Energy Policy 138 (2020) 111214

Contents lists available at ScienceDirect

Energy Policy

journal homepage: http://www.elsevier.com/locate/enpol

# What drives climate policy adoption in the U.S. states?

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ARTICLE INFO

*Keywords:*
Climate
Subnational
State policy
Renewable

ABSTRACT:

Climate advocates increasingly view state policy as a crucial tool to reduce greenhouse gas emissions in the U.S. However, the literature lacks systematic empirical analysis of which, when, and why states adopt policies mitigating climate change. While traditional climate federalism highlights the co-benefits to climate policies in driving subnational policy decisions, more recent work emphasizes the powerful role of partisan control of office. I collect and analyze panel data measuring the strength of state policy from 2007 to 2014 in four areas: renewable portfolio standards, distributed generation, energy efficiency, and severance taxes on oil and gas extraction. While renewable portfolio standards and distributed generation policies were driven primarily by Democratic partisanship in state electorates, energy efficiency policies were less responsive to Democratic partisanship but marginally responsive to unified Democratic control of state government. Finally, these political factors did not measurably influence state severance taxes.

## 1. Introduction

Having achieved limited success advancing climate policy at the national level, climate advocates in the U.S. have turned their attention to the state and local level. At least anecdotally, efforts have borne fruit. Since 1990, a full 28 states have adopted renewable portfolio standards (RPS) mandating that electric utilities procure a certain percentage of generation from renewable sources. In addition, California has established and expanded a cap-and-trade program, while RGGI, the power plant cap-and-trade program initiated in the Northeast, has been expanded to include 9 states.[1]

Scholars have long recognized the somewhat surprisingly active role of the U.S. states in advancing climate and renewables policies (e.g. Rabe, 2004; Engel, 2006; Engel and Orbach, 2008). Yet, scholars have not systematically analyzed the factors predicting uptake and strength of different types of state climate policies. In this paper, I quantitatively analyze the determinants of state climate policy across four areas: RPS, energy efficiency, distributed generation (DG),[2] and severance taxes on the extraction of oil and gas. While this list is certainly not exhaustive, it represents some of the most impactful climate policy areas on which the states have been active.

Findings in general affirm the key role of political factors versus economic factors in predicting climate policy. However, I deepen this view in several ways. First, the analysis suggests that for RPS and DG policy the underlying partisanship of a state's electorate is a much stronger predictor of policy strength[3] than which party controls state government at a given time. Second, while RPS was not responsive to economic factors like wind or solar resource, states with greater solar resource did adopt stronger DG policy over the period.

Third, I find that the politics of energy efficiency depart significantly from the politics of RPS and DG. Unlike RPS and DG, energy efficiency policy is not strongly responsive to changes in the underlying partisanship of the electorate in a state. I do find, however, that energy efficiency policy tends to be advanced under unified Democratic control of state government relative to divided control.

Finally, while political variables are strongly predictive of policy strength in RPS, DG, and energy efficiency policy, they are not predictive of higher severance taxes – taxes on the extraction of oil and gas. While deeper investigation of severance taxes is needed, I propose that the minor role of partisanship in this case reflects both the reduced variation in political leaning of oil and gas producing states, as well as the general stickiness of severance tax policy.

Put together, findings dispel the notion that state climate politics is monolithic. The politics of various policies that might be used to

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[1] As of December 2019.

[2] Distributed generation "refers to a variety of technologies that generate electricity at or near where it will be used, such as solar panels and combined heat and power." (EPA) See https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts.

[3] Conceptualized as the extent to which policy promotes transition to low-carbon energy sources.

https://doi.org/10.1016/j.enpol.2019.111214
Received 1 July 2019; Received in revised form 17 December 2019; Accepted 23 December 2019
Available online 25 January 2020
0301-4215/

mitigate climate change vary significantly, so different types of policies might be viable in different states at different times. An improved understanding of the politics of different climate policy areas might help advocates determine when and where to invest political resources.

The paper proceeds as follows. I first review existing theoretical perspectives on the determinants of state-level climate policy. Second, I provide background information and sources of measurement in four areas of state climate policy: RPS, DG, energy efficiency, and severance taxes. Third, I estimate statistical models of policy strength across the four areas. Finally, I discuss empirical results and conclude.

## 2. Theoretical perspectives

The broad question I address here is: what determines the adoption and intensity of state policies mitigating climate change? A number of studies have addressed variants of this question. I focus specifically on the internal versus external (e.g. policy diffusion) factors that affect climate policy adoption. [4]

### 2.1. Traditional climate federalism view

Early work in state climate and renewables policy emphasized two key features of state climate policies: first, they were often bipartisan and highly bureaucratic; and second, they were generally designed to produce state-level co-benefits like cleaner air. Barry Rabe's seminal work highlights the key role that entrepreneurs in state bureaucracies played in promoting early climate and renewables policies (Rabe, 2004). In addition to highlighting the role of policy entrepreneurs, Rabe's case studies demonstrate that early efforts at the state level were largely bipartisan and often endured changes to partisan control of office (Rabe, 2007, pg. 429).

This work is representative of a traditional "climate federalism" view that states generally enact climate policies only to the degree that they provide local benefits (Engel and Orbach, 2008). According to this view, since the climate is a global public good, no state would reduce carbon emissions just for the climate benefits. Rather, states enact carbon-reducing policies when the co-benefits accruing to those states outweigh the costs. Indeed, research suggests that early policies were generally framed as efforts to produce environmental or economic benefits to states – not efforts to combat climate change. Common frames included, for instance, promoting green jobs, improving air quality, or contributing to energy independence (Rabe, 2004). Building on the idea of the importance of co-benefits in state climate policy, Rabe draws a distinction between climate policies like renewable portfolio standards (RPS) that produce strong state-level co-benefits but do not reduce emissions efficiently – and policies like carbon taxes that are effective for reducing emissions but are more difficult to enact at the state level due to reduced co-benefits (e.g. Rabe, 2008).

A key implication of the traditional climate federalism view is that partisanship would matter less than policy design (e.g. Rabe 2005). To the degree that climate policy decisions are motivated by local co-benefits, we might expect geographic or economic features of a state to overpower partisan concerns. For instance, we would expect windy, rural states like Iowa with much to gain economically from promoting wind energy to lead more liberal states with less to gain economically like Massachusetts in renewables policy. This vein of scholarship is consistent with the adoption of policies like RPS across a broad swath of liberal-leaning and conservative-leaning states in the 1990's and early 2000's (e.g. Rabe, 2008).

### 2.2. Polarized federalism and climate policy

Recent quantitative empirical work, though, increasingly finds that *political factors* are the dominant predictors of state climate policy decisions (e.g. Lyon and Yin, 2010; Berry et al., 2015; Carley and Miller, 2012). The vast majority of this work has studied uptake of one policy in particular: the renewable portfolio standard (RPS). RPS policies generally mandate that electric service providers like utilities procure a certain percentage of electricity from renewable sources like wind and solar.[5] While earlier empirical studies of RPS find both political and economic factors contribute to uptake (e.g. Lyon and Yin, 2010), more recent work has demonstrated the overpowering role of partisanship (e.g. Berry et al., 2015; Carley and Miller, 2012).[6] For instance, Berry and co-authors (2015) find that while multiple factors predict uptake of RPS, the only consistent predictor of RPS strength – the measure that has real-world implications – is partisan control of office. Literature demonstrating the political polarization of RPS dovetails with other work showing the more general divergence of Democrat- and Republican-controlled states across a number of policies since 2000 (Caughey et al., 2017; Grumbach, 2018), which Grumbach (2018) calls "polarized federalism."

## 3. Policy areas

In this section, I introduce four policy areas relevant to addressing climate change on which the states have been active in recent years. After describing the policy area, I specify how the strength of the policy in a given state-year is measured and present figures demonstrating descriptive trends in the measure across states over time. Finally, I discuss what existing literature suggests about the politics of that policy area.

### 3.1. Renewable portfolio standards

Starting with Iowa in 1983, RPS policies have been adopted in 29 states and Washington, DC. While there is some debate in the literature over the actual effects of RPS on renewable energy adoption (Delmas and Montes-Sancho, 2011), most studies have shown that RPS tends to lead to expansion of renewable generation (e.g. Carley et al., 2018).[7]

I use a measure of RPS policy constructed by Carley and Miller (2012),[8] and applied by Carley et al. (2017) and Carley et al. (2018). The measure calculates stringency (or strength) of an RPS in a given year as the increase in renewable generation required divided by the number of years allotted to meet the requirement, multiplied by the percentage of a state's electricity load covered by the standard.[9]

[4] While some early work finds evidence of policy diffusion among neighboring states (Chandler, 2009), more recent work does not (Carley and Miller, 2012; Yi and Feiock, 2012). Moreover, the period I examine (2007–2014) is mainly characterized by revision of existing climate policies versus the adoption of new policies, which Carley et al. (2017) show is driven to a greater extent by internal versus external factors. Finally, other recent work demonstrates that state governments learn from policies passed in states across the country, not just from neighbors (Carley and Nicholson-Crotty, 2018).

[5] Other renewable and semi-renewable resources like hydro and biomass also qualify in some states.

[6] This more recent work has advanced methodologically by investigating both uptake and strength of RPS (e.g. Berry et al., 2015; Carley and Miller, 2012), as opposed to just binary uptake.

[7] Inconsistency across studies reflects the difficulty in measuring the strictness of RPS policies. Traditional approaches using a binary measure of whether or not a state has an RPS miss important variation in, for instance, which types of resources meet the standard. As demonstrated by Carley and co-authors (2018), states sometimes have RPS policies that do not require them to add generation beyond the business as usual scenario.

[8] In turn adapted from a measure used by Yin and Powers (2010).

[9] Negative stringency scores, where the RPS requires less renewable generation than a state already has, are coded as 0, since they are no less stringent than not having an RPS policy at all. 37 out of 400 total state-years featured negative RPS strength values over the study period. Results are robust to allowing negative stringency scores.

Appendix Fig. A1 demonstrates the path of each of the 50 states on this measure over the period from 2000 to 2014. In addition, I highlight the average RPS strength in three sets of states: those that have only voted for the Democratic presidential candidate in each election from 2000 to 2016; those that have only voted Republican; and those that have swung for both of the parties over this period.[10] Binning states in this way provides a general idea of the degree to which RPS strength is related to partisanship, as well as how this has changed over time. The figure suggests a broad increase in RPS strength from around 2003 to 2010, especially among left-leaning and purple states, that levels off from 2010 to 2014.

Existing work suggests political factors like control of state government would be highly predictive of RPS policy strength. While renewable energy captures broad support in the electorate among Democrats and independents, as well as mixed support among Republicans,[11] policy adoption and policy stringency have been shown to be responsive to partisan control of office (e.g. Berry et al., 2015; Carley and Miller, 2012; Lyon and Yin, 2010). In addition, case studies have illuminated efforts to halt or roll back RPS in Republican states in recent years (Stokes, 2015).

### 3.2. Distributed generation

While RPS policies mainly serve to promote development of utility-scale renewable generation,[12] other types of state policies are important for the growth of distributed generation (DG) – mostly rooftop solar. Rooftop solar has grown rapidly since 2010, and is now seen by prominent advocates as a key component of the energy transition in the U.S.[13]

State policy is an important factor in rooftop solar growth (Stokes and Breetz, 2018), and perhaps as a result, has been highly contentious in recent years (e.g. Stokes, 2015). At the forefront of policy debates are questions of how rooftop solar should be valued. As of 2017, 38 states and Washington, D.C. offered some sort of standardized net energy metering (NEM) program,[14] which allows individuals and businesses that install distributed power (like roof-top solar) to sell any excess electricity generated to the utility at the full retail rate. Critics argue that NEM requires non-solar customers to subsidize solar customers, while proponents argue that NEM accurately reflects the value that rooftop solar adds to the grid at low penetrations.

Interconnection standards are also essential to the development of rooftop solar (Carley, 2009). Interconnection refers to the rules for how a distributed generation system can connect to the grid. Lack of consistent interconnection standards leads to greater project uncertainty and can stymie rooftop solar growth.[15]

Some studies of DG policy have used binary outcome measures of whether states mandate NEM pricing and whether states have interconnection standards that utilities are required to follow (e.g. Carley, 2009). However, these measures are imprecise since there is significant variation across states within these categories. For instance, even among states with NEM policies vary by factors like the size of systems allowed in addition to the total amount of net-metered capacity allowed to interconnect.

To measure strength of state DG policy – defined as the degree to which states promote the development of DG – I use state scorecard data on both NEM and interconnection policies collected by *Freeing the Grid*. Since 2007, *Freeing the Grid*, a website managed by two pro-rooftop solar interest groups (*VoteSolar* and *Interstate Renewable Energy Council*), has graded state-level NEM and interconnection policies from F to A.[16] I average NEM and interconnection grades to produce a five-point rating scheme. Appendix Fig. A2 demonstrates a persistent gap between blue, purple, and red states in DG policy strength as measured by *Freeing the Grid* scores.

Existing work has not quantitatively examined the politics of DG policy. Since it also relates to promotion of renewable energy, we might expect DG policy to politically resemble RPS policy. On the other hand, there are some important differences. For instance, the central role of electric utilities in the energy system is threatened to a greater extent by distributed generation than it is by the development of utility-scale renewable generation. In addition, development of DG tends to be more labor-intensive than utility-scale renewables development ("National Solar Jobs Census" 2018).

### 3.3. Energy efficiency

The third policy area I examine is energy efficiency, which refers to a broad suite of mechanisms used to reduce consumption of energy.[17] Research suggests energy efficiency improvements have the potential to reduce emissions considerably at relatively low cost.[18]

The strength of state energy efficiency policies is difficult to measure since different states promote energy efficiency through different policy vehicles. As a broad measure of energy efficiency policy strength, I use scorecard data from the American Council for an Energy Efficient Economy (ACEEE), a U.S.-based energy efficiency advocacy organization. Since 2007, ACEEE has scored state energy efficiency policy out of 50 points by evaluating policy across several areas, including: utility programs and planning processes, transportation policies, building codes, and appliance efficiency standards.[19] Appendix Fig. A3 demonstrates a strong relationship between energy efficiency policy strength and political partisanship: blue states consistently trend higher than purple states – and purple states consistently trend higher than red states.[20]

Existing work has not systematically examined the politics of energy efficiency policies, though some commentators have discussed how energy efficiency tends to draw greater bipartisan support than other types of climate policies (Cash, 2019). One potential reason is that energy efficiency poses less of a threat to conventional power generation than renewables. While energy efficiency measures can reduce consumption of conventional power on the margins, it cannot replace conventional power on a broad scale. Moreover, energy efficiency does not pose the same threat to electric utilities as rooftop solar; indeed, in many cases utilities are offered financial incentives to achieve energy efficiency goals (Jensen, 2007).

[10] Appendix A provides a list of states in each category. States are binned based on this time-invariant measure versus time-variant measures like control of state office so that trend lines do not reflect large-scale shifts in control of state governments.

[11] See http://climatecommunication.yale.edu/visualizations-data/partisan-maps-2018/?est=supportRPS&group=rep&type=value&geo=state.

[12] Some states' RPS have carve-outs for rooftop solar.

[13] See, for instance, the campaign materials of Jay Inslee: https://www.jayinslee.com/issues/100clean/text/Inslee_100CleanPlan_2_1.pdf.

[14] See http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx. Most states adopted some form of standardized net energy metering after its adoption in California in 1995, but these policies did not have sizable effects on rooftop solar growth due to the high price of solar panels at the time and lack of federal tax incentives (Stokes and Breetz, 2018; Stoutenborough and Beverlin, 2008).

[15] See https://irecusa.org/2013/04/irec-releases-update-to-highly-influential-interconnection-model-procedures/.

[16] Note that grades have not been updated since 2016.

[17] Electric utilities and public utilities commissions consider energy efficiency as a resource used to meet electricity demand.

[18] For instance, according to a recent report from Natural Resources Defense Council (NRDC), residential efficiency would lead to the largest CO2 reduction by 2050 of any single intervention.

[19] For more information, see https://aceee.org/state-policy/scorecard.

[20] Note that the measure is not guaranteed to be consistent in its mapping of policy to scores across the full time series, so I cannot make strong claims about the broader trajectory of state energy efficiency policy.

### 3.4. Severance taxes

The policies discussed to this point relate to the promotion of low carbon energy sources like renewables and energy efficiency. But policy advocates have also increasingly supported supply-side policies aimed at curtailing the production of fossil fuel resources,[21] arguing they are crucial emissions reductions tools (e.g. Lazarus et al., 2015).

While there are a number of ways in which states regulate the production of fossil fuels, here I focus specifically on severance taxes on oil and gas extraction. I focus on severance taxes for two main reasons. First, almost all oil and gas producing states levy some sort of severance tax on production. Second, recent work allows for comparisons of the strength of severance taxes across states. Marshaling a rich set of data, Weber et al. (2016) standardize tax regimes across 23 oil and gas producing states to calculate effective average tax rates from 2004 to 2013. I measure policy strength as the effective tax rate on oil and gas. Appendix Fig. A4 shows that, unlike the other policy areas, descriptively speaking, red states tend to have higher extraction taxes than oil-and-gas producing blue states.[22] Interestingly, high severance taxes have long persisted in a number of states generally averse to high levels of taxation. These high rates were not meant to account for environmental costs, but rather to produce revenue that could keep other taxes low (Rabe and Hampton, 2015).

The emergence of fracking technology and rapid growth in drilling parts of the country has led to increased attention to severance taxes in state capitals – but, most states have not made major policy revisions. In heavily Democratic California, efforts to raise the severance tax have been repeatedly batted back by a powerful oil lobby, often working in concert with state lawmakers representing oil-producing regions.[23] On the other side, severance taxes have generally been resistant to cuts even in states under consistently unified Republican control of office. As Hampton and Rabe (2017) discuss, these taxes often build constituencies of interests that depend on targeted allocation of funds. For instance, in Wyoming severance tax funds are earmarked for a popular scholarship program (Hampton and Rabe, 2017).

Appendix Fig. A4 demonstrates the general stability of severance taxes. In addition, among the states in the sample (oil and gas producing states with severance taxes) we do not see Republican-voting states adopting lower severance taxes than Democrat-voting states. While California is the only state in the sample to only swing Democratic in Presidential elections since 2000, states that voted for both Democratic and Republican candidates over the period had lower severance taxes than states that only swung Republican, suggesting differences in the politics of severance taxes relative to the other policy areas explored.

### 3.5. Summary of theoretical expectations

Table 1 summarizes theoretical expectations from the traditional "climate federalism" and "polarized federalism" perspectives outlined. I also summarize existing quantitative empirical findings, though as the table indicates, existing work in areas beyond RPS is limited.

## 4. Data and methods

### 4.1. Dependent variables

The key outcome variables are the measures of climate policy strength across the areas discussed: RPS, DG, energy efficiency, and severance taxes. For each policy area, I collect state-year level panel data from 2007 to 2014. These years were chosen since measures are available in each policy area over this period.[24] 2007–2014 is also a suitable time period since states were highly active in adjusting climate policies in these years (Stokes, 2015).

### 4.2. Estimation strategy

Work investigating the adoption of RPS generally has used hazard models. While these models are well equipped for modeling the uptake of policy, they are less well-equipped for modeling the intensity of policy or for modeling policy revisions. As a result, in lieu of hazard models, this paper's main estimation strategy relies on state-year fixed effects models. By estimating separate fixed effects for each year and each state, these models isolate the association between changes in time-variant factors within states and state policy strength. Generally, strength of policy in state *s* and year *t* is modeled as a function of state-year level factors in state *s* and year *t-1*. Lagged measures are used since a policy passed in year *t* would be unlikely to go into effect until year *t+1*.

To investigate the relationship between time-invariant state-level factors and policy strength, I also estimate multilevel models with random effects at the state and year levels. Multilevel models are preferable for modeling panel data when the researcher is interested in the effect of both time-invariant and time-varying factors on outcomes (Bell and Jones, 2015). However, these models do not isolate the association between changes to state-level political or economic factors and changes to state policies as cleanly as state-year fixed effects models.

### 4.3. Independent variables

Rather than include as covariates any possible variable that might influence policy adoption and intensity, I estimate relatively sparse models. Sparse models are preferable here for several reasons. First is the problem of reverse causation with panel data. Certain state climate policies might both respond to and influence potential covariates. For instance, studies of RPS adoption using hazard models often incorporate a measure of electricity prices (e.g. Berry et al., 2015). While electricity prices might motivate RPS, they also are affected by RPS (Greenstone and Nath n.d.). In panel analysis, if electricity prices are higher after RPS goes into effect, this might produce a spurious association between electricity prices and RPS strength driven by reverse causation. Models therefore in most cases only include control variables that are unlikely to be strongly affected by climate policies. In specifications that might be subject to reverse causation, I use time-invariant measures of variables like electricity price prior to the period of interest (in multilevel models) to help mitigate reverse causation.[25]

Second is the problem of sample size. With a relatively small sample, using a large number of covariates can lead to unstable estimates (e.g. Chen et al., 2016). The design relies on state-year fixed effects models to mitigate omitted variable bias rather than a large number of covariates. Estimation should generally be free of substantial bias as long as models do not systematically omit variables strongly correlated with both within-state *changes* to the political factors of interest (or variables correlated with them) and within-state *changes* to policy outcomes of interest.

#### 4.3.1. Political variables

Strength of state climate policies is modeled as a function of a combination of political and economic variables. Political variables

[21] For instance, see https://www.latimes.com/politics/la-pol-ca-oil-tax-california-legislature-20190226-story.html.

[22] Some of this can be attributed to the fact that some oil-producing blue states, like California, do not exclude oil and gas wells from local property taxes, which is associated with lower state-level rates.

[23] See https://www.pressdemocrat.com/news/1858804-181/state-sen-noreen-evans-faces?ref=related.

[24] Data is only available through 2013 for severance taxes.

[25] These models should be interpreted with caution. Even using pre-period measures the problem of reverse causation remains due to the stickiness of policies. For instance, RPS in the pre-analysis period might be associated with electricity prices in that period *and* with RPS in the analysis period.

**Table 1**
Summary of theoretical expectations and existing literature.

| | Expectations from "Climate Federalism" | Expectations from "Polarized Federalism" | Existing Quantitative Empirical Findings |
|---|---|---|---|
| Renewable Portfolio Standards | • Policy strength increasing in wind potential; solar potential; unemployment; air quality | • Policy strength increasing in Democratic control of government | • Adoption and intensity of RPS associated with Democratic control of state government |
| Distributed Generation | • Policy strength increasing in solar potential; unemployment; air quality | • Policy strength increasing in Democratic control of government | • NA |
| Energy Efficiency | • Policy strength increasing in fuel prices; unemployment; air quality | • Policy strength increasing in Democratic control of government | • NA |
| Severance Taxes | • Uncertain | • Policy strength increasing in Democratic control of government | • NA |

include, first, an indicator of unified Democratic, divided, or unified Republican control of state office. This is a standard measure of partisanship among state office-holders in the literature (Caughey et al., 2017; Grumbach, 2018).[26]

I also include a measure of partisanship in state electorates (or "partisan lean"), since control of state office in a given year does not provide a complete measure of partisan politics of a state. Estimates of state-level party identification from Caughey and Warshaw (2018) are used to construct a party-identification (PID) index computed as the difference between percent Democratic identifiers and percent Republican identifiers.[27]

#### 4.3.2. *Economic variables*

Models include a number of variables capturing both the economic context in a state and the potential economic returns to various climate policies. Models for each policy area include two time-varying economic variables: first, GDP per capita, since wealthier states might be more likely to promote economically costly policies with environmental benefits (e.g. Stern, 2004); and second, state tax revenue per capita, since state governments that play a greater role in state economies and have greater capacity might adopt stronger climate policies.

In models of RPS and DG policy strength, I also include measures of renewable resource. For solar capacity (used for both policy areas), I use the National Renewable Energy Laboratory's estimates of average solar energy potential per meter-squared multiplied by the land area of a state. For wind capacity (used only for RPS), I use estimates from the U.S. Department of Energy of the annual wind energy in gigawatt-hours that could be produced from capacity installed on windy land area measure wind resource.[28] I also include average measures of air quality, unemployment, and electricity prices from 2000 to 2006 in these models.[29] Since these are time-invariant measures, they cannot be included in state-year fixed effects models.

In models of energy efficiency policy strength, I include a number of measures of energy prices, including: electricity prices, natural gas prices, and gasoline prices, in addition to a measure of pre-period unemployment rate.[30] Finally, in models of severance taxes, I include pre-period oil and natural gas production, as well as unemployment rate and a measure of whether a state exempts oil and gas wells from property taxes, which Weber et al. (2016) find to be associated with higher state-level severance taxes. Table 2 presents summary statistics for key outcomes and independent variables.

**Table 2**
Summary statistics.

| Variable | N | Mean | St. Dev | Min | Max |
|---|---|---|---|---|---|
| RPS strength | 400 | 31.69 | 40.3 | 0 | 132.31 |
| Free the Grid score | 400 | 2.93 | 1.3 | 1 | 5 |
| ACEEE score | 400 | 17.62 | 10.47 | 0 | 45.5 |
| Severance Tax | 161 | 3.65 | 2.73 | 0 | 12.87 |
| Unified Democratic | 400 | 0.26 | 0.44 | 0 | 1 |
| Unified Republican | 400 | 0.28 | 0.45 | 0 | 1 |
| Partisanship (Democratic - Republican) | 400 | 5.52 | 10.74 | -25.36 | 28.29 |
| Wind potential | 50 | 8.42 | 13.66 | 0 | 46.05 |
| Solar potential | 49 | 4.64 | 1.02 | 3.58 | 7.65 |
| GDP per capita (thousands) | 400 | 47.5 | 9.65 | 29.56 | 79.65 |
| Tax revenue per capita (thousands) | 400 | 2.63 | 1.06 | 1.52 | 12.7 |
| Air quality (pre-period) | 50 | 37.66 | 8.49 | 14.25 | 53 |
| Unemployment rate (pre-period) | 50 | 4.82 | 0.87 | 3.27 | 6.99 |
| Unemployment rate | 400 | 6.69 | 2.31 | 2.6 | 13.7 |
| Electricity price (pre-period) | 50 | 22.28 | 6.95 | 13.52 | 46.49 |
| Electricity price | 400 | 29.02 | 11.14 | 14.43 | 99.96 |
| Gasoline price | 400 | 24.87 | 4.07 | 17.41 | 36.2 |
| Natural gas price | 400 | 12.79 | 5.22 | 6.81 | 52.75 |
| Property tax exemption | 50 | 0.57 | 0.5 | 0 | 1 |
| Natural gas production (billion Btu, pre-) | 23 | 753,888 | 1,373,612 | 1254 | 6,364,628 |
| Oil production (billion Btu, pre-period) | 23 | 254,812 | 490,433 | 121 | 2,150,390 |

*Note:* Energy prices per million Btu. Pre-period data generally refers to average from 2000 to 2006.

## 5. Predictors of state climate policies

Turning first to RPS, model (1) in Table 3 estimates RPS strength as a function only of partisan control of office and broader political lean (as measured by the difference between percent Democratic and percent Republican identifiers). Model (2) adds two time-variant economic variables: GDP per capita, and total tax revenue per capita. Finally, model (3) estimates a multilevel model including time-invariant measures of wind and solar potential, as well as pre-period air quality, unemployment rate, and electricity prices.

The variable most predictive of RPS strength across the models is partisanship in the electorate. Results suggest a 10-percentage point increase in the difference between Democratic and Republican identifiers in a state[31] is associated with between a 14- and 16-point increase in RPS strength (the standard deviation of RPS strength in 2014 was 42, with a range of 0–132). Democratic control of state government is also

[26] Results are robust to using control of each of the branches as independent variables.

[27] These are latent measures estimated with error. Measurement error would be expected to attenuate estimates of the effect of partisanship, but can produce bias in estimation of other model parameters. Results are robust to using Democratic vote share in the 2012 presidential election to measure partisanship.

[28] This is defined as areas with a gross capacity factor (without losses) of 30% and greater at 80-m height above ground. See https://catalog.data.gov/dataset/u-s-state-wind-resource-potential.

[29] To measure air quality, I take the average of county-level median yearly AQI estimated by the Environmental Protection Agency.

[30] Measures of per BTU electricity, natural gas, and gasoline prices produced by the U.S. Energy Information Administration (EIA) are used.

[31] For instance, this would result from a 5-point decrease in percent Republican combined with a 5-point increase in percent Democrat.

**Table 3**
Predictors of RPS policy strength.

| | RPS Policy Strength | | |
|---|---|---|---|
| | Fixed Effects | | Multilevel Model |
| | (1) | (2) | (3) |
| Unified Democratic | 3.67* | 3.74** | 3.73* |
| | (1.91) | (1.88) | (2.07) |
| Unified Republican | -0.43 | -0.55 | -0.74 |
| | (4.28) | (4.38) | (2.43) |
| Partisanship | 1.43* | 1.41* | 1.63*** |
| | (0.76) | (0.76) | (0.43) |
| GDP per capita | | 0.08 | 0.60* |
| | | (0.30) | (0.33) |
| Tax revenue (per capita) | | -1.08 | -4.59 |
| | | (0.85) | (3.14) |
| Wind potential | | | 0.57 |
| | | | (0.46) |
| Solar potential | | | 4.06 |
| | | | (5.12) |
| Air Quality Index (pre-period) | | | -0.51 |
| | | | (0.7) |
| Unemployment (pre-period) | | | 4.28 |
| | | | (7.24) |
| Electricity price (pre-period) | | | 1.62* |
| | | | (0.88) |
| Observations | 400 | 400 | 392 |
| State and Year Fixed Effects | X | X | |
| State and Year Random Effects | | | X |
| Years | 2007–2014 | 2007–2014 | 2007–2014 |

*Note*: *p < .1, **p < .05, ***p < .01. Outcome is RPS strength, measured by Carley et al. (2018) as the increase in renewable generation required divided by the number of years given to meet the requirement, multiplied by the percentage of a state's electricity load covered by the standard. Reduced observations for models (3) reflect missing solar potential data for Alaska. Standard errors clustered at state level in (1) and (2).

associated with stronger RPS, although the magnitude of the relationship is much weaker: a shift from divided to Democratic control of government is associated with between a 3- and 4-point increase in RPS strength. Finally, strength of RPS is not significantly associated with any of the included non-political variables, including wind and solar resource.[32]

I turn next to investigating the empirical predictors of DG policy. Recall that DG policy strength is measured as an average of *Freeing the Grid's* NEM and interconnection grades assessing the degree to which state policies promote (or hinder) rooftop solar development. [33] Similar to RPS, estimates, presented in Table 4 suggest a strong relationship between partisanship in the electorate and strength of DG policy. A 10-point increase in the difference between Democratic and Republican partisanship is associated with nearly a 1-point increase in DG policy strength (in 2014, the standard deviation was 1.3). Here, changes to control of state government are not statistically significantly associated with changes to DG policy. However, unlike in the case of RPS, policy is responsive to levels of renewable potential. A one standard deviation increase in solar resource (the difference between, for instance, Connecticut and Florida) is associated with around a 0.49-point increase in policy strength.

The third area I investigate is energy efficiency policy, measured using state scores from ACEEE. Unlike in the other areas, estimates, presented in Table 5, do not suggest an association between changes in mass partisanship and changes to energy efficiency policy strength. States trending Democratic, conditional on other factors, do not adopt stronger energy efficiency policies over the period. (Consistent with

[32] The association between RPS strength and pre-period electricity prices may be driven by reverse causation.

[33] I model the outcome as an interval variable for ease of interpretation. This assumes the distance between 1 and 2 is equivalent to the distance between 4 and 5. Treating the outcome as ordinal produces consistent results.

**Table 4**
Predictors of DG policy strength.

| | DG Policy Strength | | |
|---|---|---|---|
| | Fixed Effects | | Multilevel Model |
| | (1) | (2) | (3) |
| Unified Democratic | 0.13 | 0.13 | 0.17* |
| | (0.12) | (0.12) | (0.10) |
| Unified Republican | 0.07 | 0.06 | 0.09 |
| | (0.13) | (0.13) | (0.12) |
| Partisanship | 0.09*** | 0.09*** | 0.08*** |
| | (0.03) | (0.03) | (0.02) |
| GDP per capita | | -0.001 | 0.02 |
| | | (0.01) | (0.01) |
| Tax revenue (per capita) | | -0.001 | -0.01 |
| | | (0.05) | (0.14) |
| Solar potential | | | 0.49*** |
| | | | (0.15) |
| Air Quality Index (pre-period) | | | -0.03 |
| | | | (0.02) |
| Unemployment (pre-period) | | | -0.2 |
| | | | (0.19) |
| Electricity price (pre-period) | | | -0.01 |
| | | | (0.02) |
| Observations | 400 | 400 | 392 |
| State and Year Fixed Effects | X | X | |
| State and Year Random Effects | | | X |
| Years | 2007–2014 | 2007–2014 | 2007–2014 |

*Note*: *p < .1, **p < .05, ***p < .01. Outcome is average of *Free the Grid's* scores (out of 5) for state NEM and interconnection policies. Reduced observations for model (3) reflect missing solar potential data for Alaska. Standard errors clustered at state level in (1) and (2). Standard errors clustered at state level in (1) and (2).

Appendix Fig. A3, multilevel model results suggest states that generally lean Democratic have stronger energy efficiency policies).

Similar to RPS (but not DG), estimates suggest a relationship between unified Democratic control of state government and energy efficiency policy strength. The magnitude of the relationship is small, though. Unified Democratic control of office relative to divided control is associated with just a 1-point increase in energy efficiency policy strength (the variable's standard deviation over the period was 10.5). Interestingly, multilevel model results also suggest an association between unified Republican control of government and energy efficiency policy strength, although the relationship is too imprecisely estimated to be statistically significant in the state-year fixed effects models. These models also indicate that higher pre-period energy prices are associated with stronger energy efficiency policies, although the degree to which energy efficiency policies were adopted *because of* higher energy prices is uncertain.

Finally, I examine the predictors of severance taxes – measured as the effective tax rate on oil and gas extraction. Results, presented in Table 6, demonstrate that, unlike the other policy areas, neither broad political lean nor partisan control of state office is consistently predictive of severance tax policy strength.

## 6. Discussion

I find substantial variation in the politics of the various climate policies examined. Strong RPS mandates are highly responsive to a state's general political lean and more weakly responsive to control of state office. Neither potential wind resource nor solar resource predict RPS strength, suggesting (consistent with existing work) that RPS choices are driven by politics, not economics.

For DG policy, like RPS, the strongest predictor of policy strength is general Democratic lean in the electorate. Interestingly, control of state government is an even weaker predictor of DG policy strength than RPS policy strength. On the other hand, with respect to DG policy, there is some evidence for the role of economics: states with more solar potential tend to enact policies more supportive of the development of rooftop

**Table 5**
Predictors of energy efficiency policy strength.

| | Energy Efficiency Policy Strength | | |
|---|---|---|---|
| | Fixed Effects | | Multilevel Model |
| | (1) | (2) | (3) |
| Unified Democratic | 1.04* | 1.08** | 1.09** |
| | (0.53) | (0.53) | (0.47) |
| Unified Republican | 1.53 | 1.47 | 1.52** |
| | (0.94) | (0.94) | (0.56) |
| Partisanship | 0.08 | 0.08 | 0.27*** |
| | (0.19) | (0.19) | (0.10) |
| GDP per capita | | -0.01 | 0.03 |
| | | (0.08) | (0.07) |
| Tax revenue (per capita) | | -0.29 | -0.52 |
| | | (0.25) | (0.37) |
| Electricity price (pre-period) | | | 0.55** |
| | | | (0.22) |
| Natural gas price (pre-period) | | | -0.78 |
| | | | (0.48) |
| Gasoline price (pre-period) | | | 5.31*** |
| | | | (2.13) |
| Unemployment (pre-period) | | | -0.14 |
| Air Quality Index (pre-period) | | | (1.29) |
| | | | 0.12 (0.16) |
| Observations | 400 | 400 | 400 |
| State and Year Fixed Effects | X | X | |
| State and Year Random Effects | | | X |
| Years | 2007–2014 | 2007–2014 | 2007–2014 |

*Note:* *p < .1 **p < .05 ***p < .01. Outcome is ACEEE's score for supportive energy efficiency policy (out of 50). Standard errors clustered at state level in (1) and (2).

**Table 6**
Predictors of severance tax strength.

| | Severance Tax Rate | | |
|---|---|---|---|
| | Fixed Effects | | Multilevel Model |
| | (1) | (2) | (3) |
| Unified Democratic | 0.004 | -0.09 | 0.05 |
| | (0.48) | (0.48) | (0.46) |
| Unified Republican | 0.07 | 0.16 | 0.08 |
| | (0.42) | (0.42) | (0.38) |
| Partisanship | 0.13 | 0.15 | 0.01 |
| | (0.09) | (0.09) | (0.04) |
| GDP per capita | | 0.001 | -0.03 |
| | | (0.06) | (0.04) |
| Tax revenue (per capita) | | 0.75 | 1.00** |
| | | (0.58) | (0.48) |
| Property tax exemption | | | -2.36** |
| | | | (1.00) |
| Gas production (pre-period) | | | 0.11 |
| | | | (0.07) |
| Oil production (pre-period) | | | -0.95 |
| | | | (1.01) |
| Unemployment | | | 0.03 |
| | | | (0.09) |
| Observations | 161 | 161 | 161 |
| State and Year Fixed Effects | X | X | |
| State and Year Random Effects | | | X |
| Years | 2007–2013 | 2007–2013 | 2007–2013 |

*Note*: *p < .1 **p < .05 ***p < .01. Outcome is effective tax rate on oil and gas extraction calculated by Weber and co-authors (2016). Data is only available for 23 states over the time period. Standard errors clustered at state level in (1) and (2).

solar.

The investigation of energy efficiency policy strength yields a notable difference relative to renewables policies. While energy efficiency policy is generally stronger in Democratic-leaning states, unlike in RPS and DG policy, it is not trending stronger in states that trend Democratic over the period. Moreover, while there is a relationship between Democratic control of state government and energy efficiency policy strength, it is quite small in magnitude.

Though caution is in order in interpreting null results, I offer here one potential explanation for why we might expect energy efficiency to differ politically from RPS and DG. Energy efficiency, though effective in reducing emissions, does not pose the same existential challenge to entrenched fossil fuel interests – a central actor in the Republican Party (e.g. Kim and Urpelainen, 2017) – that renewable energy does. Efficiency standards reduce consumption of fossil fuels on the margins, but energy efficiency technology generally does not offer the ability to systematically replace fossil fuels. Therefore, while energy efficiency policy can damage fossil fuel interests' bottom lines, it does not broadly challenge fossil fuel interests' powerful position in the energy system.

Finally, with respect to severance taxes, an important supply-side climate policy, neither partisan control of state government nor presidential vote share are predictive of policy strength. Again, though a null result is not strong evidence for a true null relationship, there are several potential explanations for why political factors might play a smaller role here. First, environmental groups have been less focused on severance taxes than on other policies like those around supporting renewables. Second, qualitative work suggests concentrated interests in the states have successfully stymied both increases and decreases to severance taxes (Hampton and Rabe, 2017). In addition, severance taxes, like energy efficiency, in general do not pose existential threats to fossil fuel industry. Indeed, a state with a budget dependent on severance tax revenues is also dependent on maintaining a strong extraction economy.

There are a number of limitations to this study, some of which can be addressed in future work. First, using observational data limits the causal interpretation of analysis. For instance, while solar potential is predictive of DG policy strength, the design does not permit a strong causal claim. Relatedly, the quantitative empirical methods used here do not provide a clear picture of mechanisms. Why is it, for example, that solar resource is predictive of DG policy strength? It could be that citizens in sunnier states are more supportive of liberal DG policy; or alternatively, it could be that national solar installers focus more of their political efforts in sunnier states.[34] Qualitative case studies can build on this work by investigating these types of mechanisms.

In addition, the analysis is restricted to a set of policies for which panel data comparable across states over the time period of interest is available. State climate policy extends much beyond RPS, DG, energy efficiency, and severance taxes. For instance, this study does not address decisions to establish cap-and-trade programs, efforts to promote low-carbon fuel standards and electric vehicles, or climate adaptation policies.

This study is also restricted to a relatively short panel due to data availability – in particular, the RPS measure used is only available up through 2014. As updates to the measure are produced and other types of policies are adopted, researchers will be able to apply the framework developed here to explore over-time changes in the politics of these policy areas. Finally, in terms of independent variables, the study is restricted to a limited number of political and economic factors due to both data availability and sample size.

## 7. Conclusion and policy implications

Results give rise to a couple broad conclusions. First, and most importantly, I find that existing empirical findings on the politics of RPS do not broadly generalize to other climate policies. While DG policy was similarly responsive to partisanship in the electorate, DG policy, unlike RPS, was also responsive to solar resource. The politics of energy efficiency and severance taxes varied markedly from the politics of RPS.

Second, while results in some sense affirm existing work's emphasis

[34] See https://www.rollingstone.com/politics/politics-news/the-koch-brothers-dirty-war-on-solar-power-193325/.

on the *political* versus *economic* determinants of policy, even for RPS and DG, underlying partisanship in a state is a much stronger predictor of both levels and changes to policy strength than partisan control of government. This suggests that earlier studies of RPS that do not use measures of partisanship in the electorate may over-estimate the role of partisan control of government in driving policy. Findings presented here suggest that passing climate policy is not just about having Democrats in office, but also about the pressure that individuals and groups in a state are willing and able to put on their elected leaders.

Qualitative and quantitative work that builds on this study can further clarify the drivers of climate policy adoption and strength at the state level. This is important, since developing a better understanding of the politics of state climate policy can help climate advocates to determine when and where to deploy different types of resources to affect policy change.

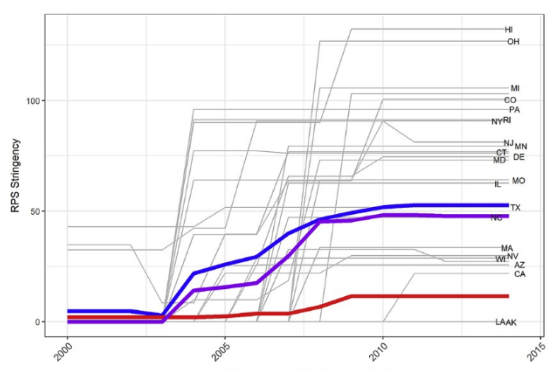
## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.


## Acknowledgements

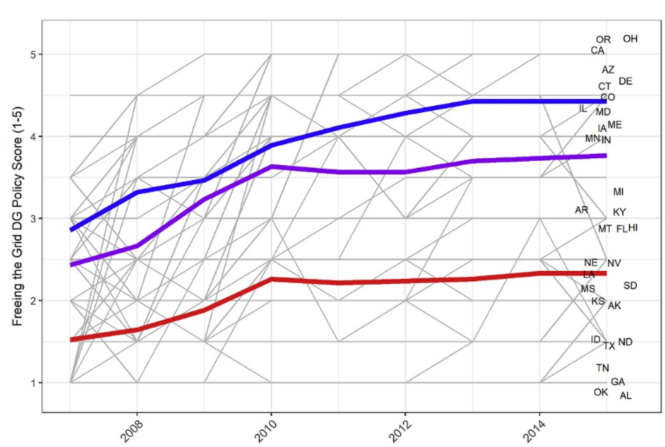
I am grateful for helpful feedback from Jonas Meckling, Sarah Anzia, Eric Schickler, Nicolas Schmid, two anonymous reviewers, participants at the 2019 Midwest Political Science Association and 2019 Western Political Science Association meetings, and participants in the Political Behavior workshop at UC Berkeley. I am grateful also to Sanya Carley, Jeremy Weber, and folks at ACEEE (particularly Weston Berg) for sharing data. The research was funded by the National Science Foundation under DGE 1752814.


## Appendix A. Descriptive Trends in Policy Measures



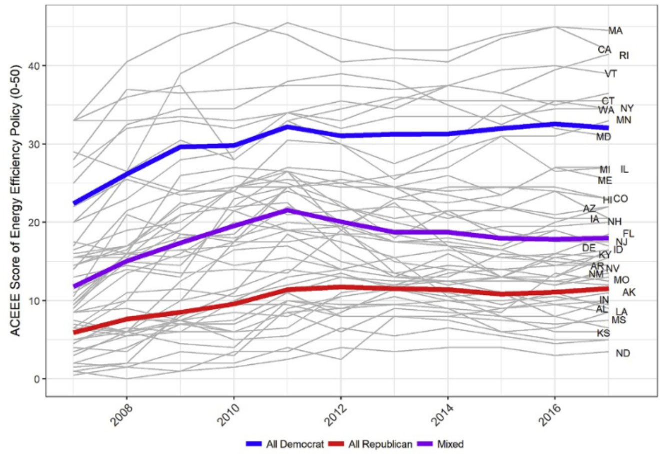

*Note*: Figure presents path of each state on RPS strength measure (Carley et al., 2018) from 2000 to 2014. Thick lines represent averages for states only voting for Democratic presidential candidates between 2000 and 2016, states only voting Republican, and states that have voted for both parties.

**Fig. A1.** RPS policy strength trends



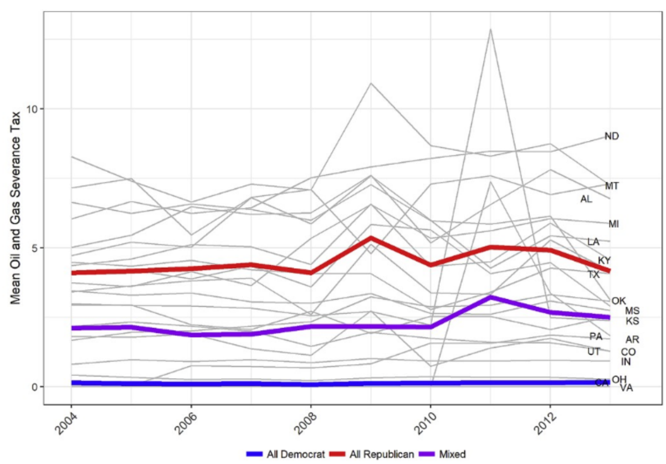

*Note*: Figure presents path of each state on DG strength measure (*Freeing the Grid* score) from 2007 to 2015. Thick lines represent averages for states only voting for Democratic presidential candidates between 2000 and 2016, states only voting Republican, and states that have voted for both parties.

**Fig. A2.** Distributed generation policy strength trends




*Note*: Figure presents path of each state on energy efficiency strength measure (ACEEE score) from 2007 to 2017. Thick lines represent averages for states only voting for Democratic presidential candidates between 2000 and 2016, states only voting Republican, and states that have voted for both parties.

**Fig. A3.** Energy efficiency policy strength trends




*Note*: Figure presents path of each state on severance tax on oil and gas (Weber et al., 2015) from 2004 to 2013. Thick lines represent averages for states only voting for Democratic presidential candidates between 2000 and 2016, states only voting Republican, and states that have voted for both parties.

**Fig. A4.** Severance tax policy strength trends

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