility would legally be able to charge $.017898 per unit of electricity throughout their service territory until the next rate case was filed. It is worth noting that rate cases only offer the opportunity for utilities to achieve a certain profit. The ability for a firm to realize its allowed return on investment (14.49% in the example provided above), or even close to it, relies on the internal functionality of the utility to be at a high level with significant emphasis on efficiency both procedurally and operationally. This puts utilities up against themselves to minimize their cost and maximize their efficiency so they may capitalize on their maximum allowed profit.

As utilities continue to strive to maximize their return for their stakeholders, the environment is becoming an increasingly relevant issue, which many utilities are starting to address. Scientists and policy makers alike recognize the importance of clean and renewable energy for a sustainable future. Currently, fossil fuels remain the largest source of energy for electricity (Energy Information Administration), and accounted for 40% of electricity generation in the United States in 2020, with coal claiming the title of the third largest source of electricity generation, accounting for 19% (EIA). In light of an impending, yet frustratingly controversial, climate crisis, 60% of the United State's energy generation still comes from fossil fuels which release Carbon Dioxide, Carbon Monoxide, Sulfur Dioxide, Nitrogen Oxide, and particulate matter amongst other combustible greenhouse gasses with significant global warming potential and health effects. The energy sector is a primary contributor to the fact that the 10 warmest years on record have occurred in the last 15 (Nasa), but it also represents an area of immense opportunity for policy, technology, and infrastructure to mitigate climate risks moving forward. Climate policy is only going to become more prevalent in the coming decades, which raises the important question of what will happen to private utility companies when it does.

Being as heavily regulated as it is, the utility industry is particularly sensitive, and partial towards specific policy changes (Basseches, 2020). California, Oregon, and Massachusetts, for example, introduced similar legislation which each contain unique provisions that directly have influenced the financial standing of utilities. In the case of California, one such provision was a cost cap of fifteen cents per kilowatt hour, meaning that if the costs of renewable electricity are greater than fifteen cents per KWH, IOUs can comply with a payment of that amount to the state (Basseches, 2020). Given the consistent gridlock and divided nature of the federal government, energy policy often falls to where it can be more readily passed and amended: the states. As intended by the drafters of the Constitution, state governments have proven themselves as much more entrepreneurial, both in issues of the environment and otherwise, than policy that has to fight through federal stagnation in Washington.

There is considerable dispute about whether decentralized environmental policy is beneficial for progress in sustainability (Fredriksson, Millimet, 2001), with some scholars arguing that leaving environmental policy to the states results in a nationwide “race to the bottom” due to the confounding factor of transboundary pollution problems and the allure to promote capital growth, and a competitive advantage, for co4mpanies and firms within state boundaries due to overly negligent environmental standards (Ulph, 1999), an assumption that may be rooted is fallacy, as exhibited by the Porter hypothesis. Such fears were recognized by the United States, which served as a catalyst for the creation of the EPA in 1968 and subsequently the Clean Air Act and Clean Water Act, two of the most important pieces of environmental legislation ever drafted in the United States (Fredriksson, Millimet, 2001). Research led by Alistair Ulph uses models of environmental dumping (albeit, under the assumption that transboundary pollution does not exist) to make a convincing argument of the value of federal involvement with environmental policy set at the state level. The problem with federal intervention, however, is that it often takes place under the assumption that counteracting this “race to the bottom” is best addressed by enacting consistent, or ‘harmonizing’ policy across all states (Ulph, 1999). As found by Ulph, along with Kanbur, Keen, and Van Wijnbergen (1995), this strategy is not effective. States vary greatly in industry, environmental characteristics, and ecology, and federal policy is effective only if these differences are considered and reflected in the policy. If federal policy takes place harmoniously, welfare costs tend to override any potential benefits (Ulph, 1999). State governments continue to be more receptive and responsive to these differences in industry and characteristics, and hence environmental policy still is largely orchestrated at the state level with general federal oversight, yet states have been particularly adept at remaining flexible in their legislation despite the looming presence of federal regulation (Fredriksson, Millamet, 2001). Renewable Portfolio Standards (RPS) reflect this flexibility at the state level, and exhibit great variance throughout the country. There are few, if any, policy instruments more relevant to the utility industry than RPS, and as such, this paper will focus exclusively on their influence with the financial standing of utility firms.

Renewable portfolio standards are policy instruments used for states to mandate a specified percentage of electricity load must be generated by renewable energy by a specified date. There is some contention as to what 'counts' as renewable energy. Unequivocally, solar and wind energy are defined as renewable, and in most cases, renewables are defined as solar, wind, hydroelectric, geothermal, and biomass generated energy. There is, however, some significant debate regarding biomass and hydro-power. Biomass production involves the burning of biotic material, namly plants, which results in both the GHG emissions from the burning process and the removal of the Carbon Dioxide sequestration power of the biotic material in question (Basseches, 2020). This commonly results in a net increase in atmospheric GHG, currently states accept hydropower unanimously, but can it be considered renewable? As for hydropower, there is no GHG output, which is certainly a positive, but it is heavily limited by the amount of rivers that can host a dam and offers a significant threat to ecosystems and biodiversity at those sites (Basseches, 2020). There are no conclusive decisions that have been made regarding which sources are eligible for states to meet their renewable energy quotas, and debate, specifically over and hydropower, is still ongoing. Fischlein and Smith (2013) research this variance and uncertainty through their analysis of the RPS design throughout different states. Their analysis displays significant variance in how states define renewable energy; many states don't allow existing renewables to be counted in hopes of spurring the generation of new infrastructure, while in the other states, the ability for IOUs to fall back on existing developments heavily limits the impact of new development (Fischein, Smith, 2013). Additionally, a graphical representation of each states' RPS reveals the unanimously accepted forms of energy being solar, wind, photovoltaic, and biomass, with among the most divided being munic (solid waste), biogas, and ocean wave (Fischein, Smith, 2013). It will be interesting moving forward, as the race to carbon neutrality becomes more time-sensitive, to see which renewable energy sources are first, defined as renewable, and second, heavily pursued.

RPS policies date all the way back to 1983 (Iowa). . They became somewhat prominent in the 1990s, and now have been adopted by 30 states, Washington D.C., and 4 territories (American Samoa, Guam, Puerto Rico, U.S. Virgin Islands) (NRDC). Early adopters of these RPS policies did so with the intent of economic development they saw possible through the job creation and energy independence that they could create, while lately states who adopt them seem almost exclusively motivated by a desire to combat climate change at the state level (Carley, 2011). Possibly the most unique feature of RPS, is the precision and specificity of its impact. Unlike most environmental policies, which apply regulatory requirements to the full range of industry within the state, RPS are much more focused, and impacts a much smaller sector of businesses, most notably private investor owned utilities (IOU). While RPS share key components, they vary greatly in their structure, size, and most notably, methods of enforcement (mandatory or voluntary). Some states like Illinois, Minnesota, New Mexico, and Texas, for example, set quotas of varying degrees for minimum generation rates of certain technologies. Other states, like Arizona, Hawaii, California, and Vermont neglect quotas but grant subsidies in the form of ‘feed in tariffs’, which ensure producers receive a direct payment for each MWh of energy produced (Fischlein, Smith, 2013). Differences like this are ubiquitous, and hence every RPS policy is unique. Through the various differences and intricacies of RPS policy, it has become clear that merely having a more ambitious percentage goal or a more ambitious target date does not result in a more stringent or effective policy, what truly determines the effectiveness are these important details. Take Colorado, for example, who’s RPS requirement, established in 2004, requires 30% clean energy by 2020 (Senate Bill 19-236). Just looking at the requirements themselves, this RPS would seem nearly identical to that of Delaware, who’s RPS, established in 2005, mandated 25% renewable energy by 2025, before it was amended in 2021 to establish its long term target of 40% by 2035 (Senate Bill 33-151). While their requirements are very similar in theory, Colorado’s RPS includes a cost cap of 2%, which Delaware does not (although it did previously enforce a cost cap of 3%, so again, very similar.), but Colorado’s policy features multiple credit multipliers for new technologies, one of many economic add-ons that are often included to increase eagerness to participate amongst utilities and, consequently, protect consumers from utilities shifting increasing costs from RPS policy to their customer bases. As a result of these well designed aspects of the RPS policy, Colorado’s renewable energy output has tripled since 2010 (EIA).

Martin & Saikawa (2017), and Prasad & Munch (2012)'s research found no correlation between the mere presence of an RPS policy and any significant decrease in GHG emissions. Oregon, for example, has among the most ambitious RPS targets in the country, with an overarching target of 100% renewable energy generation by the year 2040. Despite environmental advocates seeing this as a victory, IOUs had their hand in negotiations, which led to favorable components for the IOUs such as tradable renewable energy credits (REC) (tradable credits that indicate 1MWh of electricity was generated by a renewable source of some sort), unlimited banking of REC, and a cost cap (Basseches, 2020). These additions shifted costs from the IOU and applied them to environmental organizations and customers (Basseches 2020).

While RPS policy has an extensive base of literature, structure is less commonly studied in the depth which Basschetes demonstrates. As noted by Haitao Yin and Nicholas Powers, variance in structure of RPS policy is rarely considered in the framework of financial implications in the existing literature (Yin, Powers, 2009). I will address this later on in the paper using a curated 'stringency score' by Sanya Carly. One economic factor that does stay relatively consistent, however, is the policy design resulting in the financial burden falling on the IOU. Infrastructure, technologies, and process changes all represent significant costs that are prompted by RPS policy, and regardless how strongly the IOUs of a state flex their political muscle (as observed in Oregon), RPS force utilities to significantly change their business model and processes in a quick and sweeping manner. Such policy begs the question, does limiting the externality of pollution in such a profound way hurt the profits of utilities, and how does this relationship reflect Porter's theory, or is the effect minimal? Regardless, achieving a better understanding of this relationship will better advise renewable energy policy, and environmental policy in general moving forward, with better informed data regarding its effects to this point.

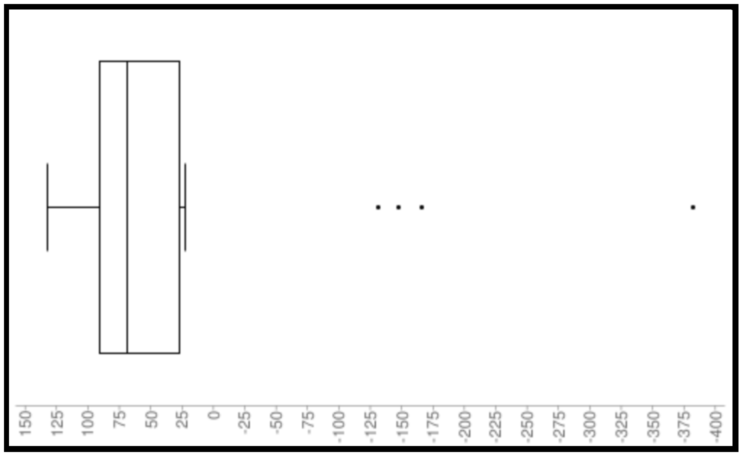
3. Methods

The independent variable I will be using throughout this study is quantifiable variance in RPS stringency. As noted earlier, the metric of RPS stringency goes much deeper than merely comparing target percentages and dates, despite those being the most widely publicized and recognizable features of the legislation. With that considered, establishing a more comprehensive measurement for RPS stringency is necessary to conduct this reaearch. Thankfully, a preexisting and comprehensive measure of RPS stringency already exists. Carley, Davies, Spence, and Zirogiannis' 2018 research developed an algorithm for stringency score that will be used as the independent variable of this study. Their stringency score was calculated using a multitude of equations and variables with the base equation being the following:

$$S = \frac{M_T - M}{Z_T - Z} \times L$$

Where S is the stringency score during time t, M represents the percentage mandate and Z signifies the year of the mandate requirement, in the form of the first year and the last year of regulation (T referring to the last year of the policy and I referring to the year of the policy's enactment). Lastly, L represents the fraction of the state in question's electricity infrastructure that is regulated by the RPS policy (Carley et al, 2018). The variables M and Z are malleable in this equation. Over time as states update their percentage targets or time frames, these variables are subject to change. The L variable can also change, if for example, the policy in question was amended to affect both IOUs and government owned utilities rather than just IOUs, the value of L would increase and vice versa (Carley et al, 2018). While this equation includes basic variables like time and percentage targets, and does not explicitly include some of the aforementioned policy intricacies, it is important to note that Carley used "several policy design features" in the equation that counted towards the stringency score. These design features include a binary measure of whether energy efficiency is counted towards RPS policy targets, a ‘categorical’ variable representing the highest possible amount of RPS policy targets that can be satisfied by non-renewable sources, penalties for non compliance, and credit multipliers (Carley et al, 2018). With these design features considered, this stringency score provides a holistic representation of the true stringency of RPS policy.

Developing a concise, digestible, and inclusive stringency score is massively important in the process of providing empirical analysis; Carley’s score allows for comprehensive analysis of nationwide trends in RPS policy. For example, of the 28 states that had adopted mandatory RPS policy at the time of this article’s publication, 14 RPS policies had remained stagnant since their adoption, 12 increased their stringency since being adopted, and only two decreased in stringency (from their adoption until 2014, the year data collection concluded). Notable highlights of this data include Nevada, whose stringency score rose a staggering 190 points, from -160 to 30, from 1997 to 2014, and California, whose stringency score rose 81 points from 2002 to 2014 from a score of -59 to 22 (Carely et al, 2018). Instances of such significant change can be attributed to performance akin that of Nevada from the time of their RPS conception until present day. Since 1997, Nevada has consistently outperformed their baseline RPS standard, passed more stringent revisions to their policy, and have ultimately tripled their net use of solar energy (EIA). As for the 14 policies that remained stagnant, one, Michigan, has enacted legislation since this article increasing its stringency. Before diving into the data in any capacity, it is clear at first glance the positive trends in RPS stringency reflect that RPS policies are only becoming more prevalent with time, and utilities, governments, and ratepayers will become increasingly familiar with them, with this in mind, understanding their impacts is considerably important.



The box and whisker plot shown above represents the stringency scores of the 28 states that have adopted mandatory RPS policies as of 2018. The data have a median stringency score of 68.5, with first and third quartile values of 27.5 and 91 respectively and an interquartile range of 63.5. There are notable outliers with this data that strongly deviate from the rest of the data; Montana, Maine, Oregon, and Washington find themselves far below the first quartile, with stringency scores of -131, -147, -166, and -382 respectively. This spurs an interesting question and topic for further research; exploring the difference between a state with a negative RPS stringency score vs one that does not have RPS policy at all. Once again, the purpose of this study is to examine effects of RPS stringency, so the data that was collected is pulled from states of each of the four quadrants portrayed in the box and whisker plot above, along with states that have not enacted mandatory RPS policy as a control. This study will focus on 10 states, which are listed and whose RPS policy is briefly summarized below.

The States

Washington - Stringency score: -382

Established in 2006 via ballot initiative (which, at the time, was only the second state to pass renewable energy policy by ballot initiative), Washington's RPS policy was updated in 2019 with Senate Bill 5116 which requires a 100% transition to renewable energy by 2045 (DSIRE). An important feature to note with this policy is that utilities are not required to meet targets outlined in the policy if it spends at least 4% of its retail revenue requirement on the gradational cost of renewable energy.

Oregon - Stringency score: -166

Established in 2007 in the Oregon Renewable Energy Act of 2007 (SB 838), Oregon's RPS policy, which was updated in 2016, now targets 50% renewable energy output by the year 2040. This RPS policy is unique in the fact that the renewable energy requirement in place depends on the size of the utility. Utilities that generate 3% or more of the state's load must meet larger benchmarks like 27% by 2025, 45% by 2035, and 50% by 2040 while smaller utilities (those that generate less than 1.5% of the state's load, abide by less ambitious targets like 5% by 2025 (DSIRE).

North Carolina - Stringency score: 47

Established in 2007, North Carolina's RPS policy mandates that all IOUs operating in the state meet the requirement of 12.5% renewable energy by the year 2021. Utilities may comply with these regulations through RECs, which is defined as equivalent to 1 MWh of electricity derived from a renewable energy source (DSIRE)

Illinois - Stringency score: 63

Established in 2007, Illinois' RPS policy mandates that 25% of its load be generated by renewables by the year 2025. Compliance is measured through a percentage of the amount of metered electricity provided in any given year. Utilities must meet at least 50% of their goal through standard alternative compliance payments (ACPs), which are very similar to RECs.

Minnesota - Stringency score: 79

Established in 2007 with the establishment of a mandatory RPS requirement from their previously voluntary requirement, Minnesota's RPS requires that 25% of retail energy sales must be generated by renewable energy sources by 2025. To comply with this requirement, utilities must obtain a certain amount of tradable RECs, which are, as seen in North Carolina, created for each MWh of renewable generated electricity (DSIRE).

New York - Stringency score: 91

Established in August of 2016, New York's RPS policy was updated in 2019 to set a target of 70% renewable electricity by the year 2030 (DSIRE). To ensure compliance, New York uses a model in which the New York State Energy and Research Department obtains RECs through yearly scheduled reviews.

Ohio - Stringency score: 127

Established in May of 2008, Ohio's RPS requires that 8.5% of its load be generated by renewable energy by the year 2025. While this requirement may seem too modest to warrant such a high stringency score from Carley et al, remember that the minutiae of enforcement mechanisms and other policy structures that truly determines stringency. Compliance in Ohio is determined by a calculation which observes sales using sales from the previous three years as a benchmark. Compliance can also be achieved through RECs.

Hawaii - Stringency score: 132

Established in 2001, Hawaii's RPS establishes the ultimate target of 100% renewable energy by the year 2045. Possibly the most notable feature of Hawaii's policy is the fact that, as of 2015, it was mandated that the RPS must be entirely met with electricity generated from renewables. Meaning that energy efficient add ons and other non-renewable tools will continue to be ignored in the enforcement of this policy (DSIRE).

Using stringency score as our independent variable, we chose to isolate stock prices as the dependent variable of this study in order to evaluate whether or not there is a relationshipbetween RPS stringency and profitability of IOUs. Stock prices are good indicators of the financial health of a firm. Most economic theory would suggest that stock prices are influenced by a number of internal and external (market based) factors (He, Sun, Zhang, 2020) that influence where supply and demand intersect within the market. Stock price signifies how shareholders feel about the current strength, and future prospects of an economic environment, and policy changes have proved to weigh heavily on the minds of investors as regulatory constraints lead to increased uncertainty which can affect stock prices across entire industries (Pastor, Veronesi, 2012). While Pastor and Veronesi, among others, have displayed the effects of policy implementation on stock prices, it would certainly be shortsighted to assume that RPS policy is the only contributing factor in the quarterly output of IOUs; there are a myriad of internal market influences that operate in conjunction with external pressure like RPS policy to ultimately decide the fate of a firm's cost per share. Given the complexity of the market, I found it necessary to isolate focus on specific times when RPS policy was, in all likelihood, of particular interest. To achieve this important quality of isolation, data was extracted from the two months, and one year both preceding and following the enactment of an RPS policy based on which state the utility primarily operates in.

Data was obtained using the University of Penn's Wharton Research Data Services (wrds) database, which contains The Center for Research in Security Prices (CRSP). CRSP is the most comprehensive, and as such is a commonly used, database for security prices in the NYSE, AMEX, and NASDAQ stock markets. Spanning back decades, CRSP has marketwide and firm specific data, by the day, on asking prices, closing bids, value weighted return, and more. CRSP was an invaluable resource, and allowed this research to really hone in on specific times in which RPS policy enactment was a primary consideration in the stock behaviors of IOUs.

Data was then taken, using CRSP, for one or two utilities in each state. Admittedly, most IOUs operate in more than one state, so in order to be considered for a state, the utility must be, at least, one of the three most prevalent utilities, even if their presence is not exclusive in that state or to that state. An interesting area for future research in this arena would be conducting case studies on larger scale companies like Consolidated Edison and Exelon, and discern the effect of RPS policy by looking at state specific financial data and observing any variance that may be present. Data extracted from CRSP for each of the utilities includes: ask or high price, price or bid/ask average, open price, value-weighted return-including dividends, value-weighted return-excluding. dividends, equal-weighted return-including. dividends, equal-weighted return-excluding. dividends, return on the S&P 500 index.

After obtaining our data, we then transitioned toward calculating the cumulative abnormal return (CAR) for each company's stock price. This equation allowed us to control marketwide fluctuations in the stock market, once again, isolating our focus. This time on a specific company to study if their returns during the 4 month period and 2 year period surrounding the enactment of RPS policy were abnormally positive, negative or neutral. Using the CAR model and narrowing focus on a short time preceding and following the RPS policy first allows us to control for marketwide fluctuations in the stock market that affect returns and secondly allows us, in good confidence, to attribute any abnormal returns or lack thereof to the enactment of a RPS policy. The CAR equation is displayed below, and is obtained from Brayden King of Northwestern University and Sarah Soule of Stanford University(2007), who's research used the model to study the effects of social protests on stock prices in various industries. The daily abnormal return for firm j is represented by:

$$abnormalreturn_{i} = R_{i} - a_{i} - (b_{i}R \quad)$$

R_{i} is the rate of return for the days surrounding the enactment of the RPS policy. a_{i} and b_{i} are regression coefficients taken from the expected return equation below:

$$R_i \quad = \alpha_i + \beta_i R \qquad + \varepsilon_i$$

In this equation, R_i is the rate of return for a firm in the days surrounding the enactment of an RPS policy. R is the market return, an equally weighted number generated by CRSP indicating the overall performance of the market on a particular day. β_i is the systematic risk for the firm in question. α_i is the rate of return of the firm in question when R is equal to zero. ε_i is an 'independent distribution term' which, for the purposes of our data, did not affect the results of our calculations (King, Soule, 2007). In summary, the abnormal return calculation, which was calculated for each IOU for 60 days preceding and following the enactment of an RPS policy, displays the difference between the actual daily returns experienced by the utility and the expected daily return based on the average performance of the market on those days. A positive abnormal return value indicates that the IOU performed better than expected based on the performance of the market while a negative return value indicates that the IOU underperformed the market.

After data was obtained for each IOU, regression analysis was conducted using the recently mentioned CAR equations to determine the abnormality of the company's stock behavior during the time surrounding the enactment of the RPS policy, indicative of investors' assessment of the RPS policy and the ability for the firm to remain profitable in the face of varying degrees of increased renewable energy mandates. Before revealing the results of this analysis, it seems of value to first introduce readers to the IOUs that were observed in this study and their statements on renewable energy and sustainability. Corporate statements, advertising, and marketing about the environment should be taken with a grain of salt however, as greenwashing is a common and serious issue. Greenwashing is essentially the act of misleading customers through promoting ethical and progressive environmental and sustainability performance when, in fact, performance is weak in those areas. There are several motivating factors to greenwash, such as the nonchalant regulatory environment surrounding greenwashing, pressure from external entities like activists and the media, and the pressure from the market and consumers to come off as environmentally conscious and lead efforts in protection and remediation (Delmas, Burbano, 2011). All utilities of interest in this study market themselves as leaders in the environmental movement within the energy industry, and many accompany those claims with ambitious goals, most commonly net neutrality by 2050. Simply making a claim or stating a goal does not make it so, greenwashing is common and easy and should be considered when reading the material these companies put out.

The Utilities

Avista: Washington

Founded in 1889, Avista is the largest publicly traded IOU in the state of Washington, and covers upwards of 30,000 square miles, which also includes some territory in Idaho and southern Oregon. In their environment, sustainability, and governance (ESG) reports, Avista promotes their goals of a carbon neutral supply of electricity by the end of 2027 and 100% clean electricity by 2045. As of December 2020, Avista has made considerable progress towards those goals and now generate more than 60% of their energy through renewables. Avista will be the only utility under observation for the state of Washington. The other hegemonic utility in Washington, Pacificorp is technically an IOU, but is traded over the counter (OTC), and not listed in any stock exchange.

Portland General Electric: Oregon

Portland General Electric (PGE) serves about 2 million Organians throughout a particularly urban territory. PGE places significant emphasis on supply chain sustainability, and evaluates their suppliers and business partners through regular check-ins and an annual report. Among their requests for suppliers are business partners for them to set voluntary reduction goals, and report their performance publicly. PGE will be the only utility under observation in the state of Oregon. Pacificorp, also known as Pacific Power, is the other central utility in Oregon but is traded over the counter, and as such there is no data available for their shares as is it not a member of any stock exchange.

Duke Energy: North Carolina

Duke Energy serves about 1.5 million accounts in central and eastern North Carolina, accounting for about 32,000 square miles of service territory; they also operate in South Carolina, Florida, and Indiana, though their presence is much more pronounced in the Carolinas. Through their website and their annual sustainability reports, they market themselves as a utility that values sustainability in their triple bottom line. Among Duke's sustainability goals is the target of net zero carbon emissions by 2050, which is a more stringent baseline than their current RPS policy mandates.

Dominion Energy: North Carolina

Dominion energy provides electricity to about 130,000 homes and businesses in eastern North Carolina. They also operate in Virginia. Dominion and Duke energy combine to serve the majority of the state. Dominion promotes heavy investment in renewable energy through their website and sustainability reports, and also establishes a goal of net zero emissions by 2050.

Allete Inc: Minnesota

Allete serves approximately 145,000 residents in Minnesota which accounts for approximately 26,000 square miles in Northern Minnesota. Through their sustainability reports and marketing, Allete also reflects a strong commitment to sustainability. Among the companies under the Allete umbrella is Allete Clean Energy, which develops and implements clean energy across the United States, and has a "growing reputation" as a "respected national player" in the development of wind energy. As is the case with several of the utilities in this study, Allete also establishes an internal goal of carbon neutrality by 2050.

Xcel Energy Inc: Minnesota

Xcel Energy covers an expansive territory in the United States, with operations in Minnesota, Michigan, Wisconsin, North Dakota, South Dakota, Colorado, Texas, and New Mexico. Headquartered in Minnesota, they almost exclusively serve the southern portion of the state. As is standard at this point, Xcel establishes an internal goal of net zero carbon emissions by 2050, and has impressively cut carbon emissions by 51% since 2005.

National Grid: New York

National Grid is a multinational IOU, with operations in the United Kingdom and the United States. In the United States, National Grid operates exclusively in the Northeast, serving 26 counties in New York, primarily upstate (but also the metro territory of Brooklyn and Queens), along with significant territory in Massachusetts and essentially all of Rhode Island. National Grid is particularly outspoken about their corporate commitment to sustainability, best exemplified with their own commitment to reduce their greenhouse gas emissions to net zero by 2050, including a checkpoint of reaching a 70% reduction in greenhouse gas emissions by 2030 from a 1990 baseline (National Grid).

Consolidated Edison: New York

Consolidated Edison (ConEd) is a considerably large IOU, netting about $12 Billion in annual revenue, with headquarters in New York City. ConEd services Westchester County, the Bronx, Manhattan and parts of Queens. ConEd has also stated on their website that they are taking aggressive action towards sustainable and renewable energy development, and similarly to National Grid, advertises a goal of net zero emissions by 2050 (coned).

Exelon (Commonwealth Edison): Illinois

Commonwealth Edison (ComEd) is one of six subsidiary firms of Exelon, a fortune 100 energy company headquartered in Chicago, Illinois. Exelon operates in Delaware, Washington D.CIllinois, Maryland, New Jersey and Pennsylvania, and ComEd exclusively handles their Illinois territory, servicing 70% of the state's population. ComEd and Exelon also recognize sustainability in their business model, noted by their commitment towards building an alternative and hybrid vehicle fleet, their green supply chain network, and their restoration work to sequester Carbon naturally (comed)

Ameren Illinois: Illinois

Ameren Illinois services the majority of the remaining population in Illinois. Ameren acknowledges the environment in their business model with plans in accordance with the Paris Climate Agreement, with goals to reduce carbon emissions 50% by 2030 and 85% by 2040, from 2005 levels with the ultimate goal of limiting the temperature increase to 1.5 degrees Celsius above pre-industrial levels (Ameren).

AEP Ohio: Ohio

AEP Ohio is a subsidiary of American Electric Power (AEP), a major electric provider in the United States with operations in eleven states. AEP is headquartered in Columbus Ohio, and has a significant presence in the state serving about 1.5 million customers. AEP Ohio acknowledges the environment in their business model as well, adhering to a goal (which seems to be very much the standard amongst IOUs) of achieving net zero carbon dioxide emissions by 2050, with an interim goal to cut emissions 80% from 2000 levels by 2030 growing our renewable generation portfolio to approximately 50% of our total capacity by 2030 (AEPOhio).

AES Ohio

AES Ohio is a subsidiary of the AES corporation and, along with AEP Ohio, services the majority of residents in the state. AES Ohio markets themselves as a leader in “Accelerating the future of energy”, and offers energy saving programs, electric vehicles programs, and renewable energy installation incentives for their customers.

Hawaiian Electric

Hawaiian Electric Light Company (HELCO), is the parent company of Kauai Island Utility Corporation (KIUC), Hawaiian Electric (HECO), and Maui Electric Corporation (MECO), which operate in conjunction to service the entire territory of the four islands. Similar to the ambitious goals of the state, HELCO holds sustainability as a high priority in their business model, and has already exceeded their goal of 30% renewable energy by 2020, and as of their last sustainability report, currently maintains an infrastructure of 43.4% renewable energy. It should be noted that while two utilities were selected for other states, this study will just analyze HELCO for Hawaii as they operate in concurrence with the other utilities in the state (HELCO).

4. Results and Data Analysis

The CAR equation was calculated for each utility and is represented in graphical format. For analytical purposes, the slope of the graph (calculated through a regression formula) is the CAR value, or how well the utility performed against the market during the time period surrounding the enactment of the RPS policy. The X axis represents the average return rate for the market and the Y axis represents the firm specific return rate data from the time period. This relationship implies that any plots with a regression line with a slope of less than 1 indicates a relationship in which the firm performed worse than the market, slopes greater than indicate a situation in which the firm outperformed the market, and a slope of 1 would indicate a perfect relationship between market and firm returns. The stock performance of the aforementioned 13 utilities is analyzed on two time scales; two months before and after the enactment of the RPS policy and one year before and after the enactment. These time scales allow us to anaylze the immediate impact of RPS policy and the longer term effect on the stock after the initial impact of the RPS policy has diccipated. The statistical analysis will evaluatethe following hypotheses:

Hypotheses

H_0: Stringency of renewable energy score has no effect on the short term stock returns of IOUs within the state of its adoption.

H_1: Stringency of renewable energy score has a statistically significant effect on the short term stock returns of IOUs within the state of its adoption.

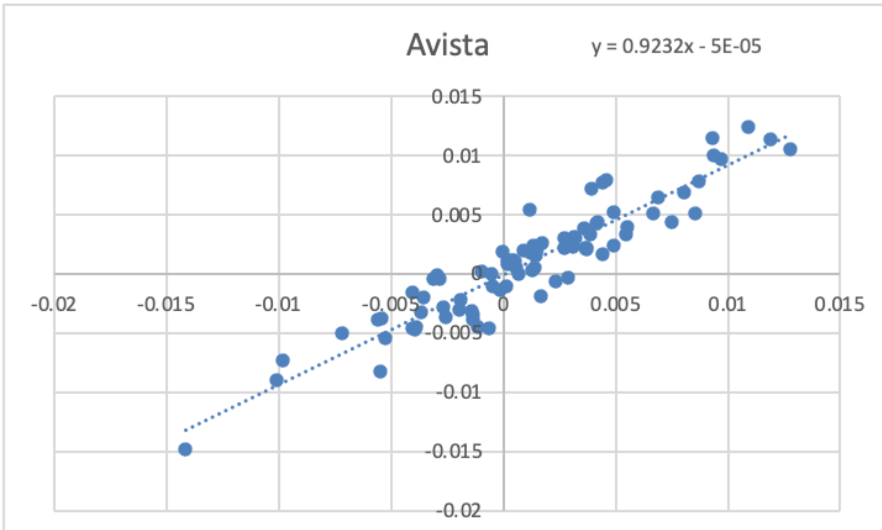
The results that we obtained are listed below by utility and summarized in the table following the graphs.

Data

<u>Washington: -382 Stringency Score</u>

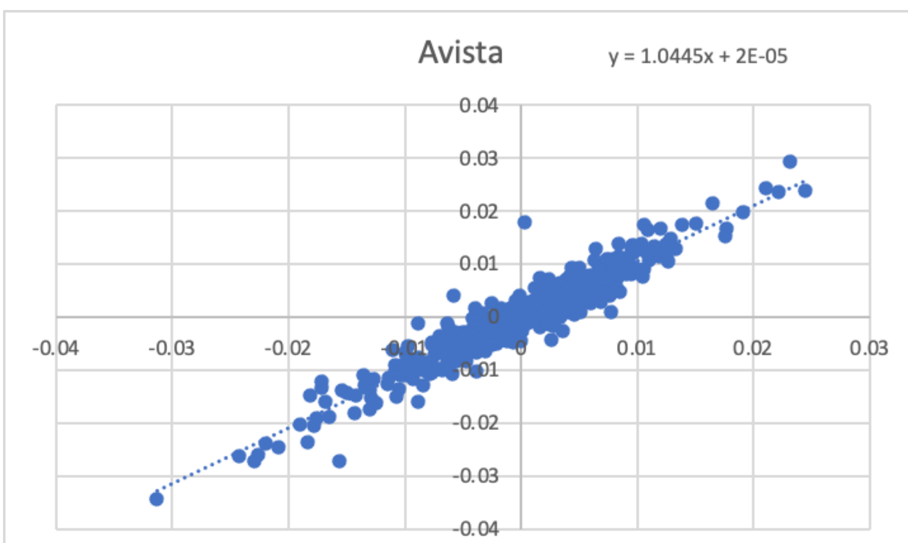
Avista

Within 4 Months



$$y = .9232x - 5E^{-5}$$

Within 2 Years

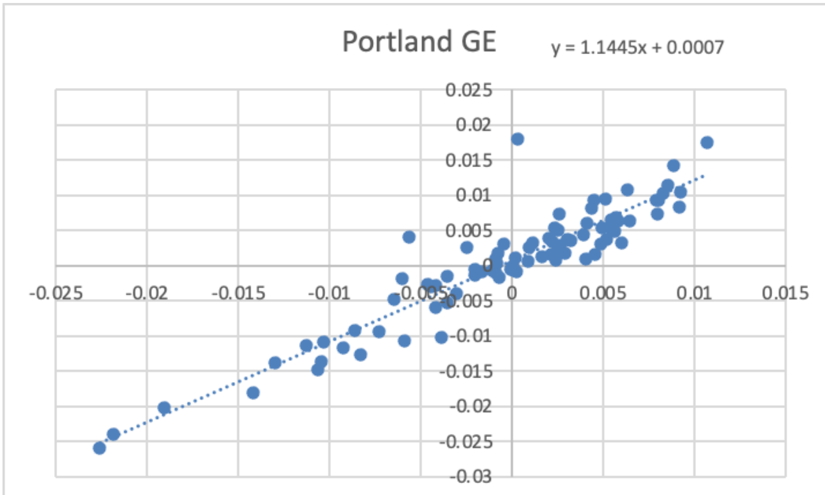


$$y = 1.0445x + 2E^{-5}$$

Oregon: -166 Stringency Score

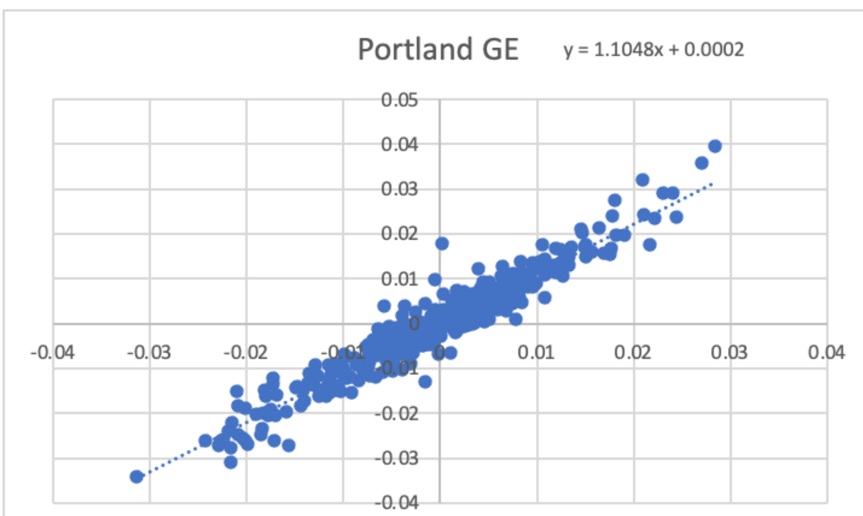
Portland General Electric

Within 4 Months



$$y = 1.1445x + 0.0007$$

Within 2 Years

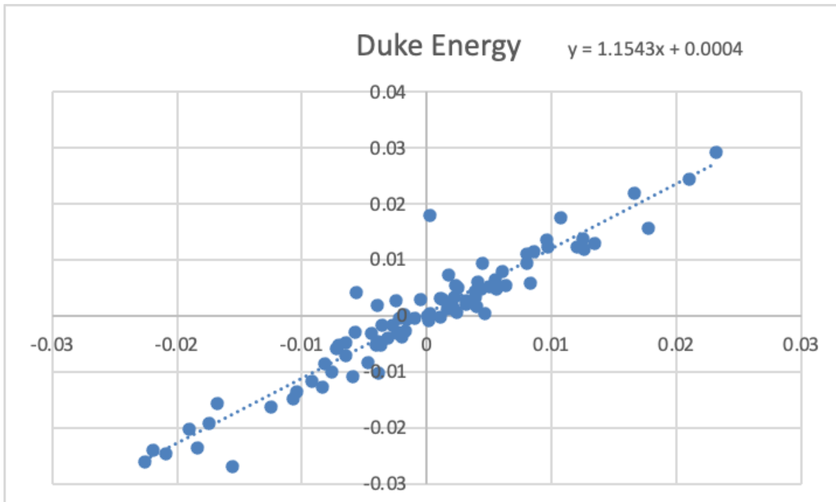


$$y = 1.1048x + 0.0002$$

North Carolina: 47 Stringency Score

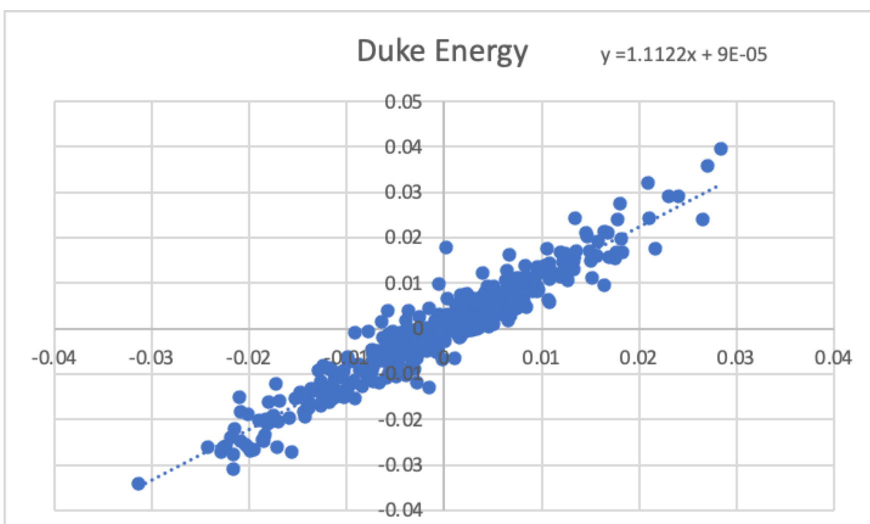
Duke Energy

Within 4 Months



$$y = 1.1543x + 0.0004$$

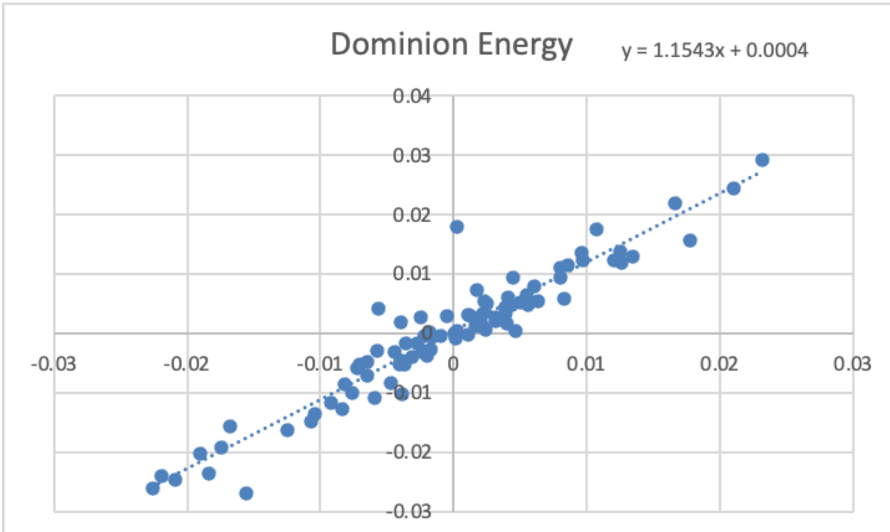
Within 2 Years



$$y = 1.1122x + 9E^{-5}$$

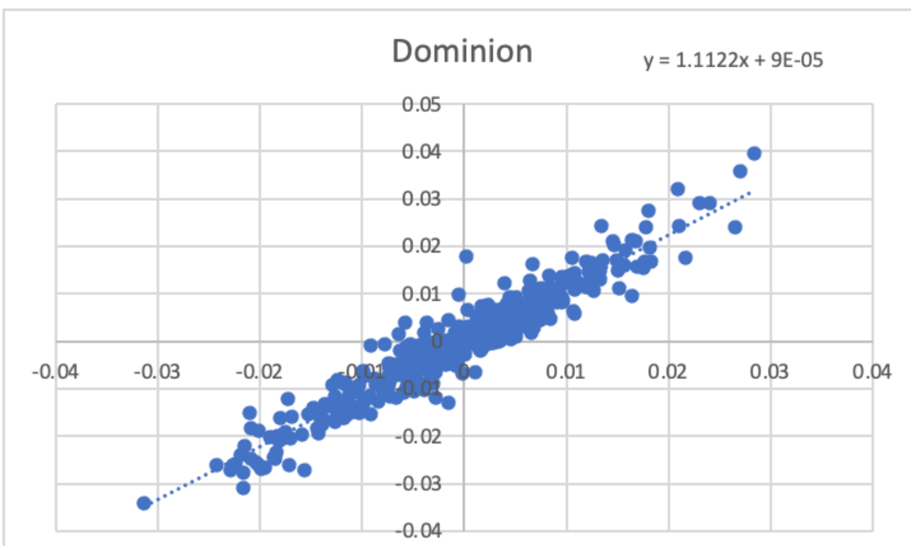
Dominion Energy

Within 4 Months



$$y = 1.1543x + 0.0004$$

Within 2 Years

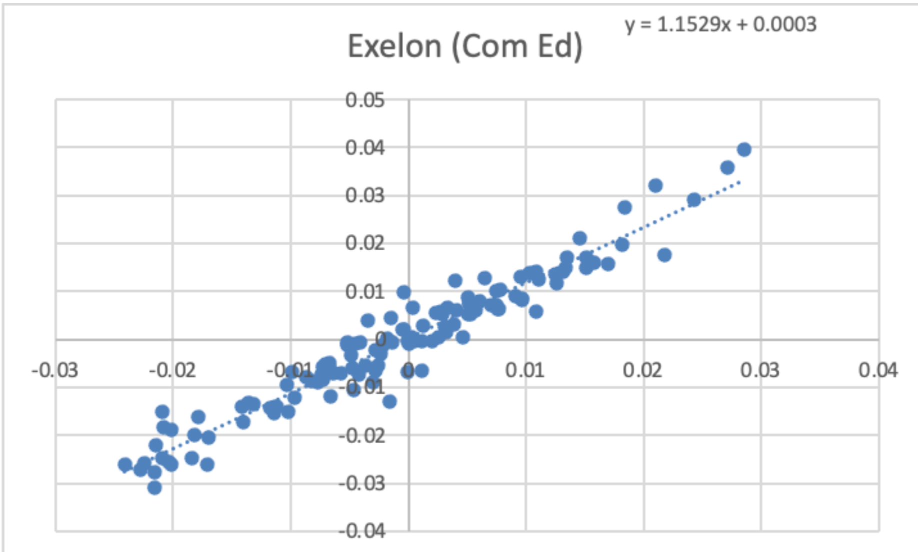


$$y = 1.1122x + 9E^{-5}$$

Illinois: 63 Stringency Score

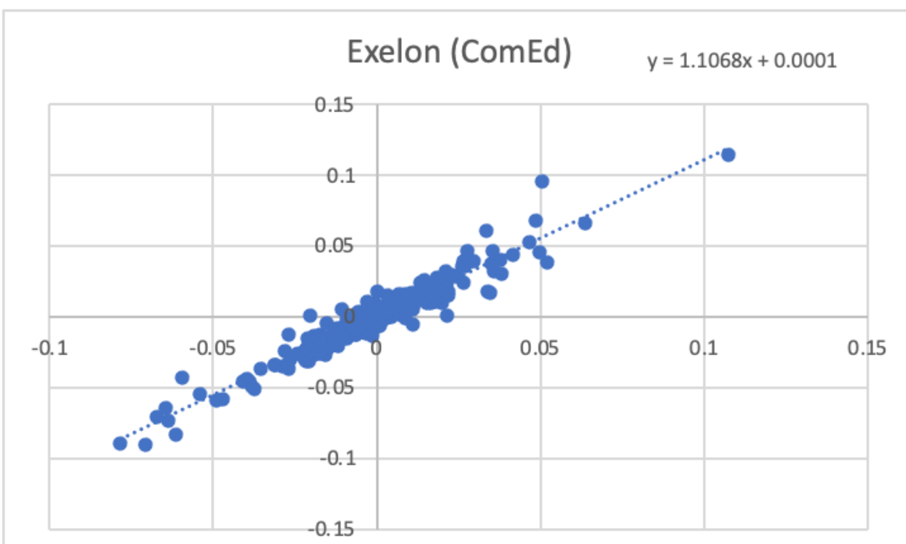
Commonwealth Edison

Within 4 Months



$$y = 1.1529x + 0.0003$$

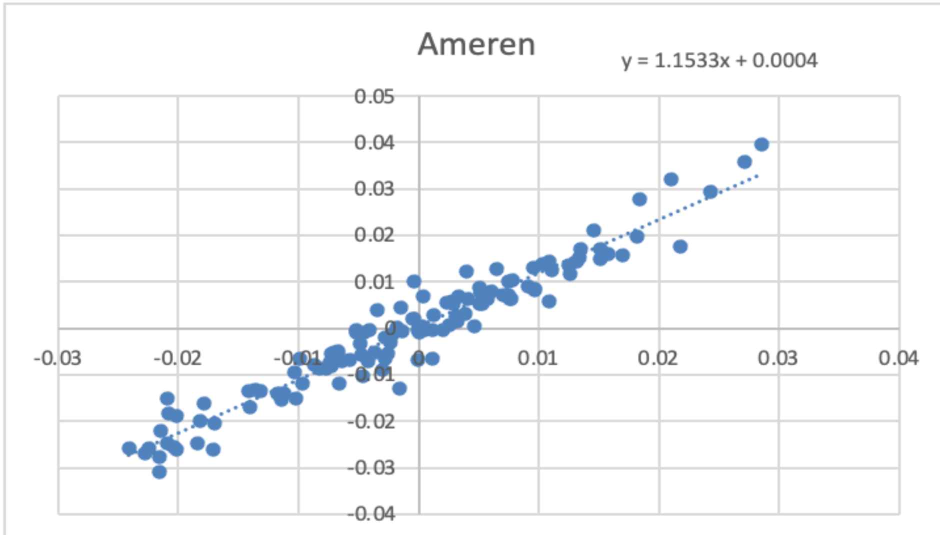
Within 2 Years



$$y = 1.1068x + 0.0001$$

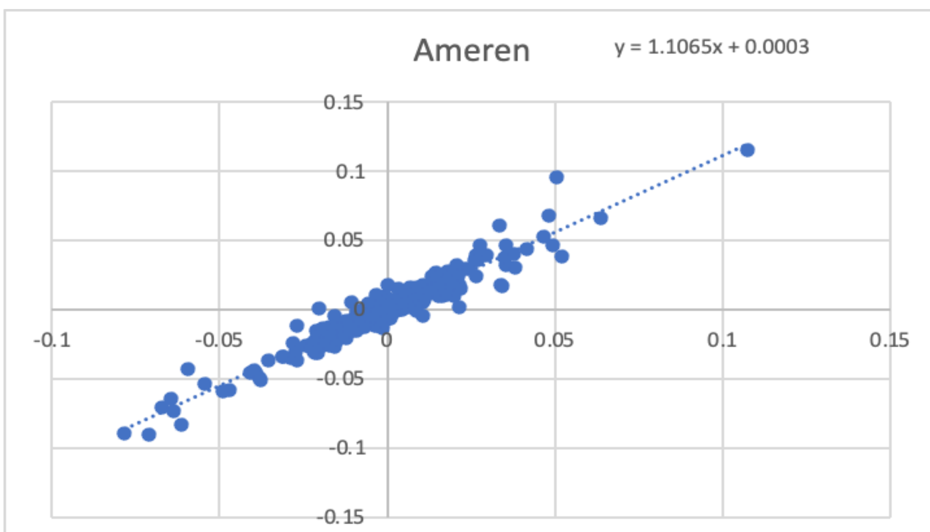
Ameren Illinois

Within 4 Months



$$y = 1.1533 + 0.0004$$

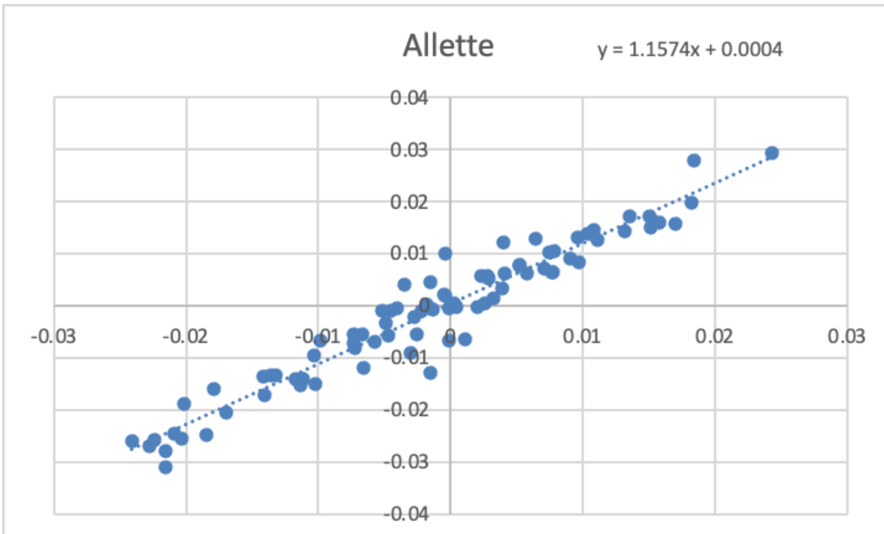
Within 2 Years



Minnesota: 79 Stringency Score

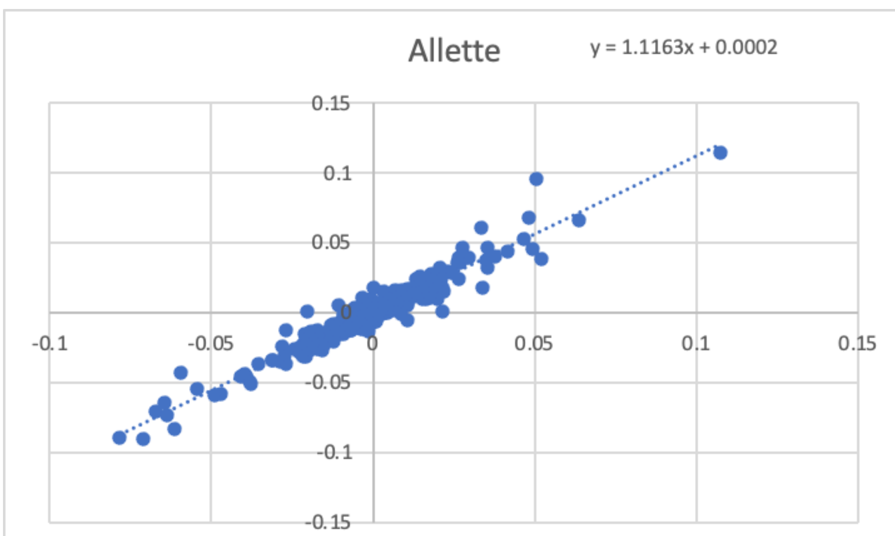
Allete Inc

Within 4 Months



$$y = 1.1574x + 0.0004$$

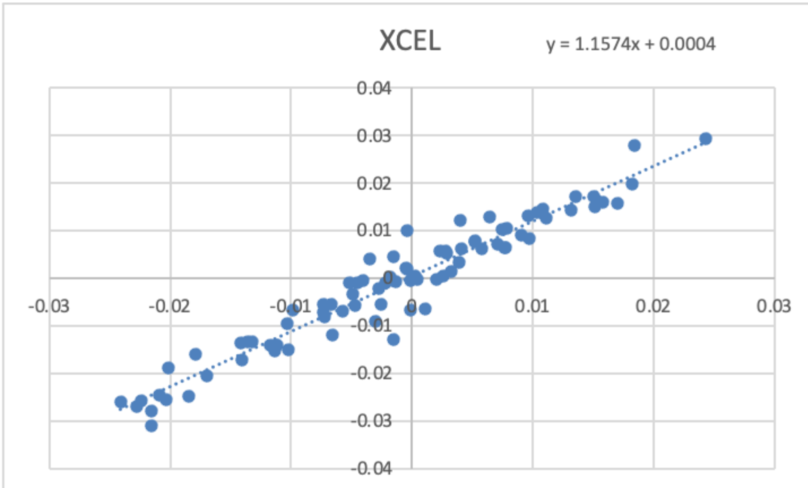
Within 2 Years



$$y = 1.1163x + 0.0002$$

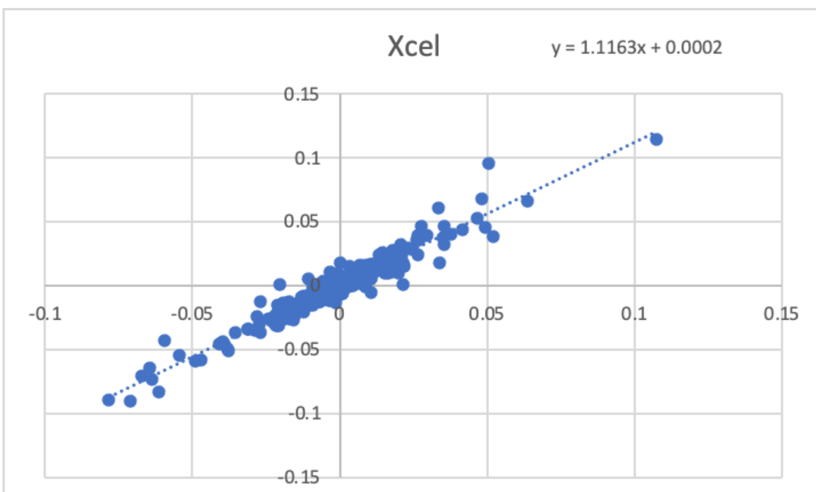
Xcel Energy

Within 4 Months



$$y = 1.1574x + 0.0004$$

Within 2 Years

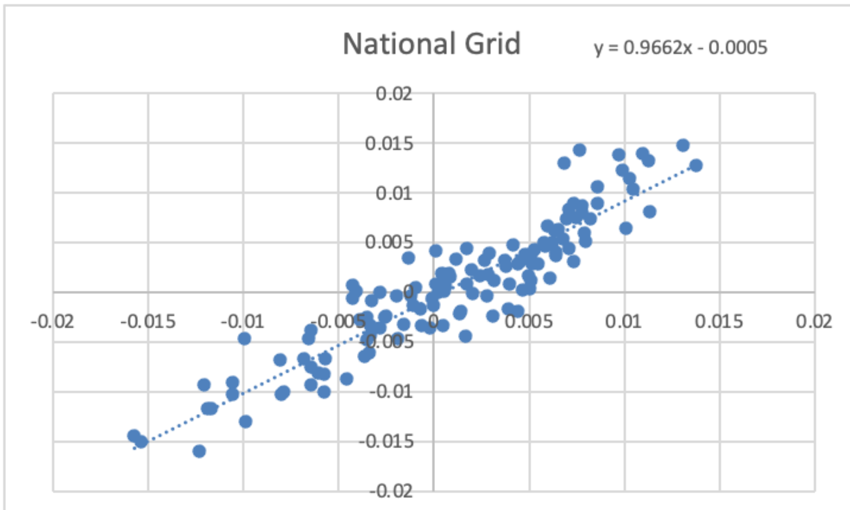


$$y = 1.1163x + 0.0002$$

New York: 91 Stringency Score

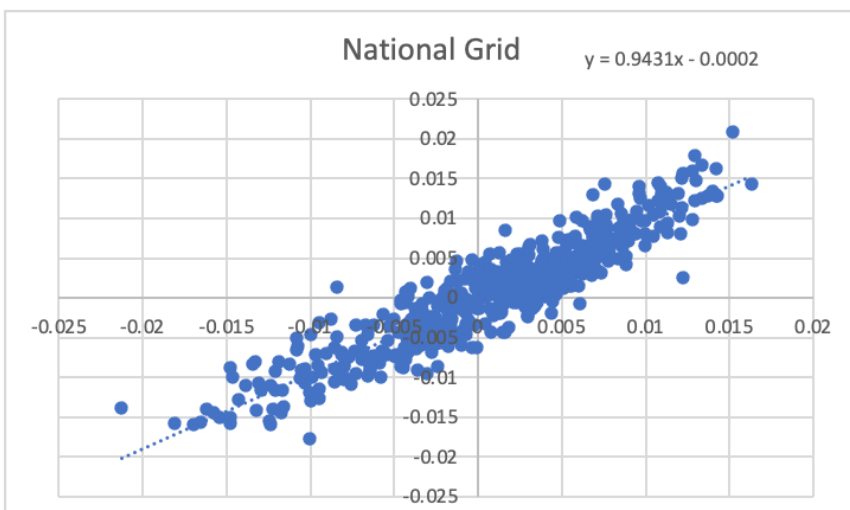
National Grid

Within 4 Months



$$y = 0.9662x - 0.0005$$

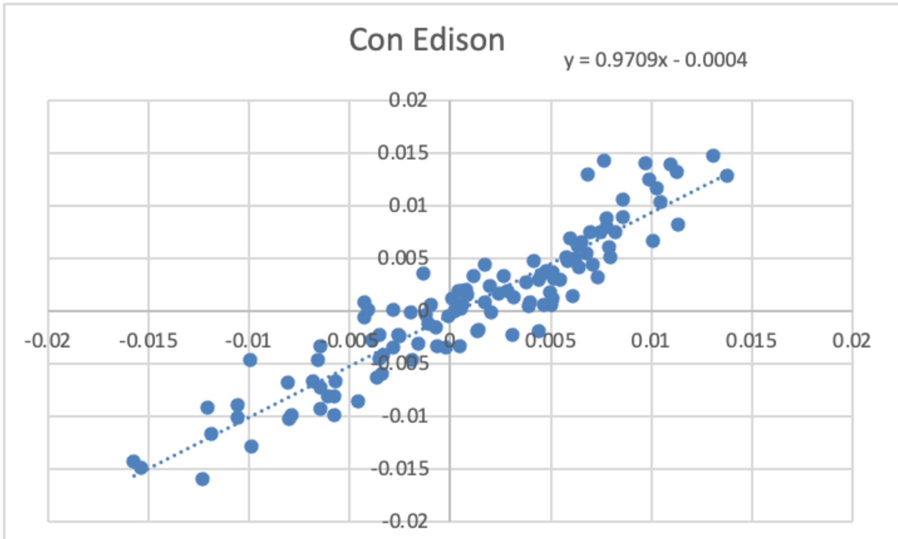
Within 2 Years



$$y = 0.9431x - 0.0002$$

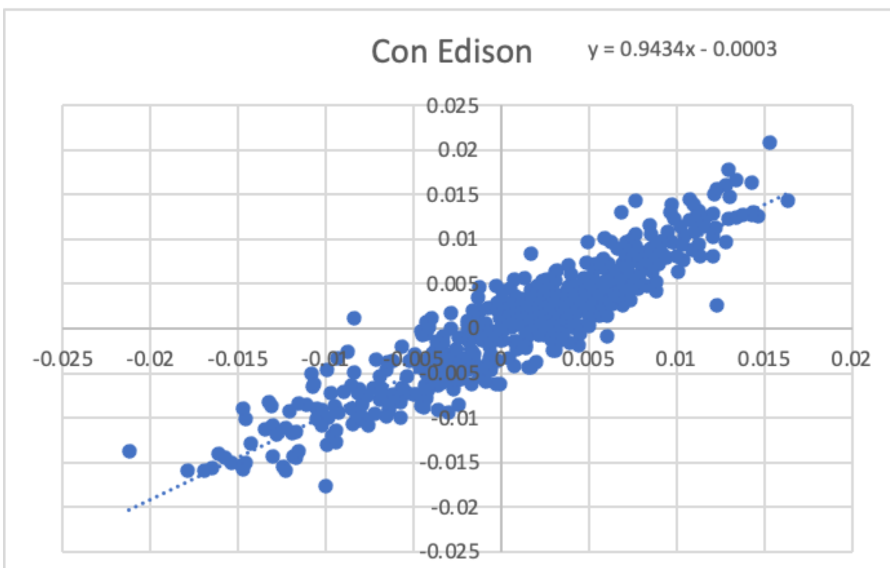
Consolidated Edison

Within 4 Months



$$y = 0.9709x - 0.0004$$

Within 2 Years

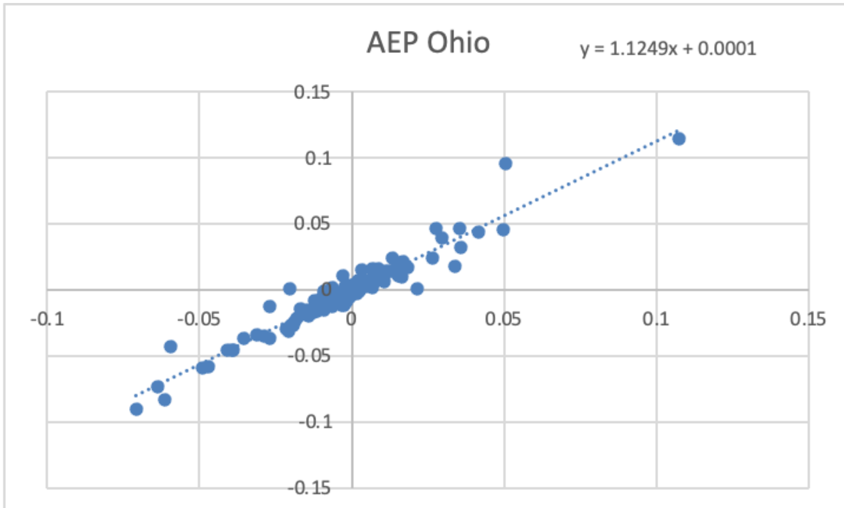


$$y = .9434x - 0.0003$$

Ohio: 127 Stringency Score

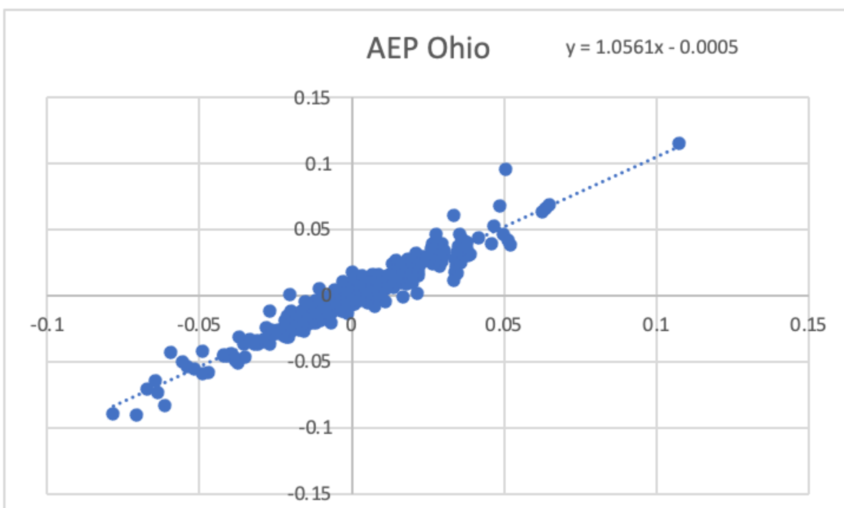
AEP Ohio

Within 4 Months



$$y = 1.1249x + 0.0001$$

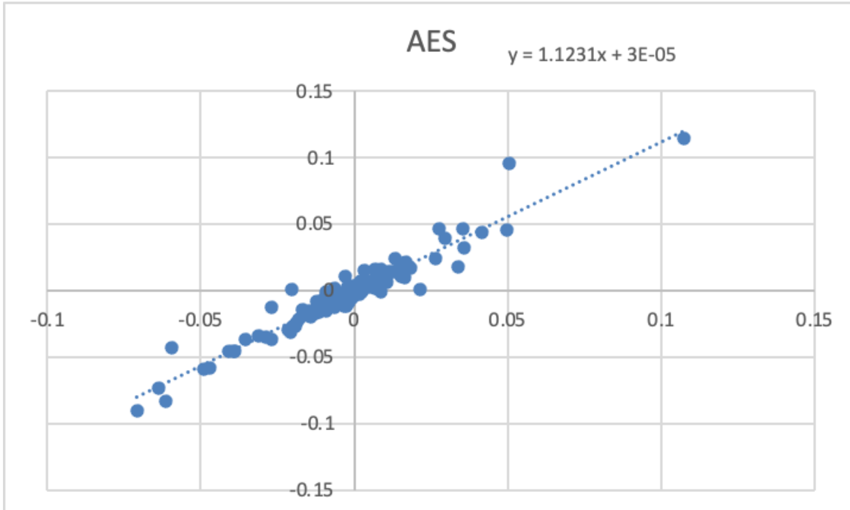
Within 2 Years



$$y = 1.0561x - 0.0005$$

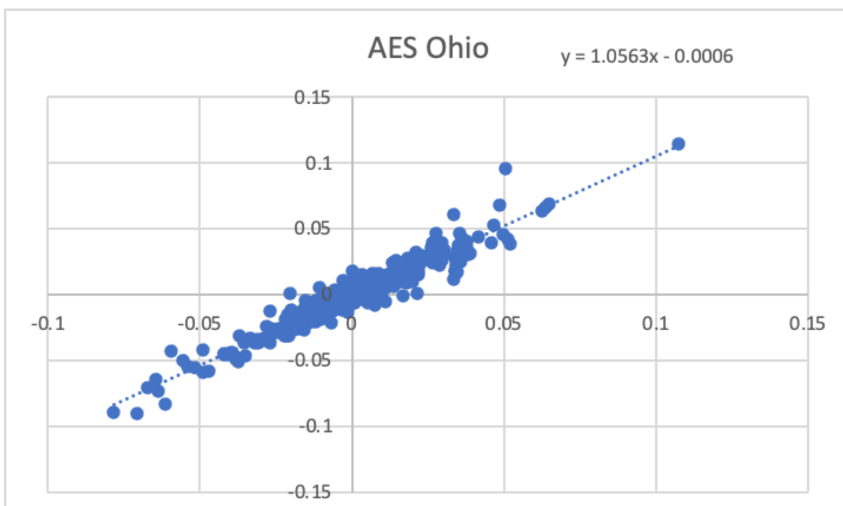
AES Ohio

Within 4 Months



$$y = 1.1231x + 3x10^{-5}$$

Within 2 Years

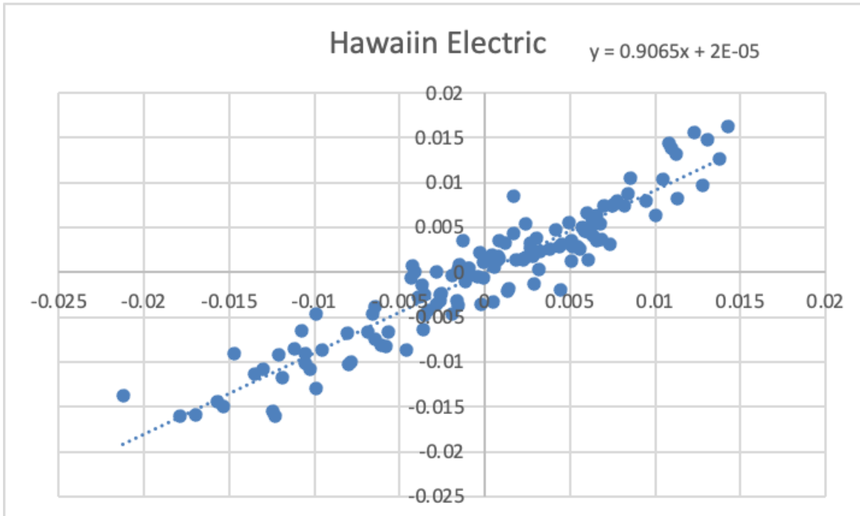


$$y = 1.0563x - 0.0006$$

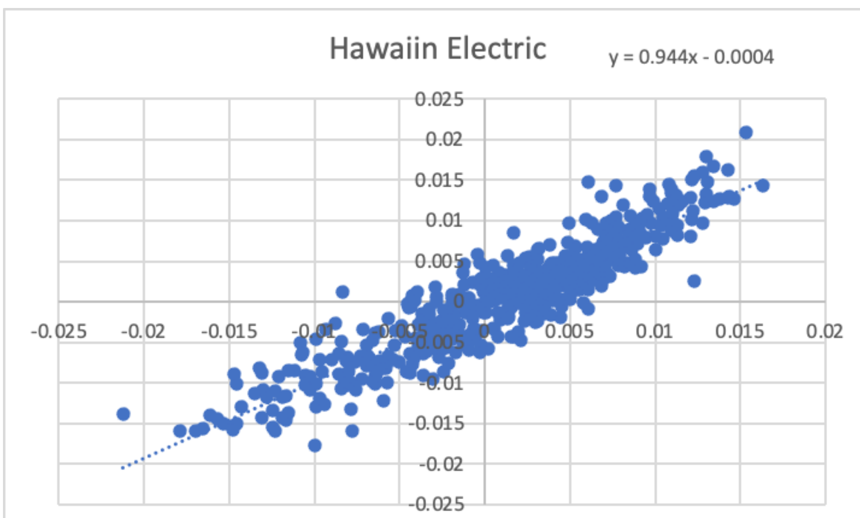
Hawaii: 132 Stringency Score

Hawaiian Electric and Light

Within 4 Months



Within 2 Years

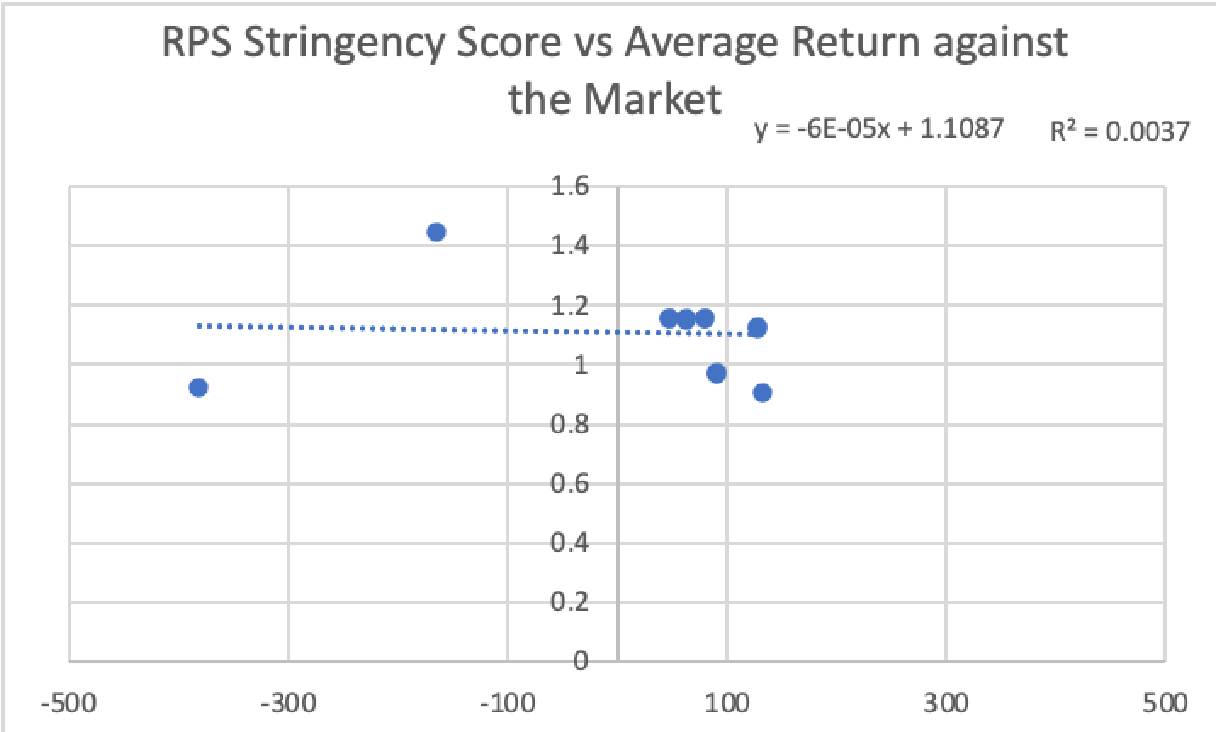


$$y = 0.944x - 0.0004$$

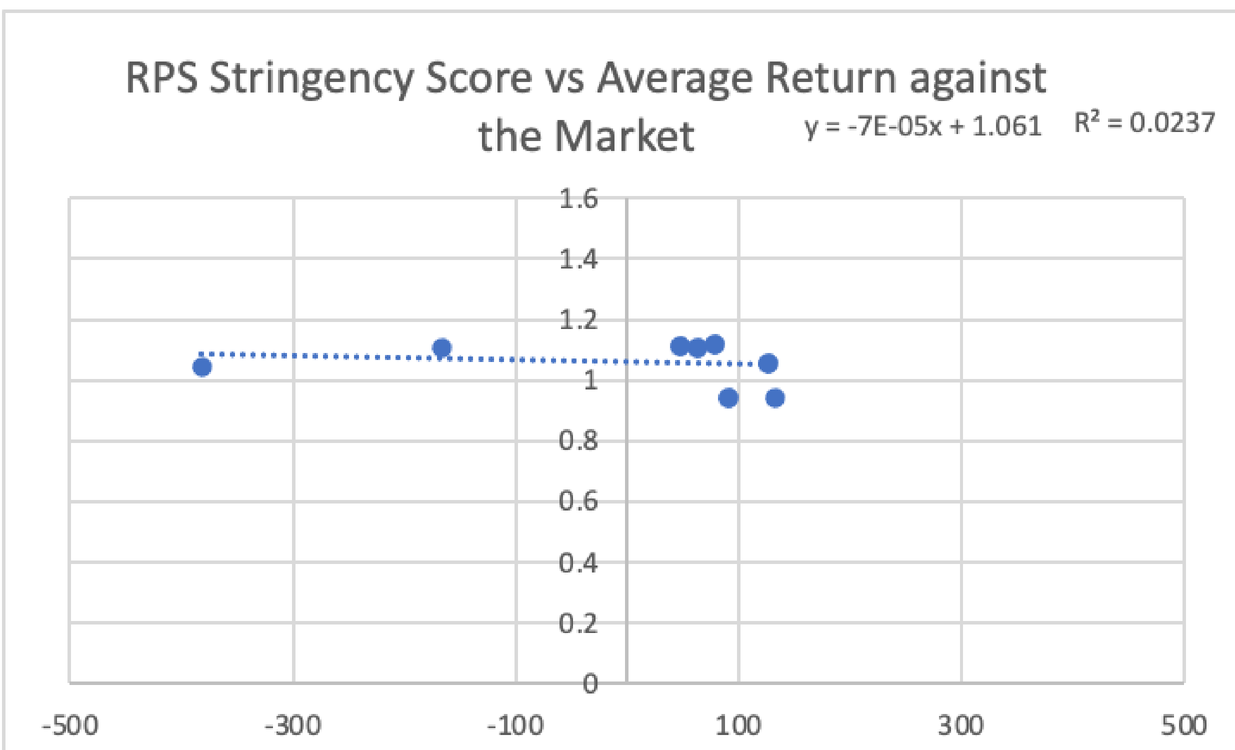
Data Summary

State	Utility	Stringency Score	Return vs Market (+/- 2 months of enactment)	Return vs Market (+/- 1 year of enactment)
Washington	Avista	-382	.9232	1.0445
Oregon	PGE	-166	1.445	1.1048
North Carolina	Duke Energy	47	1.1543	1.1122
North Carolina	Dominion Energy	47	1.1543	1.1122
Illinois	Ameren	63	1.1533	1.1065
Illinois	Exelon (ComEd)	63	1.1529	1.1068
Minnesota	Allette	79	1.1574	1.1163
Minnesota	Xcel	79	1.1574	1.1163
New York	National Grid	91	.9662	0.9431
New York	Con Ed	91	.9709	0.9434
Ohio	AEP Ohio	127	1.1249	1.0561
Ohio	AES Ohio	127	1.1231	1.0563
Hawaii	Hawaiian Electric	132	.9065	0.944

Within 4 Months



Within 2 Years



This data provides insight into a few of the possible effects of RPS policy, and prompts some surprising conclusions. Firstly, it is significant just how similar intrastate stock performance is during the period of time surrounding the enactment of the rps policy. Among states in which two IOUs were studied, the average percentage differnce of stock performance between the companies in the 4 month interval was a mere .135% with a standard deviation of 0.00204 and .064% with a standard deviation of 0.00115 for the 1 year sample. This aspect of our findings suggests a remarkably strong connection between the stock behavior of intrastate IOUs surrounding landmark policy changes. This was an unanticipated, and unintended finding of the study and prompts several interesting areas for future research. The apparent synergy between utilities in the same state prompts several possible areas of inquiry surrounding the internal factors that may lead to similar performance among the composition and behavior of their major investors. As for the main findings of this study, the correlation between stringency score and stock performance, our study was not able to reject the null hypothesis, and hence we are unable to conclude that RPS stringency score has any effect on the stock performance of IOUs.

To conduct our analysis, we first ran linear regression models using the stock data of each utility as obtained by WRDS. The value of interest obtained from these regressions is the slope, which indicates how the firm of interest performed as compared to the market. As stated earlier, if a slope of a regression is greater than 1, the firm performed better than the market over that period of time, if the slope is less than 1, the firm performed worse. The values obtained from these regressions are listed for each state in the table above, followed by a regression analysis of the stringency scores and their associated slopes. Using this data obtained from the various regression plots, F tests were performed. An F test is essentially any test that uses an F value, which is meant to test if the variance observed in a study is statistically significant or not. F tests are used in a variety of statistical settings, but in our regression analysis, it is meant to test if our model, which was calculated through our company specific analysis of stringency scores and stock returns, fits the data better than a model with no independent variables (in our case, stringency scores). If the F test obtained a P-value of less than .05, we would be able to reject the null hypothesis, and conclude that our data shows there is a relationship between stringency score and stock return. After running our F tests with 12 degrees of freedom (which is established by our sample size), we obtained a P-value of .8438 for the 4 month interval and .6151 for the 2 year interval. These P-values are alarmingly high, and are far greater than any legitimate significance level, including ours of .05. Such a large p-value indicates that our data did not suggest any significant relationship between stringency score and stock price, and hence this study is unable to conclude that RPS stringency has any sort of effect on stock price in the short term.

Time Scale	F-value	P-value
Within 4 Months	.04072	.8434
Within 2 Years	.2677	.6151

5. Conclusion and Discussion

Our conclusion suggests that politicized tradeoffs between environmental policy and economic prosperity may be overstated in the electricity sector. Business owners and corporations often serve as major adversaries to the advancement of stringent environmental policy, this research suggests that the basis for this antagonization is not based in reality when considering RPS. Our data proves that there is no significant effect of RPS on stock price, yet I would assume that there is some impact on the internal culture and behavior of the utilities, which is an area for future exploration. For example, nearly every utility expressed a goal of carbon neutrality by 2050; how does RPS stringency affect the level of commitment or seriousness that companies treat these goals with? RPS policies are very unique and continue to grow in prominence, understanding their effect on the business world is pertinent, and looking at stock price is just one piece in a much larger puzzle.

The central conclusion drawn from this data is that companies in the energy industry can be successful in spite of stringent environmental policy. The Porter Hypothesis continues to be a hotly debated issue, this research would suggest that for IOUs, it may hold more merit than one would think. If findings like this continue to present themselves, a less polarized climate surrounding environmental policy is possible. If the economic consequences of stringent environmental policy are more mild than they are made out to be, more voters and politicians may support such policy, and IOUs may become more willing to lead industry wide efforts of renewable energy development. Hopefully, the findings of this study prompt broader and longer term findings which also support the Porter hypothesis and continue to investigate the true relationship between environmental policy and business.

While these findings are concentrated in the utility industry, they are highly applicable to the broader political climate surrounding the environment, which remains one of the most contentious and divisive topics in the current political sphere. Any and all instances of mutualism between environmental policy and business success should be viewed as a massive victory for the environmental movement. This research should foster hope and inquiry regarding the Porter hypothesis as it applies to other industries. Given that our scope was quite narrow, running similar tests in other industries in relation to different policies is certainly an area for future research, as the results of this study are not widely applicable, but accompanied with other similar studies they could be.

What once was a unifying force in the midst of a very divisive political space in the 1960s and 70s, with contention surrounding civil rights, anti war movements, and student power movement, is now one of many discussions sparking such strife (Dunlap, Xiao, McCright, 2010). Despite a scientific consensus regarding the existence and extremity of a looming climate crisis resulting from anthropogenic alterations to the atmosphere, even the most fundamental aspects of the issue have sparked intense discourse. The origin of this contention is political: a study conducted by the Pew Research Center displays a stark difference in opinions on the legitimacy of climate scientists based on political affiliation. Some of the most alarming findings of this particular study include only 9% of Conservative Republicans expressing the belief that "climate scientists' research findings are influenced by the best available scientific evidence most of the time", compared to 55% of Liberal Democrats, and a similar 18% to 68% difference between the two parties in regards to the question of if participants believe climate scientists "Understand very well whether climate change is occurring" (Pew Research Center, 2016). Of all forms of science denial climate science denial is the most coordinated, and well funded (Bjornberg et al., 2017), and almost always are attached to industry. Of the published literature written by climate science skeptics, a large percentage of those organized represent some sort of conservative establishment. One of the most significant contributors to literature about climate change skepticism is industry, most prominently representatives of oil and coal extraction operations, mining companies, and the automotive industry (Bjornberg et al., 2017). The culprits of promoting denial and skepticism identified by Bjornberg come as no surprise, as environmental policy tends to regulate and monitor these exact industries while promoting technology and science that will likely render them outdated in the future. Industry and politics are not separate, and their intersectionality promotes the narrative of anti-climate politics and climate change denial. Given the professional affiliation of many of these think tanks and publications as identified by Bjornberg et al, combatting the notion of certain conflict between environmental policy and financial success is essential in creating a more unified effort towards combating climate change. Our study does just that through the examination of investor owned utilities and their performance against the market in the face of environmental policy of varying stringency. Counter to what anti-climate activists and professionally affiliated think tanks promote, policy stringency had no effect on the financial performance of these IOUs. This research displays that within the private utility sector, coexistence of environmental stewardship and financial success is, at the very least, a strong possibility.

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