Pro-Carbon Policymaking in Renewable Portfolio Standards: An Empirical Assessment

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Abstract: Here, we develop and deploy a procedure to identify pro-carbon policymaking in state renewable portfolio standard (RPS) policy from 1983-2011. We then evaluate a battery of plausible theoretical explanations that could account for state-level adoption of pro-carbon RPS policy. We ultimately find substantial support linking pro-carbon RPS policy adoption to states with high coal production doing so proactively in order to protect that industry in the face of possible Obama administration electricity policy action; and we find possible (though less robust) support for the same explanation with respect to states with high natural gas production. One implication of our findings is that states might utilize policymaking to protect component industries of their electricity sectors given Biden administration electricity policymaking, and another implication is that states might utilize the same process to protect non-fossil fuel-based sources of carbon emissions.

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Introduction

Notwithstanding the recent passage of the Inflation Reduction Act, in the United States, policymaking spurring the promotion of renewables in the electricity sector has been a largely state government-driven affair (Parinandi 2020; and Parinandi 2023). Among the menu of policy tools that U.S. states have adopted with respect to renewables and electricity, the most well-known is arguably the renewable portfolio standard, or RPS (Rabe 2007; Carley and Miller 2012; and Carley, Nicholson-Crotty, and Miller 2017). RPSs generally function through establishing requirements that electricity providers (most notably though not always investor-owned utilities) procure some amount of the electricity they provide to consumers from renewable sources (Ibid). By ratcheting up the amount of renewable-derived electricity that is required to be supplied to consumers over time, RPSs have to some extent served as a catalyst for the utilization of renewable energy and the development of renewable energy technology in the United States (Greenstone and Nath 2019; and Stokes 2020).

In spite of their importance to American energy policy, however, RPSs have a key structural characteristic that is often overlooked by scholars as well as the public at large: the meaning of the word *renewable* is defined by state legislation. This means that each state with a RPS program defines the kinds of energy sources that count as renewable differently, with an implication being that some states are more creative (and generous) in their definition of renewable energy than others and allow for traditional fossil fuel-based sources such as coal to be considered as renewable. A second characteristic of these policies that is admittedly not unique to them but common to the renewable energy space generally is that not all traditional renewable energy sources are carbon-negative or even carbon-neutral: some traditional renewable energy sources have the potential to generate significant carbon emissions using lifecycle “cradle to grave” projections and only show carbon reduction when compared to using coal or in some cases, natural gas (United Nations 2021).

Both of these characteristics together create the possibility that some ostensibly “renewable” state policy interventions may be carbon-neutral or even carbon-positive in nature. However, aside from recent research looking at freezes and rollbacks in state RPS policy (Stokes 2020), much extant work on RPS adoption and implementation assumes that policymaking in this area is compatible with goals to reduce carbon emissions and mitigate impacts from climate change (Hughes and Lipscy 2013). Empirically disentangling when states adopt RPS policy that is carbon-neutral or even carbon-positive is valuable insofar as it allows us to identify when states embrace definitions of renewable that may fall far from the mark of popular conceptions (and politician pronouncements) concerning renewable energy policy commitments. This topic is also important since it builds knowledge on variation in state policymaking in energy policy and looks at how the policy experimentation inherent in decentralization, an area of current academic interest (Grumbach 2022), can spur heterogeneity in policy content even when a family of policies (such as the RPSs of different states) purportedly share a similar motivation. Lastly, given possible attempts at federalization in this area and given that the federal government often uses state policymaking as a template for its own action (McCann et al 2015; and Shipan and Volden 2021), learning about pro-carbon RPS policymaking in the U.S. states could serve as a window into potential future federal renewable energy policy efforts.

In this paper, we leverage recent policy adoption data on policy features or provisions that were incorporated into U.S. state RPS programs between 1983 and 2011 (Parinandi 2020; and Parinandi 2023) to identify and code state RPS policy feature adoptions as being pro-carbon using two definitions of pro-carbon policymaking that differ in their level of restrictiveness. We then employ pooled event history analysis regression (Hinkle 2015; Kreitzer and Boehmke 2016; and Mallinson 2021) to interrogate various explanations into why state governments might adopt carbon friendly provisions into their RPS programs. Our objective here is focused on empirically examining possible extant theories and giving readers a balance sheet of which of these have evidentiary support; a benefit of doing this is that we are able to provide a service that other energy and environmental scholars can utilize to inform their own research into energy source heterogeneity in renewable energy policymaking, and at a minimum, we hope to draw attention to the fact that RPSs are far from uniform from the vantage point of being comprised of policy dedicated to carbon reduction.

Our analysis yields a key result. Using the expansive and restrictive definitions of pro-carbon policy, we find evidence linking the importance of coal and natural gas production within a state to an increased probability of that state adopting pro-carbon RPS policy stipulations. This result sits squarely in line with expectations gleaned from the interest group (Olson 1971; Dahl 1972; and Crosson, Furnas, and Lorenz 2020) and regulation (Stigler 1971; and Carpenter and Moss 2014) literatures about policymaking being written and codified to safeguard entrenched industries and moreover provides clear evidence of states trying to influence future national policy choices through state-level policy action. The significant findings with respect to coal and natural gas production but not petroleum production also make sense given that coal and natural gas are utilized heavily in the electricity sector while petroleum is more important to the transportation sector. A takeaway of the paper, given newfound federal efforts to write electricity policy through the Inflation Reduction Act (Bistline et al 2023), is that the states may continue to sculpt their renewable energy policies strategically in hopes of steering federal electricity and energy policy. A second takeaway, given that certain sources within the renewable industry (such as landfill gas and wood-based biomass) are carbon intensive and given the current integration of the electricity and transportation sectors, is that one might imagine state-level policymakers utilizing state action to protect new industries (such as wood biomass and petroleum) if the zone of renewable energy policy contestation shifts from being organized around renewables versus fossil fuels to being organized around carbon reduction versus increase (Schattschneider 1960). In the rest of the paper, we review extant work on this issue; go over our method for categorizing RPS policy as being pro-carbon in character; discuss our results; and end with major points moving forward.

Extant Research on RPS Policy Adoption

The advent of RPSs as an instrument to foster increased utilization of renewable energy marked a sea change in U.S. energy policy, which had been mostly silent to date on the question of directly influencing transition from fossil fuels to renewables in the electricity sector through policy (Allison and Parinandi 2020).[2] The first prototype of an RPS was Iowa's Alternative Energy Law, which mandated that the state's investor-owned utilities procure some electricity from renewable sources (North Carolina Clean Energy Technology Center 2023; and Parinandi 2023). Since that time, RPSs—which have historically been defensible since they indirectly affect ordinary ratepayers (or "consumer-voters," using the parlance of the political economy of energy literature) and place the costs of compliance on utility companies that typically interact with ordinary ratepayers through billing processes and power outages (Lyon 2016)—have been

[2] Although there were attempts to foster increased renewable energy use through policymaking in the 1970s, much of that effort was focused on the transportation rather than electricity sector (Allison and Parinandi 2020).

adopted by dozens of U.S. states and have been adopted across states that are diverse with respect to ideology, nature of economic activity, region, and size (Carley, Nicholson-Crotty, and Miller 2017). Since RPSs have also emerged as one of the premier tools to spur renewable development in the American electricity sector, they have also received considerable attention from the scholarly community. Scholars, for example, have evaluated the determinants of regulatory stringency in terms of how aggressively a state moves to larger renewable electricity sourcing (Carley and Miller 2012), the drivers of adopting RPS policy at macro (Lyon and Yin 2010) as well as micro (Parinandi 2020; Parinandi, Langehennig, and Trautmann 2021; and Parinandi 2023) levels; and how renewable energy policy has developed in a comparative context (Aklin and Urpelainen 2018).

Scholarship has also increasingly analyzed heterogeneity in the RPS space, both in terms of the ideological makeup of adopting governments (Thombs and Jorgenson 2020) and potential divergence in content across governments. Hess et al (2016) demonstrate that politically conservative states are more receptive to certain kinds of renewable policy interventions (those emphasizing fewer requirements and less regulation) over others. Stokes (2020) perhaps goes the furthest to account for heterogeneity in content in the RPS space and details attempts to freeze and even reverse RPS laws; Stokes also describes how the naming of RPS laws in certain states (such as Ohio's use of the phrase "Advanced Energy Portfolio Standard") captures an intent to pivot from traditional renewable energy policy (Ibid; and Romich 2010).

Nonetheless, while existing research has documented heterogeneity in RPS policymaking and even addressed the possibility of pro-carbon policymaking being incorporated into RPS programs, existing research has not (1) identified and isolated the universe of pro-carbon policy features or provisions within the pantheon of state RPS programs nor has it (2) evaluated the factors that correspond with adoption of pro-carbon RPS policy features or provisions. Pursuing these two goals is helpful so that we can capture the broad swath of RPS policymaking that has occurred in a pro-carbon direction and thereby better understand the full scope of policy experimentation that has happened in the RPS space (Callander and Hummel 2014; Callander and Harstad 2015; Parinandi 2020; and Parinandi 2023); and pursuing these goals is helpful so that we can better understand when states may adopt pro-carbon policy in RPS, which might help us discern future conflicts in the political economy of policymaking in the RPS space as well as future attempts to influence federal electricity policy. To these ends, we apply standard event history techniques used in the study of adoption (Berry and Berry 1990; Boushey 2016; and several others) to analyze the adoption of pro-carbon policy within RPS using two definitions of pro-carbon policymaking. Here, we draw from the RPS policy feature adoption dataset used in Parinandi (2020) and Parinandi (2023). Given that our objective is empirical evaluation of possible theories rather than the explicit development of a core theoretical argument, we next discuss our coding procedure and construction of our pro-carbon policy adoption dataset before describing how this dataset will be employed in the service of investigating various theoretical propositions.

Identifying Pro-Carbon Policymaking and Constructing the Adoption Dataset

In order to identify pro-carbon policy adoption in RPS programs, it is important to first have access to comprehensive data tracking the adoption of different RPS policy features or provisions across the states. Parinandi (2023) has already gathered this data in research exploring the institutional factors motivating U.S. state-level invention and borrowing of RPS policy. This data, gathered from 1983 (when Iowa adopted the first prototypes of what would eventually be regarded as RPS policy) through 2011 (when the diffusion wave of RPS policymaking across the states had largely abated and the conversation about RPSs turned to nationalization among advocates and elimination among opponents), breaks down RPS policy adoption into its sub-policy (sometimes referred to as policy features or provisions) components and studies the adoption of these sub-policies.[3] One of the largest groupings of RPS sub-policies relates to the energy sources and technologies that a given state considers to be renewable. The decision of what is considered renewable energy is typically made through legislation (and to a lesser extent, public utilities commission rulemaking) and is incredibly important within the context of RPS policy as the entities regulated under a RPS program (typically but not exclusively investor-owned utilities) can meet RPS obligations through procuring electricity from sources and technologies defined as renewable.

In this paper, we restrict our attention to sub-policies from that dataset used in Parinandi (2023) that relate to what sources and technologies are considered to be renewable in state RPS programs. Having extracted these sub-policy adoptions, we then use a classification process to determine whether a given eligible renewable source or technology is pro-carbon or not, and we do this twice utilizing different levels of restrictiveness in defining pro-carbon policy. Our first (and less restrictive/more expansive) definition of pro-carbon policy is based on the idea that several different energy sources and technologies have the potential to create carbon emissions.

[3] The logic of analyzing sub-policies is that a policy consists of a collection of sub-policies that work together to make up the policy. Since diversity in RPS policymaking is more easily captured at the sub-policy level, treating sub-policies as the unit of analysis appropriately facilitates the examination of policy differentiation within RPS (Parinandi 2020; and 2023).

This is obviously true with respect to the fossil fuel family of energy sources (coal, natural gas, and petroleum) but is also a possibility with respect to sources that may fall under the rubric of traditional renewable energy but produce carbon emissions. The gas produced from decomposition in landfills, for example, heavily consists of methane and carbon dioxide and is often turned into electricity through conversion into usable natural gas, suggesting that landfill gas could be considered a pro-carbon RPS policy choice (Larney et al 2006; and Eberle et al 2020). Another common RPS policy choice, combined heat and power or cogeneration, uses the same energy source to produce electricity and heat but is often agnostic as to what the feedstock energy source should be, suggesting that combined heat and power *could* be pro-carbon in nature (Kalam et al 2012). Other RPS policy choices, like the inclusion of waste tires or tire-derived fuel as renewable energy, are also potentially problematic from a carbon reduction perspective as tires are sometimes converted into crude oil, which releases carbon dioxide when burned (Zerin et al 2023).

Even biomass, which arguably is a key energy source that comes to mind when the public thinks of renewable energy, has the potential to produce significant carbon emissions. The argument for the carbon neutrality of biomass rests on the idea that the carbon emissions created from the burning of biomass are canceled out by the carbon that was consumed by biomass plants via photosynthesis (Abbasi and Abbasi 2010).[4] Although it is generally accepted that biomass has the potential to be carbon neutral, this is not automatically the case. The burning of

[4] This is in stark contrast, as Abbasi and Abbasi (2010) point out, to fossil fuels, where carbon was consumed via photosynthesis millions of years ago but is being burned to raise carbon emissions in the present day.

wood, for example, has the potential to increase carbon emissions (Zanachi et al 2012); moreover, some possible feedstock plants are naturally high in hydrocarbon content (Abbasi and Abbasi 2010). These two points do not even take into account the possibility that the clearing of forests to create land for biomass utilization has the potential to increase carbon emissions in the near term (National Renewable Energy Laboratory 2024).

The above discussion is to say that even energy sources considered as renewable have the capacity to be pro-carbon in nature. A clear cut way to identify pro-carbon policymaking arguably does not exist and is challenging, but in this paper we include three kinds of sub-policies within the pro-carbon moniker in our less restrictive definition of pro-carbon policy: (a) energy sources and technologies that traditionally fall under the rubric of being considered fossil fuels (such as coal-derived energy sources); (b) energy technologies that can be harnessed through the use of fossil fuels (such as combined heat and power or cogeneration); and (c) energy sources and technologies that have the potential to produce carbon emissions during burning (landfill gas and biomass-derived sources). For the more restrictive definition of pro-carbon policy, we include fossil fuels and technologies that can be operated using fossil fuels within the pro-carbon designation. Table 1 displays RPS energy sources and technologies considered to be pro-carbon using both definitions of pro-carbon policy.

<TABLE 1 ABOUT HERE>

As can be seen from table 1, the more expansive definition of pro-carbon policy adoptions includes biomass derivatives while the more restrictive definition revolves around explicitly fossil fuel-derived sources. The names of the sub-policies follow from the procedure used in Parinandi (2020; and 2023) to identify synonyms in RPS sub-policy (where states A and B can include the same sources as eligible sources within their respective RPS programs but give those sources different names); interested readers should consult Parinandi (2020; and 2023) for details on the synonym identification process. Although there is a debate about the carbon producing potential of hydropower (as Almeida et al 2019 explain, emissions stem from the breakdown of organic material within reservoirs), adjustments to the design of hydroelectric dams can dramatically reduce carbon production (Ibid); therefore, we do not consider hydropower to be pro-carbon under either definition of pro-carbon policymaking. We similarly do not consider other traditionally renewable energy sources (such as solar or wind) to be pro-carbon under either definition due to the very low amounts of carbon produced from these sources using life cycle calculations (United Nations 2021); the energy sources and technologies coded as pro-carbon, on the other hand, have the potential to produce carbon at levels similar to conventional fossil fuels (or in the case of when fossil fuel sources are outright incorporated into RPS programs, the energy sources and technologies are fossil fuels).

Given that we know (from Parinandi 2020; and 2023) when and where various state-level RPS sub-policies have been adopted during the 1983-2011 timespan, we employ pooled event history analysis (the pooling here refers to combining different pro-carbon RPS policy adoptions into a single dataset; since we utilize two different operationalizations of pro-carbon policy adoption, we construct two pro-carbon policy adoption datasets) to evaluate factors motivating states to adopt pro-carbon RPS policy. In keeping with modeling choices in previous work (Parinandi 2020; and Parinandi 2023), a state has the opportunity to adopt any of the pro-carbon RPS policies in 1983, corresponding to when Iowa adopted the first RPS prototype (the assumption here is that pro-carbon RPS policy choices were possible from that time onward). A state loses the opportunity to adopt a pro-carbon policy once it has adopted that policy. Since a given RPS program is a collection of sub-policies (Ibid), we do not employ a multi-stage adoption setup and instead treat RPS construction as a single-stage process where the adoption of sub-policies dictates the construction of the RPS program (this is the opposite of a hypothetical process where a state government may decide to adopt a RPS program prior to determining the composition of that program). Our decision to treat RPS construction as a single-stage process mirrors the way that RPS construction is characterized in state legislative and rulemaking documents (Ibid). In the next section, we delve into possible theoretical reasons for the adoption of pro-carbon RPS policy before presenting empirical results.

Possible Theoretical Motives and Empirical Results

Literature in political science and public choice gives us several reasons why state governments may wish to incorporate pro-carbon policies within their RPS programs. Business interests often use codification into law as a means to preserve their market position and limit the ability of alternative suppliers to gain a foothold in an industry (Stigler 1971; Demsetz 1982; and Kiesling 2014). Given the historical primacy of fossil fuels within the U.S. electricity sector, it is possible that fossil fuel interests sought to incorporate fossil fuel sources within RPS programs to protect these sources from competition via true renewable sources; if this is the case, we might see evidence of states with stronger fossil fuel interests advocating for the inclusion of fossil fuel sources within RPS programs. At the same time, states often adopt policy in anticipation of future federal policy efforts in hopes of influencing those efforts (McCann et al 2015). The Obama administration, which assumed office in 2009, embraced a clean energy agenda to a degree not witnessed by previous administrations and discussed a national energy policy for the electricity sector that would become the cornerstone for the clean power plan (Davis et al 2016; and Obama 2017). We would not expect that every state would be worried about the clean power plan; Hawaii, which has nearly no fossil fuel production presence, would probably welcome the

Obama administration's clean energy attempts. States with a significant fossil fuel production presence, however, may choose to try to water down possible federal electricity policy through including fossil fuel sources within their RPS programs in hopes to change the federal-level narrative about what policy choices are permissible within a national electricity policy. If this behavior were to occur, we believe that states with substantial coal production would be most keen to incorporate coal-based sources into state RPS programs so as to attempt to introduce coal energy to the conversation about a national renewable energy electricity policy; our rationale here is that coal historically has been the most utilized source in the U.S. electricity sector (Allison and Parinandi 2020) and also is regarded as the biggest offender from a carbon emissions perspective, suggesting that the coal industry might have the most to lose in the event that a national electricity policy develops in which it does not play a key role.

Some observers might think that the coal industry would unconditionally oppose RPS programs, but we do not think this view is entirely accurate. First, the adoption of pro-carbon (and specifically coal-based) energy sources within a number of state-level RPS programs (e.g., Pennsylvania and Michigan, for example) suggests that the coal industry employed a strategy of cooption in some instances, as a strategy of unconditional opposition would necessitate that no state-level RPS program contained coal-based energy sources under its list of eligible renewable sources. Second—and relatedly to the first reason—the successful election of a candidate such as Obama (who made clean energy and the climate key planks of his platform) may have spurred some within the coal industry (and its political allies) to view cooption as a worthwhile strategy.

We are torn on how partisan preferences should relate to pro-carbon RPS policy adoption. While some scholars (Lyon and Yin 2010) have linked Democratic affiliation among policymakers to an increased likelihood of RPS program enactment, those scholars do not identify and isolate pro-carbon policy, which may have more support across political parties. Furthermore, during the timespan analyzed (1983-2010), the parties had not yet sorted themselves with respect to the issue of renewable energy; there were Republicans (such as Mike Bost of Illinois) who advocated for RPS programs and Democrats (such as West Virginia's Joe Manchin, who served as governor of that state during part of the study's timespan) who sought to advance the interests of fossil fuels (Illinois General Assembly 2001). Therefore, we are agnostic as to how partisan control of state government influenced pro-carbon RPS policy adoption during the study period.

In terms of the ideological makeup of state government, we are similarly flummoxed. Parinandi (2020; and 2023) finds that the greater liberalness of a state legislature increases its probability of being a first adopter (or "inventor") of RPS policy. However, this finding was based on a dataset of RPS policy adoptions where pro-carbon sub-policies were in the clear minority of the universe of RPS sub-policies adopted across the system of U.S. states. Moreover, in the same research, Parinandi (2020; and 2023) shows that the borrowing (or later adoption) of RPS sub-policies occurs among an ideologically broad set of states; here again the finding comes from a dataset where pro-carbon sub-policies are in the clear minority of adopted RPS sub-policies. If adopting non-carbon-based RPS sub-policies is accessible to a swath of ideologically diverse states, adopting pro-carbon RPS sub-policies might be similarly accessible. Here, however, we remain agnostic since analogous to partisan sorting with respect to renewable energy, ideological sorting with respect to renewables arguably did not occur until after the study period, as states such as Texas and Arizona (conservative during the study period) were pioneers in the development of RPS policy.

Other factors might also relate to the adoption of pro-carbon RPS policy. The impact of deregulation on RPS development is still under debate (Kim, Yang, and Urpelainen 2016), although some scholars (Lyon and Yin 2010) argue that electricity market deregulation increases the likelihood of RPS policy adoption. If this is the case, market deregulation may spur the adoption of pro-carbon RPS policy. At the same time, vertically integrated electric utility companies in states without deregulation may better be able to use their influence to get pro-carbon RPS stipulations passed into law. Lastly, factors related to state wealth might influence the adoption of pro-carbon RPS policy, as poorer and less resourced states might be more likely to adopt pro-carbon RPS policy due to concerns about their residents being able to subsidize a transition to a more renewables dominated (using a traditional definition of the word renewables) electricity sector (Farrell and Lyons 2015; and Knapp et al 2020).

In order to evaluate the theoretical possibilities outlined in this section, we utilize pooled event history analysis on our two operationalizations of pro-carbon RPS policy adoption. The first and less restrictive dependent variable, ***Expansive Pro-Carbon Adoption***, is a binary variable that receives a value of 1 if a state adopts a RPS policy designated as being pro-carbon according to the less restrictive definition in year *t* and 0 otherwise. The second and more restrictive dependent variable, ***Restrictive Pro-Carbon Adoption***, is a binary variable that receives a value of 1 if a state adopts a RPS policy designated as being pro-carbon according to the more restrictive definition in year *t* and 0 otherwise. We follow convention within event history analysis and eliminate the opportunity to adopt a particular pro-carbon policy for a state once that state has adopted that policy (Box-Steffensmeier and Jones 2004). The first dependent variable, *Expansive Pro-Carbon Adoption*, has 22,310 observations with 150 adoptions while the second dependent variable, *Restrictive Pro-Carbon Adoption*, has 22,310 observations with 44 adoptions. We record each dependent variable from 1983 to 2011, implying that the usual right censoring occurs in every instance where a pro-carbon RPS policy has not been adopted by a state as of 2011; we believe left censoring is not a threat since begin observation the very first year the first prototype of a state RPS was adopted.

We capture fossil fuel interests with ***Percent of Coal Production***, ***Percent of Natural Gas Production***, and ***Percent of Petroleum Production*** variables. These figures, taken from the U.S. Energy Information Administration (U.S. Energy Information Administration 2013), capture the percentage of energy produced in a given state in year *t* that comes from the particular indicated source (coal, natural gas, and petroleum in each of these three respective variables) and express the importance of a given energy sector to a given state. We capture influence of the Obama administration from a binary ***Obama*** variable that takes a value of 1 during the years in which the Obama administration was in office and 0 otherwise. We also construct and include interaction variables between the Obama administration variable and each of the fossil fuel production variables.

We account for state partisan preferences with a ***Unified Democratic Government*** variable that takes a value of 1 if a state's government is under Democratic Party control in year *t* and 0 otherwise. We account for the ideological makeup of a state's government with a ***Government Ideology*** variable that comes from Berry et al (1998) and captures a state's governmental ideological makeup on a 0-100 scale where 0 denotes pure conservatism and 100 denotes pure liberalism. Additionally, we include a binary variable (termed ***Deregulated***) from Delmas et al (2007) denoting whether a state has a deregulated electricity sector in year *t* or not; we also include a ***State Per Capita Income*** variable capturing a state's per capita income in year *t*. This variable is scaled and expressed as a percentage of the federal per capita income baseline where the federal value is set to 100).

We include several controls in our analysis. These include whether a state has a ***Ballot Initiative*** process in year *t*; the percentage of a state's population that is ***Urban*** in year *t* (Walker 1969); a state's ***Change in Unemployment*** between years *t* and *t-1* (Parinandi 2020; and Parinandi 2023); a state's ***Citizen Ideology*** taken from Berry et al (1998) and measured analogously to the government ideology variable; a state's level of ***Legislative Professionalism*** taken from Squire (2007); whether a state has enacted ***Legislative Term Limits*** (Kousser 2005); a state's ***Real Energy Price*** in 2011 dollars per million British thermal units (U.S. Energy Information Administration 2013; Parinandi 2020; and Parinandi 2023) and whether a ***Democratic President*** is in office (to distinguish the effect of Democratic presidential administration generally from that of Obama's administration).

We lastly include variables to capture spatial and temporal influences on pro-carbon RPS policy adoption. ***Yearcount*** is a variable measuring the linear passage of time through the study period. ***Lagpolicy*** records the fraction of pro-carbon RPS policies adoptions to date that have been adopted in a given state as of year *t-1*. ***Geopolicy*** records the fraction of pro-carbon RPS policy adoptions to date that have been adopted in geographical neighbors of a given state as of year *t-1*; and ***Ideopolicy*** records the fraction of pro-carbon RPS policy adoptions that have been adopted in ideological neighbors (based on government ideology) of a given state as of year *t-1*. In our models, we utilize logistic regression with standard errors clustered at the state level.

Results

<TABLE 2 ABOUT HERE>

Table 2 displays empirical results. In models 1 and 2, we display estimation results from using the *Expansive Pro-Carbon Adoption* variable while in models 3 and 4, we display estimation results from using the *Restrictive Pro-Carbon Adoption* variable. We do not display results for the linear year or lagged adoption variables due to space limitations. Results indicate substantial support for the idea that states with a high degree of fossil fuel production were more likely to adopt pro-carbon RPS policy during the years of the Obama administration compared to outside this period. A plausible interpretation for this result is that states with large fossil fuel production sectors perceived possible federal-level renewable energy action in the electricity sector coming from the Obama administration and adopted pro-carbon RPS stipulations in their own states, both to protect the fossil fuel industry at the state-level and create a claim that fossil fuels should be considered to be renewables in the event of the passage of a federal electricity policy espousing renewable energy targets.

What is also noteworthy about these results is that the magnitudes of the interaction variables are theoretically consistent with the importance of each fossil fuel source type to the electricity sector. Coal is historically the most utilized fossil fuel source in the U.S. electricity sector (Allison and Parinandi 2020) and also the dirtiest fossil fuel source from a carbon emissions perspective (United Nations 2021); therefore, we should perhaps expect that state-level officials would try the hardest to protect the coal industry through policymaking action. Natural gas is also a commonly used fossil fuel source in the electricity sector though less dirty than coal (Ibid). Therefore, it is perhaps unsurprising that state policymakers would still aim to protect this source and also perhaps unsurprising that magnitudes are slightly lower than with coal (potentially owing to less dirtiness being associated with natural gas). Lastly, the non-significance of petroleum makes sense given that petroleum is more relevant to the transportation sector than the electricity sector. However, the potential integration of the electricity and transportation sectors based on increased usage of electric vehicles (Kannan and Hirschberg 2016) might create opportunities for future protective state policymaking in the future.

It helps to visualize possible probabilities; in figure 1, we display how the influence of a state's coal production on pro-carbon adoption changes depending on the Obama administration being in office; in this visualization, we keep continuous variables at their sample means and binary variables at their most common values except for the Democratic presidential administration variable, which we keep at 1 so that the presence or absence of the Obama administration variable is compared to a baseline of a Democratic presidential administration being in office.

<FIGURE 1 ABOUT HERE>

Figure 1 displays the influence of state percent coal production level on the probability of adopting pro-carbon RPS policy during the Obama administration compared to the time outside Obama's administration. When Obama was not in office, increases in state percent coal production level do not appear to increase a state's probability of adopting pro-carbon RPS policy. However, when Obama is in office, notice a sharp divergence in the influence of percent coal production on pro-carbon RPS policy adoption starting around 50-60 percent.[5] A plausible

[5] Although the point predictions on the plot are non-significant, this is perhaps to be expected given that (1) there are only three states (Indiana, Kentucky, and West Virginia) have coal production percentages greater than 80; (2) only two of these three states (Indiana and West Virginia) adopted pro-carbon RPS policies; and (3) the Obama administration timespan only coincides with three years of the twenty-nine years in the dataset. Nonetheless, a post-estimation

implication is that perception of attempts to promulgate federal renewable energy electricity among states with large coal production sectors could motivate these states to adopt pro-carbon RPS policy regimes in hopes of protecting their coal industries.

<FIGURE 2>

In figure 2, we conduct an analogous visualization to that of figure 1 except we look at a state's percentage of natural gas production instead of coal. Here, there is a similar divergence in slopes based on whether (or not) the Obama administration is in office. The x-axis spans to 80 since only two states (Louisiana and Oklahoma) have natural gas production percentages in the study period than exceed 80 percent. Unlike in the case of percent coal production, a post-estimation test of the marginal effect of the Obama administration on pro-carbon RPS policy adoption as a function of state natural gas production percentage is positive but slightly non-significant at a level of 0.139. While some readers might interpret this result as implying that the influence of natural gas production on pro-carbon RPS adoption is not influenced by the Obama administration being in office, we believe that closeness to significance suggests that the influence of natural gas production is activated by the Obama administration being in office, albeit to a lesser extent than the influence of coal production.

Robustness

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test of the marginal effect of the Obama administration on pro-carbon RPS policy adoption as a function of state coal production percentage is positive and significant at a level of 0.053, suggesting that the Obama administration binary variable activates state coal production percentage with respect to pro-carbon RPS policy adoption (Kam and Franzese 2007).

We include robustness checks. Table 3 displays results from table 2 with the inclusion of year effects. Here, we omit the linear year variable since the year effects collectively capture the influence of time.

<TABLE 3 ABOUT HERE>

As readers can see from table 3, key results of the paper are robust to the inclusion of year effects.

<TABLE 4 ABOUT HERE>

Table 4 displays results from table 2 with the inclusion of state effects. Here, we include the linear year variable in the regression equation. We only show expansive pro-carbon adoption results since we are unable to estimate a restrictive pro-carbon model with interactions (analogous to that shown in table 2) due to concavity issues during estimation. Note that results retain robustness with respect to the interaction variables. Lastly, in table 5, we display results for the expansive pro-carbon adoption models and again find consistent results for the interaction terms (concavity issues again prevent the estimation of the restrictive models). In sum, results demonstrating a greater likelihood of pro-carbon RPS adoption with respect to coal and natural gas during the Obama administration generally hold.

<TABLE 5 ABOUT HERE>

Conclusion

In this paper, we undertake an important objective: we establish a procedure of identifying pro-carbon policymaking in U.S. state RPS policies, and we then evaluate factors motivating the adoption of such policies with an eye toward determining support for possible theoretical explanations. We ultimately find support for an explanation that has roots in the political economy of federalism (Shipan and Volden 2006; and McCann et al 2015): that policy often percolates upward in a federal system, and that the states might adopt regulatory policies with a goal of protecting their industries in the event of possible federal regulatory action. Applied to the area of renewable energy policy, a subset of states with key fossil fuel sectors arguably anticipated possible Obama administration action on a national renewable energy electricity policy and sought to protect their own fossil fuel industries (definitely at the state-level and aspirationally at the federal-level) by including pro-carbon sources within the aegis of RPS policy. A current ramification of this study is that we should perhaps expect similar policymaking attempts in the present day, as the Biden administration has made forays into electricity policy with the Inflation Reduction Act. Another possible ramification of the study relates to the idea that fossil fuel sources are not the only sources with potential to produce carbon (Zanachi et al 2012; and Zerin et al 2023). As the debate over renewable energy policy development in the United States shifts from fossil fuels versus other sources to carbon generating versus non-generating sources, we might expect states to employ similar strategies to protect their carbon producing non-fossil fuel industries. Future research should unpack this possibility further.

Table 1: Sub-policies Designated as Pro-Carbon

Expansive Definition	*Restrictive Definition*
Biomass/Densified Fuel Pellets/Synthetic Gas	CHP/Cogeneration
Biomass Thermal	Co-Firing
CHP/Cogeneration	Coal Bed Methane
Co-Firing	Clean Coal/Coal Technology/Carbon Capture and Storage/Gasification/Coal Gasification
Coal Bed Methane	Coal Mine Methane
Clean Coal/Coal Technology/Carbon Capture and Storage/Gasification/Coal Gasification	Municipal Solid Waste/Energy from Waste/Energy Recovery Processes
Coal Mine Methane	Natural Gas
Electricity from Waste Heat/Waste Heat/Recycled Energy	Waste Coal
Fuel Cells using Renewable Fuels/Renewable Fuels/Biodiesel/Ethanol/Methanol	Tire-derived Fuel/Waste Tires
Landfill Gas/Anaerobic Digestion/Biogas	
Microturbines	
Municipal Solid Waste/Energy from Waste/Energy Recovery Processes	
Natural Gas	
Other Distributed Generation Technologies	
Waste Coal	
Tire-derived Fuel/Waste Tires	

Table 2: Estimation Results for the Adoption of Pro-Carbon RPS Policy

Variable	Expansive Adoption	Expansive Adoption	Restrictive Adoption	Restrictive Adoption
Percent of Coal Production	0.009 (0.005)	0.000 (0.007)	0.016*** (0.006)	0.003 (0.008)
Percent of Natural Gas Production	0.003 (0.010)	-0.003 (0.014)	-0.005 (0.006)	-0.016 (0.022)
Percent of Petroleum Production	-0.014 (0.011)	-0.010 (0.010)	-0.027 (0.018)	-0.019 (0.017)
Obama	-1.750* (0.936)	-3.800*** (0.850)	-0.940 (1.364)	-3.731** (1.830)
Percent of Coal Production*Obama		0.049*** (0.015)		0.058*** (0.022)
Percent of Natural Gas Production*Obama		0.039** (0.018)		0.050** (0.024)
Percent of Petroleum Production*Obama		-0.004 (0.024)		-0.027 (0.068)
Unified Democratic Government	-0.338 (0.474)	-0.032 (0.519)	-0.758 (0.650)	-0.336 (0.732)
Government Ideology	0.006 (0.009)	-0.000 (0.019)	0.011 (0.012)	0.002 (0.013)
Deregulated	0.000 (0.327)	0.213 (0.338)	-0.377 (0.577)	-0.120 (0.531)
State Per Capita Income	0.023* (0.014)	0.022 (0.015)	0.004 (0.023)	0.001 (0.027)
Ballot Initiative	0.274 (0.508)	0.247 (0.538)	-0.171 (0.634)	-0.168 (0.703)
Urban	0.017 (0.016)	0.018 (0.017)	0.029 (0.022)	0.035 (0.023)
Change in Unemployment	-0.044 (0.254)	-0.122 (0.193)	0.008 (0.255)	-0.078 (0.195)
Citizen Ideology	0.056*** (0.016)	0.067*** (0.018)	0.050** (0.023)	0.066** (0.029)
Legislative Professionalism	1.302 (1.758)	1.140 (1.887)	1.939 (2.007)	1.802 (2.360)
Legislative Term Limits	0.568 (0.602)	0.620 (0.637)	0.973 (0.867)	1.105 (1.002)
Democratic President	0.559 (0.627)	0.479 (0.617)	0.149 (0.943)	0.123 (0.935)
Real Energy Price	-0.126 (0.080)	-0.122 (0.083)	-0.151 (0.096)	-0.156 (0.106)
Observations	22310 (150)	22310 (150)	22310 (44)	22310 (44)

***critical value at 0.01 threshold; **critical value at 0.05 threshold; and ***critical value at 0.10 threshold.

Table 3: Estimation Results Including Year Effects

Variable	Expansive Adoption	Expansive Adoption	Restrictive Adoption	Restrictive Adoption
Percent of Coal Production	0.010* (0.006)	0.001 (0.007)	0.016** (0.007)	0.001 (0.007)
Percent of Natural Gas Production	0.002 (0.010)	-0.004 (0.012)	-0.005 (0.014)	-0.017 (0.018)
Percent of Petroleum Production	-0.012 (0.010)	-0.008 (0.010)	-0.026 (0.018)	-0.018 (0.015)
Obama	2.464 (1.668)	0.217 (1.770)	2.806 (1.964)	-0.280 (2.427)
Percent of Coal Production*Obama		0.048*** (0.014)		0.060*** (0.022)
Percent of Natural Gas Production*Obama		0.041** (0.017)		0.057** (0.023)
Percent of Petroleum Production*Obama		-0.008 (0.025)		-0.053 (0.079)
Unified Democratic Government	-0.283 (0.443)	0.043 (0.492)	-0.583 (0.586)	-0.119 (0.644)
Government Ideology	0.006 (0.009)	-0.001 (0.009)	0.009 (0.013)	-0.001 (0.013)
Deregulated	0.104 (0.320)	0.340 (0.335)	-0.118 (0.535)	0.256 (0.559)
State Per Capita Income	0.016 (0.013)	0.014 (0.014)	-0.004 (0.023)	-0.010 (0.026)
Ballot Initiative	0.270 (0.494)	0.237 (0.523)	-0.235 (0.599)	-0.217 (0.624)
Urban	0.015 (0.015)	0.016 (0.016)	0.030 (0.023)	0.037 (0.024)
Change in Unemployment	-0.169 (0.347)	-0.329 (0.282)	-0.282 (0.368)	-0.512 (0.318)
Citizen Ideology	0.045*** (0.016)	0.056*** (0.017)	0.039 (0.024)	0.053* (0.027)
Legislative Professionalism	1.249 (1.718)	1.100 (1.870)	1.669 (1.957)	1.444 (2.321)
Legislative Term Limits	0.539 (0.571)	0.586 (0.606)	0.884 (0.787)	0.985 (0.864)
Democratic President	-2.955** (1.498)	-3.078** (1.394)	-3.566 (1.809)	-3.846*** (1.446)
Real Energy Price	-0.044 (0.103)	-0.036 (0.100)	-0.095 (0.125)	-0.088 (0.113)
Observations	11912 (150)	11912 (150)	8809 (44)	8809 (44)

***critical value at 0.01 threshold; **critical value at 0.05 threshold; and ***critical value at 0.10 threshold.

Table 4: Estimation Results Including State Effects

Variable	Expansive Adoption	Expansive Adoption
Percent of Coal Production	-0.315*** (0.098)	-0.390*** (0.110)
Percent of Natural Gas Production	-0.170 (0.108)	-0.414*** (0.118)
Percent of Petroleum Production	-0.213* (0.114)	-0.216 (0.173)
Obama	-3.137** (1.491)	-7.230*** (2.123)
Percent of Coal Production*Obama		0.109*** (0.021)
Percent of Natural Gas Production*Obama		0.079*** (0.024)
Percent of Petroleum Production*Obama		-0.075 (0.080)
Unified Democratic Government	-0.836 (0.811)	-0.730 (0.920)
Government Ideology	0.013 (0.013)	0.011 (0.016)
Deregulated	0.340 (0.759)	0.882 (0.624)
State Per Capita Income	0.071 (0.055)	0.073 (0.067)
Ballot Initiative	3.904 (6.243)	-1.634 (6.657)
Urban	-0.163* (0.096)	-0.144 (0.091)
Change in Unemployment	0.046 (0.311)	-0.323 (0.213)
Citizen Ideology	0.018 (0.032)	0.013 (0.036)
Legislative Professionalism	1.159 (4.286)	-12.296* (6.554)
Legislative Term Limits	-1.196 (0.870)	-1.146 (0.990)
Democratic President	-0.283 (0.384)	-0.802 (1.009)
Real Energy Price	-0.409** (0.200)	-0.597*** (0.228)
Observations	16278 (150)	16278 (150)

***critical value at 0.01 threshold; **critical value at 0.05 threshold; and ***critical value at 0.10 threshold.

Table 5: Estimation Results Including State and Year Effects

Variable	Expansive Adoption	Expansive Adoption
Percent of Coal Production	-0.337*** (0.102)	-0.422*** (0.109)
Percent of Natural Gas Production	-0.213* (0.111)	-0.469*** (0.162)
Percent of Petroleum Production	-0.231* (0.120)	-0.217 (0.174)
Obama	5.050 (3.708)	5.559 (3.562)
Percent of Coal Production*Obama		0.110*** (0.023)
Percent of Natural Gas Production*Obama		0.083** (0.025)
Percent of Petroleum Production*Obama		-0.081 (0.082)
Unified Democratic Government	-0.799 (0.773)	-0.729 (0.931)
Government Ideology	0.011 (0.014)	0.007 (0.017)
Deregulated	0.644 (0.874)	1.154 (0.837)
State Per Capita Income	0.070 (0.064)	0.071 (0.070)
Ballot Initiative	3.814 (5.997)	-0.850 (6.519)
Urban	-0.174 (0.106)	-0.168 (0.108)
Change in Unemployment	0.085 (0.353)	-0.104 (0.362)
Citizen Ideology	-0.003 (0.046)	-0.006 (0.048)
Legislative Professionalism	2.480 (5.589)	-11.989* (6.570)
Legislative Term Limits	-1.697 (1.184)	-0.678 (1.353)
Democratic President	-6.164 (4.016)	-10.167*** (3.904)
Real Energy Price	-0.346 (0.529)	-0.783* (0.431)
Observations	8584 (150)	8584 (150)

***critical value at 0.01 threshold; **critical value at 0.05 threshold; and ***critical value at 0.10 threshold.

Figure 1: Influence of Percent Coal Production on Pro-Carbon RPS Adoption Based on the Absence/Presence of the Obama Administration

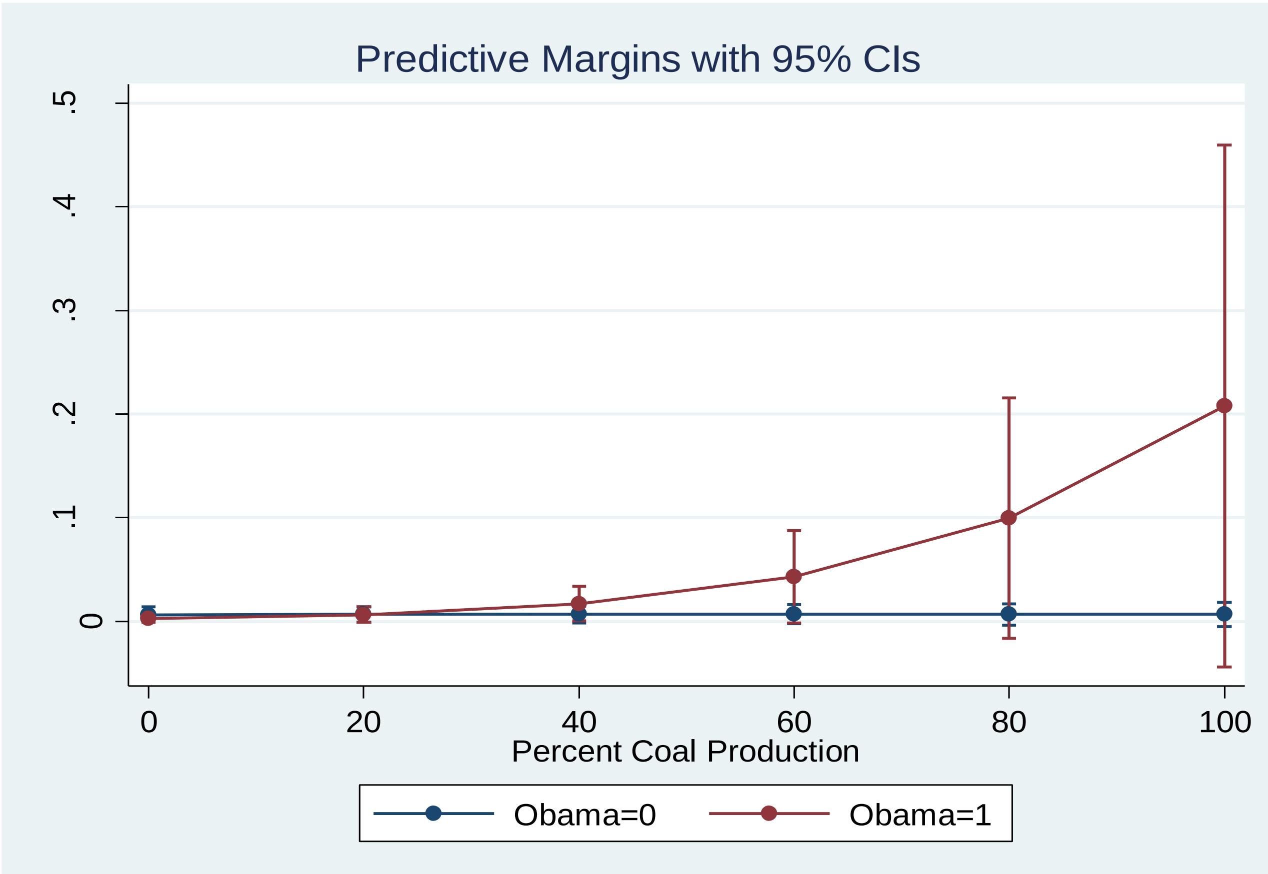
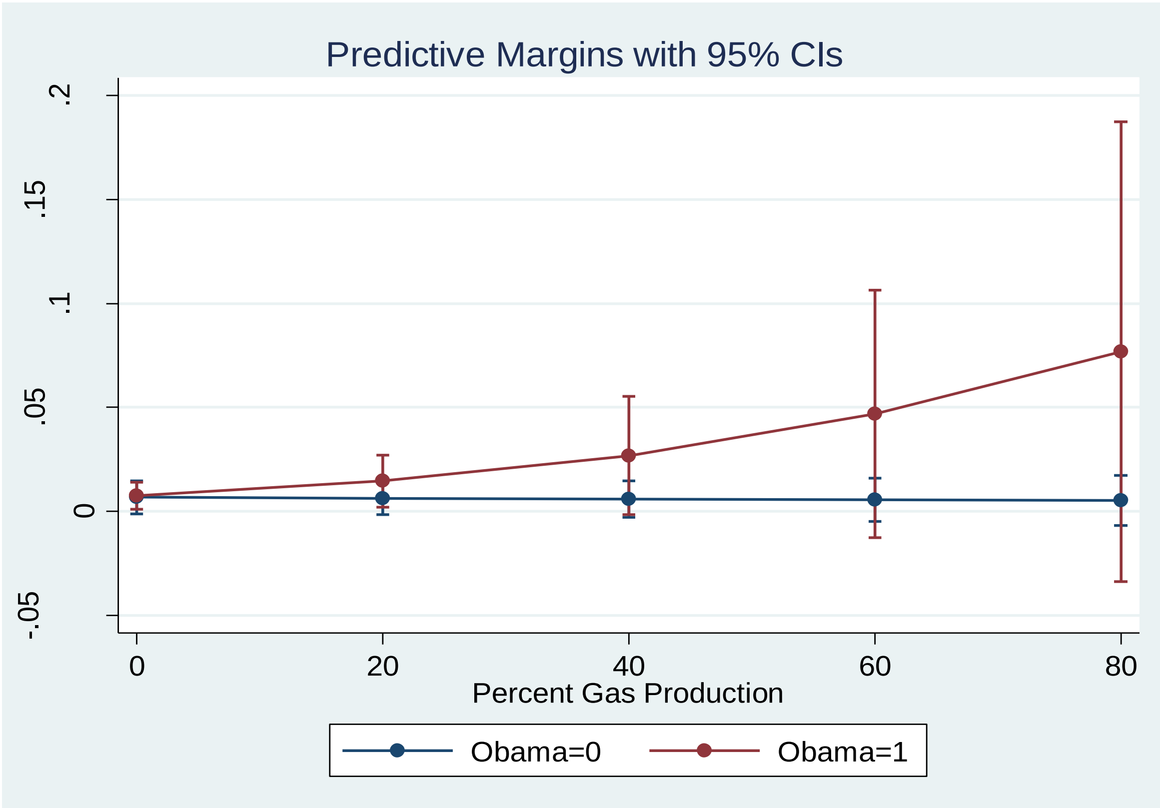


Figure 2: Influence of Percent Natural Gas Production on Pro-Carbon RPS Adoption Based on the Absence/Presence of the Obama Administration



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