Unequal State Air Pollution: Adopting and Adapting to State Clean Air Policy

BY

Derek John Glasgow

Submitted to the graduate degree program in Political Science and the Graduate Faculty of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

____

Chairperson Professor Donald Haider-Markel

____

Professor Dorothy Daley

____

Professor Steven Maynard-Moody

____

Professor Elaine Sharp

____

Professor Alesha Doan

Date Defended: May 12, 2015

The Dissertation Committee for Derek John Glasgow
certifies that this is the approved version of the following dissertation:

Unequal State Air Pollution: Adopting and Adapting to State Clean Air Policy

Chairperson Professor Donald Haider-Markel

Date approved: May 15, 2015

Abstract

This dissertation looks at the relationship between American subnational governments and clean air policy in three different cases. I investigate the impact of state reduction policies on the emission of Greenhouse emissions, the subnational adoption of Greenhouse Gas tracking and reduction policies, and the impact of Clean Air Act standards on the siting of coal-fired power plants. The major finding is that in both the adoption and business response to these policies, a state's political context can limit its ability to regulate air pollution. These factors contribute to the unequal protection of air quality across the United States.

Acknowledgements

I would like to thank my advisor, Professor Haider-Markel, for his willingness to work with me on the drafts of this dissertation. I'm glad that I was able to finally put this project together after a few delays. Also, I thank my dissertation committee for taking time out of their busy schedule to participate in this process. I especially would like to thank Professor Dorothy Daley for bringing me in on her climate policy project, which greatly assisted me in finishing this dissertation. She was very willing to answer questions and assist me, which ultimately made me a better scholar. I would like to thank Cristian Cantir and Mali Benvenutti for taking the time to edit this dissertation and provide general guidance concerning graduate school. Finally, I would like to thank my parents for providing the love and support all these years. I appreciate the freedom and support they gave to me in obtaining my degree. This dissertation is dedicated to the memory of Al Hartman.

Table of Contents

Introduction

It strikes me that much of our country's ongoing efforts to clean up air pollution is about playing fair, and doing our share. In my home state of Delaware, we've done our homework and worked hard and, as a result, we've made great strides in cleaning up our own air pollution. Unfortunately, a number of the upwind states to the west of us have not made the same commitment to reducing harmful pollution by investing in cleaner air. Some of those states have even built taller smokestacks so their pollution would fall -- not on them -- but on downwind states like us, keeping their air clean while making our air dirty, polluting our environment and making our children sick. [1]*- Senator Tom Carter*

Currently, air quality governance in the United States is a complex system that involves multiple layers of government regulating a vast portion of all economic sectors. Despite major decreases among many major air pollutants over the last thirty-five years, many scholars and public officials debated the role of certain governmental entities in maximizing reductions. As mentioned in the above quotation, state governments can and have played a major part in this regulatory structure. However, there has been concern over the capacity of states to combat this problem when air pollution is a complex problem that does not respect geo-political borders.

Even with the large role state governments currently play in the regulation of air quality, traditionally the federal government has made regulatory decisions concerning only some pollutants. Major changes occurred in the last thirty-five years over whether state or federal governments should regulate and what emissions should be regulated. Gradually, subnational governments became much more involved in this regulatory structure. While initially the federal government played a central regulatory role with the Clean Air Act of 1970 (CAA), in the Eighties and Nineties, states began to play a larger part in the regulation of criteria pollutants. Over time, definitions of clean air shifted to include even more pollutants. Originally, the CAA

[1] See: http://www.huffingtonpost.com/sen-tom-carper/showing-a-fathers-love-by_b_1601013.html?

mandated that the federal government regulate six criteria pollutants: carbon monoxide, ozone, particulate matter (first PM 10 and later PM 2.5), nitrogen oxides, lead, and sulfur dioxide. However, attitudes shifted towards a concern for global climate change and the Supreme Court ruled that the EPA should regulate greenhouse gases (GHGs) (carbon dioxide, nitrous oxide, and methane) under the auspices of the CAA (see: *Massachusetts v. EPA*).

The federal and state regulatory environment for some pollutants remained uneven for many decades. While the CAA addressed many major air pollutants, the law did not regulate GHGs. There was major debate about the United States joining the Kyoto Protocol in the Nineties, but the federal government did not make major changes to its regulatory regime concerning greenhouse gas emissions until the 2010s. In absence of a concrete federal climate policy, many states adopted different policies to mitigate GHG pollutants, promote the development of renewable energy sources, and other ideal policy outcomes.

I argue that the optimism expressed by scholars overstates the ability of states to regulate air quality. There are several limitations in the adoption and implementation of air quality policies, and industry may adjust its economic behavior to negatively impact the environment or ignore certain state air quality regulations. Similar to Senator Carter's implicit suggestion in the opening quotation: the efforts that states take to protect air quality have been unequal.

The underlying justification for this argument is that state adoption of clean air policy varies by state and largely depends on the internal politics of certain states over other factors, which limits the scope of the collective response to air pollution. Also, economic forces can respond to regulations by migrating to those states with lower clean air standards or may ignore efforts by states to improve air quality. Therefore, some of these policies are only symbols to appease constituents who wish to mitigate the factors that contribute to climate change.

To support this argument, I investigate different parts of subnational clean air policy through three chapters. Specifically, chapter one looks at the state factors that influenced the adoption of three different state climate change policies. Previous policy literature on policy diffusion and the internal determinants literature attempts to explain the adoption of policy across a federalist system based on internal and external state factors, such as state economic and political conditions. Using Event History Analysis to evaluate EPA adoption data from 2001 to 2010, the major finding is that states with more liberal citizens were more likely to adopt policies to track, mitigate, and establish reduction goals. This unequal policy adoption shows the importance of climate change politics in policy change. Other factors, such as scope of the problem, learning from other states, and the potential for renewable energy, and economic conditions, were less consistent in their impact on change.

With states adopting differing standards for air pollution, businesses act strategically to unequal air quality policy. In chapter two, I investigate how utility companies responded to states with more stringent Clean Air Act standards through the siting of coal-fired power plants. Past literature on the “Race-to-the-Bottom” hypothesis finds inconclusive evidence as to whether businesses site facilities within states with less stringent environmental standards to maximize profits. In an attempt to improve on this literature, I look at the permitting behavior of utility companies and coal-fired power plants. Using Negative Binomial and Ordinary Least Squares statistical analysis to evaluate the relationship between the number and size of each new source of coal application and state air policy and political conditions from 1999 to 2009, this study finds that utility companies tended to site facilities in states with more conservative populations and less stringent regulations. Utilities were less likely to build in more liberal states with more restrictive standards.

States can change their behavior in response to certain clean air regulations, but they can also outright ignore other state policies. Chapter three explores the impact of state GHG reduction targets on the output of facility pollution. Many states adopted state GHG targets to reduce carbon dioxide emissions, and past scholars indicate that these policies produce modest reductions. However, there is reason to suspect that these policies have little impact on emissions. Using data from the Greenhouse Gas Report Program (GHGRP) and the Center for Climate and Energy Solutions (C2es) from 2010 to 2013, I create an ambitiousness index to evaluate whether more ambitious targets reduce carbon dioxide emissions at both the state and facility level. The evidence suggests that that states with more ambitious GHG targets did not reduce more carbon dioxide emissions. However, states with less carbon dioxide emissions were more likely to adopt more ambitious GHG targets in the first place.

Chapter 1: Greenhouse Policy adoption

Greenhouse Policy adoption: The diffusion and/or internal determinants of three subnational climate change policies

Over the past decade, some state-level officials began to express concern over the growth of Greenhouse Gas (GHG) emissions in the United States and the inaction of the federal government to address the problem of anthropogenic climate change. As of 2005, U.S. GHG emissions were up 16.3% from 1990 emission levels, most of which originated from electricity generation, transportation, and industry (Wheeler 2008). As a result of the failure of the federal government to take drastic legislative and executive policy steps to diminish these carbon dioxide emissions, subnational governments began to construct a patchwork of GHG policies. The most commonly utilized policies were through GHG climate inventories, action plans, and reduction targets.[2] Most of those involved in the creation of these policies indicated that a moral imperative drove them to combat climate change through subnational action (Wheeler 2008). Through these policies, states attempted to change public and private economic behavior in energy, transportation, and industrial development, which they viewed as contributing to the problem of anthropogenic climate change.

This dissertation chapter investigates the entirety of the state climate policy niche through the adoption of three state climate change policies.[3] Each policy addressed different parts of the problem: climate inventories measure the amount of state GHGs, climate action plans analyze ways to reduce GHGs throughout a state's economy, and climate reduction plans establish timelines for reducing these emissions. This chapter ultimately seeks to address the following

---

[2] Often these policies are referred to as Climate Action Plans. However, since this study dissects these policies into three different components, one of which is a plan of specific actions to mitigate climate change, for sake of clarity, collectively these are referred to "GHG tracking and reduction policies" to refer to these three major subnational policies

questions: 1) do state political and economic factors influence the rate of adoption of these policies, or 2) do external state factors, such as regional and neighbor adoption rates, matter? I use internal determinants and policy diffusion theory (Berry and Berry 1990) to examine the speed of adoption of each of these GHG tracking and reduction policies and answer these questions.

The approach of this chapter is necessary for theoretical and empirical reasons. First, previous literature only analyzes the adoption of one climate change policy at a time. While previous scholars investigate the factors that influence the adoption of climate change policies like Renewable Portfolio Standards, Net Metering, et cetera (Carley and Miller 2012), often these policies are only one component of the climate change policy field. Second, the methodological approach of scholars who investigate climate change policies is limited. Finally, previous analysis ignores the adoption of these GHG tracking and reduction policies and the relationship between them. The advantages of comparing these three policies are: 1) they are often adopted together, 2) they span across sectors that contribute to climate change, and 3) there is variation across states in the adoption of all three policies.

Using adoption data from the EPA spanning from 2001 to 2010, this study finds, consistent with past research, that internal state politics play the largest influence in adoption of all three climate governance policies. The evidence suggests that the policies that develop, track, solutions, and create goals are more likely to be adopted as a result of a more liberal state citizenry. Additionally, states with more conservative citizens are more likely to adopt no policies or only Greenhouse Gas inventories. Conversely, states with more liberal citizens are more likely to adopt all three climate policies.

This chapter first discusses the diffusion and internal determinants theories of policy adoption. Secondly, it explores the literature concerning state climate policies. Thirdly, it evaluates the variables that influence the adoption of these climate change policies, and finally discusses the empirical results and implications.

Literature review

Diffusion and Internal Determinants

Theoretical and empirical studies in the policy diffusion literature established that both internal and external factors influence the adoption of subnational policies. Initially, public policy studies addressed the speed of adoption of similar policies across subnational governments in the United States (Walker 1969). Subsequent studies continued to clarify the theory in order to separate and further understand the internal and external dynamics in this process (Berry and Berry 1990). Internal determinants literature sought to determine if political, economic, problem severity or any other internal state factors push states to adopt certain policies. The diffusion of innovation literature investigated outside factors such as neighboring and regional state influences or external factors in the adoption of policy. However, more recently, many scholars have made efforts to combine both external and internal factors into a single framework to explain policy adoption across numerous subnational policies (see: Barrilleaux and Miller 1988; Haider-Markel 2001; Hays and Glick 1997). Currently, a proliferation of literature using both of these theories explains the adoption emerging subnational climate change policies.

Subnational Climate Change Policies

The two aforementioned theoretical frameworks have been fruitfully applied to the question of subnational climate change policies. Climate change policies attempt to mitigate the factors contributing to anthropogenic climate change to encourage a market transition away from traditionally carbon-dioxide intensive economic sectors (like oil, natural gas, and coal) to “cleaner” renewable energy sources (wind, solar, biodiesel, etc.). Scholars investigated different climate policies, such as Net Metering (Stoutenborough and Beverlin 2008), Renewable Portfolio Standards (Lyon and Yin 2008; Coley and Hess 2012; Fowler and Breen 2013; Matisoff 2008), Property-Assessed Clean Energy (Coley and Hess 2012), and Sustainable Energy Portfolios (Chandler 2009), and other policies seeking to assist in this energy transition. Other policies include investigating building efficiency to reduce the consumption of energy from buildings, direct caps on carbon dioxide emissions and other policy goals. Essentially, these groups of policies seek to minimize carbon dioxide emissions from the energy, transportation, and buildings sectors.

Previous research indicates mixed results concerning climate change policy adoption by emphasizing the role of internal state economic and political factors over regional or neighboring effects. Matisoff (2008) finds that the adoption of Renewable Energy Portfolios depends on citizen ideology instead of regional or neighboring adoption effects (Matisoff 2008). Stoutenborough and Beverlin (2008) find that Net Metering policies diffused in patterns based on the EPA region of previous adopters, which suggests that geography does matter in the adoption of new clean energy/climate change policies.

There are two main problems with this literature. First, most of these scholars only address the adoption of specific energy policies, which only focus on a narrow portion of a spectrum of climate change policies. To address the internal and external factors influencing climate policy, scholars must address policies that cross multiple economic sectors, due to the complexity of each in attempting to mitigate the factors that contribute to climate change.

Second, previous climate change scholarship that attempts to explain the entire climate change niche suffers from methodological problems. Matisoff (2008) provides some evidence for the political and economic factors in the adoption of an aggregated total of climate change policies (GHG tracking and reduction policies included). However, he does not incorporate internal and external factors into a single framework. Instead, his study only addresses internal factors and fails to address external ones, primarily because the aggregation of these policies prevents the use of time sensitive variables which measure for effects like neighborhood and regional diffusion effects. Additionally, Matisoff (2008) treats each of these policies as equal to one another, although certain factors may be more important for some policies and less for others. This chapter disaggregates these policies by focusing on three GHG tracking and reduction policies in separate statistical models and compares the influence of each factor on their adoption.

In this chapter, I overcome these problems by first combining internal and external factors into the same statistical models. Second, I do not look only at one climate change policy, but instead I address three climate tracking and reduction policies which is representative of a state's effort to address climate change. This allows me to compare and contrast policies that involve all economic sectors, but with divergent climate mitigation policy goals.

GHG Tracking and Reduction Policies

In the past decade, state officials adopted three broad interrelated policies for state climate change mitigation: GHG Inventories, GHG action plans, and GHG reduction targets.

These three mitigation policies are built upon the principles of calculating emissions, adopting targets, developing policies, implementing measures, and monitoring results (Pollak et al. 2011). First, states develop ways to calculate and track GHG emissions through GHG inventories. Using software from the Center for Climate Strategies, inventories set-up data collection mechanisms, and quantify GHG emissions by a state's economic sectors and sources (Lutsey and Sperling 2008). These policies collect specific GHG emissions, identify sectors and activities that emit pollutants, and track progress in reducing emissions ("Greenhouse Gas Inventories" 2014).[4] Adopted widely around the U.S., thirty-one states have adopted GHG inventories between 2002 and 2010. For some Southern states, like Oklahoma and Texas, who are reluctant to adopt other climate change policies, this is the only reduction and tracking policy adopted by these states.

Second, states adopted GHG action plans. Developed by governing state parties, major regional business interests, and environmental organizations, these plans generally include specific proposals or plans to develop and implement change mitigation, which often includes utilities, land use, building codes, transportation, taxation, environmental programs, and other policy areas ("Climate Action Plans" 2014; Pollak et al. 2011). Pollak et al. (2011) indicate that the most common strategies consist of improving building efficiency, the promotion of renewable energy, and modification of forests and soils. Most surveyed climate action plan participants indicate that these strategies were better for promoting economic opportunities and

[4] These inventories are separate from the Mandatory Reporting of Greenhouse Gases Rule of 2009, which mandates that the EPA gather emissions data for the National Greenhouse Gas Inventory (Cook 2013).

less likely to produce economic and environmental risks. Thirty-two states have adopted action plans between 2002 and 2010.

Finally, states can adopt climate reduction targets. These policies set emissions targets for the state to reach by a certain year compared to a baseline year (Drummond 2010). States may set targets based on entire sectors or specific economic sectors. These goals may be either voluntary reductions or mandatory ones. For example, in 2006, California adopted a statewide cap on emissions at 1990 levels by 2020, which mandated sector-wide emission reductions.[5] Normally, these targets are embedded within climate action plans for specific goals and targets for states to meet. However, not every state adopts a mitigation goal. Only twenty states have adopted GHG reduction between 2001 and 2009.

Often state agencies, such as departments of environmental protection, air quality agencies, and governors' offices take the lead in the development of these policies. Many different stakeholders partake in an advisory group which either creates or assists in the construction of these policies (Wheeler 2008). As indicated in Table 1, while some states adopt all three policies to achieve these goals, others adopt only one or two.

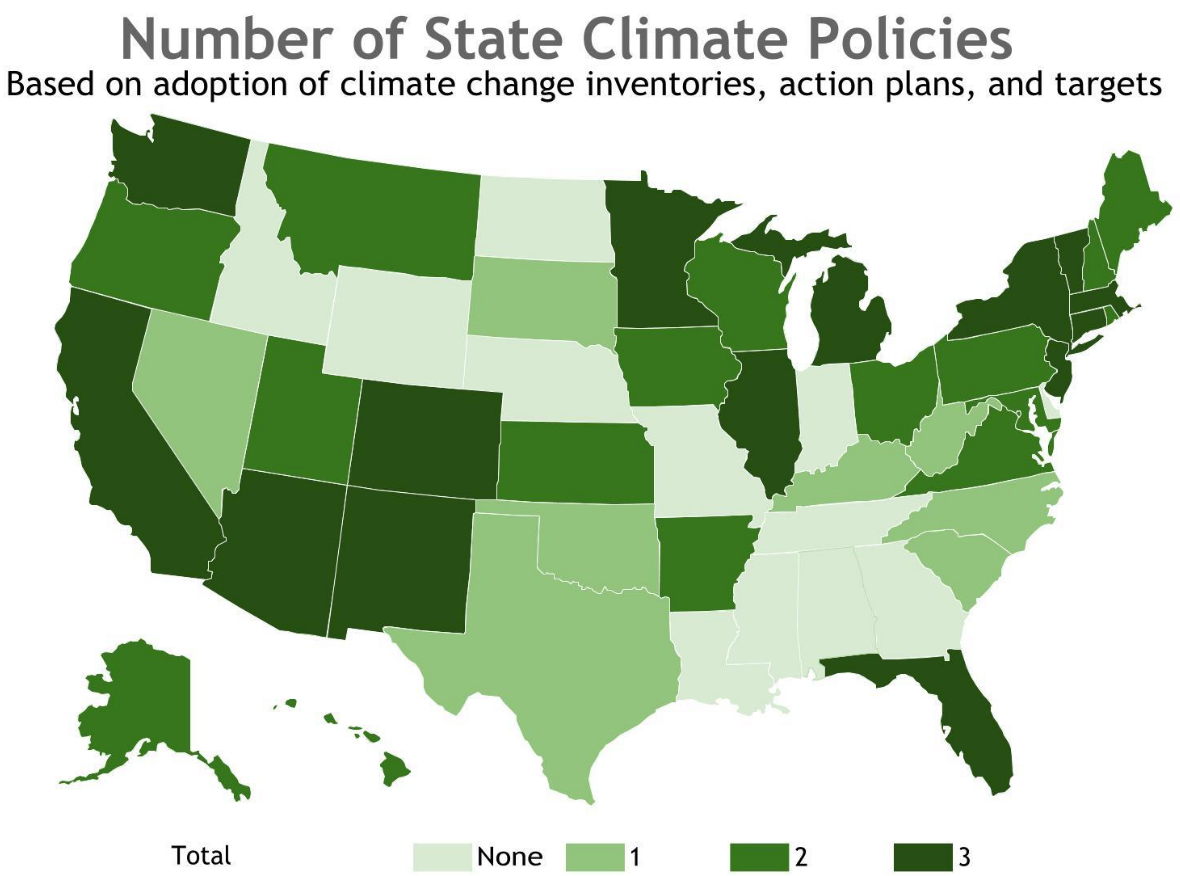
[5] http://www.c2es.org/sites/default/modules/usmap/pdf.php?file=5902

Table 1: Adoption Dates for Each Climate Change Policies (source: EPA)

State	Inventory	Action Plan	Emission Goals
Alabama	X	X	X
Alaska	2008	2009	X
Arizona	2006	2006	2006
Arkansas	2008	2008	X
California	2007	2006	2005
Colorado	2007	2007	2008
Connecticut	2006	2005	2008
Delaware	X	X	X
Florida	2008	2008	2007
Georgia	X	X	X
Hawaii	2003	X	2007
Idaho	X	X	X
Illinois	2007	2007	2007
Indiana	X	X	X
Iowa	2011	2008	X
Kansas	2008	2011	X
Kentucky	X	2011	X
Louisiana	X	X	X
Maine	X	2004	2003
Maryland	X	2008	2009
Massachusetts	2009	2004	2008
Michigan	2005	2007	2009
Minnesota	2008	2008	2007
Mississippi	X	X	X
Missouri	X	X	X
Montana	2008	2007	X
Nebraska	X	X	X
Nevada	2008	X	X
New Hampshire	X	2009	2002
New Jersey	2008	2008	2007
New Mexico	2006	2006	2005
New York	2008	2009	2002
North Carolina	X	2008	X
North Dakota	X	X	X
Ohio	2011	2011	X
Oklahoma	2002	X	X
Oregon	X	2011	2007
Pennsylvania	2006	2009	X

Rhode Island	X	2002	2002
South Carolina	X	2008	X
South Dakota	2007	X	X
Tennessee	X	X	X
Texas	2002	X	X
Utah	2007	2007	X
Vermont	2007	2007	2006
Virginia	2008	2008	X
Washington	2007	2008	2007
West Virginia	2003	X	X
Wisconsin	2007	2008	X
Wyoming	X	X	X
Total	30	32	20

Figure 1: Number of state Climate Policies



Climate Tracking and Reduction Scholarship

Although much is known about state climate tracking and reduction policies, surprisingly no research has examined the adoption of these policies. Of those scholars who investigate specific climate change policies, most only address the details and impact of the GHG tracking and reduction policies. Lutsey et al. (2008) explains some of the minutiae surrounding these three policies, including state adoption at the time and information about each policy. Gallivan et al (2011) investigates the flaws in current GHG inventories, action and reduction plans in achieving planned outcomes and the divergence of results. Others notice the positive impact of the adoption of one or more of these policies and find that states that adopt these policies produce modest reductions across state commercial and transportation sectors (Drummond 2010).

Despite vast information on some climate change policies, existing literature fails to explore the adoption of state GHG tracking and reduction policies. While Matisoff (2008) aggregates GHG tracking and reduction policies into an amalgamated measure of state adoption of climate change policies, the methodology fails to capture the variation of adoption patterns and, because of temporal constraints, does not incorporate post-2005 adoption of these policies. This is especially problematic when a majority of states adopted climate action plans (27 out of 32 states), GHG inventories (25 out of 30 states) and reduction policies (15 out of 20 states) between 2006 and 2010. Further investigation that includes adoption analysis provides a fuller picture of the development and impact of these policies.

The limitations of the scholarship at the state level are overcome by city-level scholarship. Scholars explore the municipal policies of Green Building Policies (Kontokosta

2011) and climate action plans (Bassett and Shandas 2010; Tang et al. 2010; Krause 2011a; Krause 2011b). Plenty of urban policy scholars provide empirical evidence and details surrounding city level climate action plans (Bassett and Shandas 2010; Tang et al. 2010; Krause 2011a; Krause 2011b). Krause (2011) links city and state action plans through multi-level analysis to determine the influence of state characteristics and adoption of GHG reduction target and climate action plans on a city's adoption of a Climate Protection Agreement. While analysis of the adoption of climate action plan scholarship is mainly limited to city level, this analysis provides a methodological foundation for a state level approach.

Dataset, Methods, and Variables

This chapter includes a cross-sectional time-series dataset and analyzes the factors that influence the adoption of these three different subnational climate change policies between 2001 and 2010, since most states began and ended the adoption process during this period. [67] Similar to previous research on the influence of subnational adoption of policies at the state level (see: Berry and Berry 2007), this chapter uses Event History Analysis to statistically analyze the state adoption of each GHG tracking and reduction policy.

Dependent variables

The major dependent variables in this study are the adoption dates of these three policies. The EPA chronicled the adoption of subnational GHG action plans ("Climate Action Plants" 2014), GHG inventories ("Greenhouse Gas Inventories" 2014), and GHG reduction targets (Greenhouse Gas Emission Targets" 2014). Thirty states adopted a GHG inventory, thirty-two

---

[6] There have been two waves for climate action plans. Most scholarly attention investigates the second wave. This is for good reason because most state funding and planning occurred in this second way (Wheeler 2008).
[6] The year 2011 had to be dropped from the analysis due temporal constraints of the citizen ideology measure. However, only Ohio's adoption of GHG inventory is dropped from the analysis.

adopted a climate action plan, and twenty adopted emission targets. Fourteen states adopted all three plans, while eleven adopted none. Those who adopted partial plans either decided to only adopt GHG inventories (5 total) or adopt inventories and action plans but no emission goals (10 total).

Independent Variables

I analyze the internal and external state variables that influence state adoption of policies. External variables consist of whether neighboring or regional states adopted these policies, as well as the ideological distance of previous state adopters. Internal state factors should also play an additional role in adoption; therefore, state characteristics, such as citizen ideology, partisan type of governor, level of gross state product, carbon dioxide emissions, and renewable energy potential should affect adoption, which are most commonly used in the climate change policy and diffusion literatures.

Hypotheses

Hypothesis #1: States neighboring adopters of climate change action plans, GHG inventories, and reduction targets are more likely to adopt these policies.

As previously mentioned, traditional diffusion literature identifies that states that border other states that adopt a policy are more likely to adopt that policy. Using data acquired from adoption year of states along with percentage of state adopters on a state's border by year.

Hypothesis #2: States in the same EPA region of the adopters of climate change action plans, GHG inventories, and reduction targets are more likely to adopt these policies.

Similar to measures of neighborhood diffusion, adoption of subnational climate change and energy policies is often associated with regional diffusion variables. Stoutenborough and Beverlin (2008) notice patterns of regional diffusion of environmental and energy policies based on whether or not states are in the same EPA region. Using data acquired from adoption year of states along with EPA region maps, this study I create a variable that shows the percentage of state adopters in a state's EPA region by year.

Hypothesis #3: States similar in government ideology to adopters of climate change action plans, GHG inventories, and reduction targets are more likely to adopt these policies.

I measure the ideological distance between previous adopters and the state in question. Grossback et al. (2004) argues that when a state adopts a policy, it sends a signal to other states about the position of that policy on the ideological spectrum. The closer a state is ideologically to previous state adopters the more likely they are to adopt the same policy than those further away. A variable similar to Grossback (2004) is constructed based on the state government ideological scores developed by Berry and Berry (1998) and adoption patterns of GHG tracking and reduction policies.

Hypothesis #5: States with more liberal citizenry are more likely to adopt climate change action plans, GHG inventories, and reduction goals.

Research indicates that citizen ideology is a major influence on the adoption of subnational climate change policies (Matisoff 2008). The more liberal the public, the more likely states produce policies to respond to climate change policy due to an ideological belief in the role of government to intervene in the economy to achieve certain goals. I use the revised 1960 to 2010 citizen ideological series (Berry et al. 1998) between 2002 and 2010.

Hypothesis #6: States with Democratic governors are more likely to adopt climate change action plans, GHG inventories, and reduction goals.

As many states rely on the executive branch to write and implement all three of these policies, the party identification of the sitting governor should matter in adoption. Previous scholars indicate states with Democratic governors support pro-environmental policy (Lester 1980). States with Republican governors should be less likely than Democratic ones to adopt these policies due to ideological preferences concerning the role of government in solving environmental problems. The data used in this study includes the party of the governor between 2001 and 2010.

Hypothesis #7: States with higher Gross state product (GSP) are more likely to adopt climate change action plans, GHG inventories, and reduction goals.

Previous studies of bureaucracies indicate that resources play a key role in a state's decision to innovate (Mohr 1969). While Matisoff (2008) finds no evidence that state financial resources influence the adoption of Renewable Energy Portfolio Standards and energy efficiency programs. However, Chandler (2009) finds that state affluence is a key factor in the development of Sustainable Energy Portfolios. To ensure that state innovation of GHG tracking and reduction policies is not hampered by lack of state resources, I use a measure based on a state's Gross State Product per capita from the Bureau of Economic Analysis between 2001 and 2010, similar to the one developed in Matisoff (2008).

Hypothesis #8: States with more carbon dioxide emissions are more likely to adopt climate change action plans, GHG inventories, and reduction goals.

In studies of the adoption of energy efficiency and renewable promotion policies, Matisoff (2008) finds some evidence that states with a more carbon-based economy are less likely to adopt these initiatives. In a similar manner, states that emit more carbon dioxide may be less likely to adopt GHG track and reduction policies to protect carbon-intensive industries. A measure is built based on the Energy Information Administration's estimates of carbon intensity by state.

Hypothesis #9: *States with more potential for renewable energy are more likely to adopt climate change action plans, GHG inventories, and reduction goals.*

One major component of these GHG tracking and reduction policies is the promotion of alternative, less carbon intensive energy sources. Two major sources of renewable energy are wind and solar power. It would be expected that state officials would be more likely to adopt these policies if they saw it as a chance to promote these energy sources. There is past evidence that suggests this is the case. Lyon and Yin (2008) find that those states with large wind and solar potential are more likely to adopt renewable energy portfolios. As a result, states should be more likely to adopt these policies if there is higher potential for wind and solar power in a state.

Results

To explore the relationship between political and economic conditions and the adoption of these three GHG tracking and reduction policies, I use logistic regression with an Event History Analysis (EHA) structured dataset. Since the dependent variable is temporal and dichotomous, logit with EHA is appropriate.

Table 2: Determinants of the Adoption of GHG Inventory (Logistic Regression)

DV: Adoption by state and year	Full Model	Reduced Model 1	Reduced Model 2	Reduced Model 3
Neighbor Adoption	-1.862*	-1.093		
	(1.108)	(0.968)		
Regional Adoption	1.178		0.591	
	(1.090)		(0.926)	
Ideology Distance	-0.0457			-0.0324
	(0.0685)			(0.0656)
State Citizen Ideology	0.0706***	0.0677***	0.0617***	0.0710***
	(0.0222)	(0.0200)	(0.0198)	(0.0212)
Party of Governor	0.343	0.290	0.241	0.310
	(0.454)	(0.435)	(0.433)	(0.446)
Gross State Product	6.91e-06	5.23e-06	4.22e-06	6.09e-06
	(6.60e-06)	(5.93e-06)	(5.76e-06)	(6.57e-06)
C02 Production	0.00628	0.00539	0.00436	0.00634
	(0.00629)	(0.00601)	(0.00580)	(0.00617)
Coal Production	6.30e-08	-4.36e-08	-4.29e-08	5.00e-08
	(2.21e-07)	(2.09e-07)	(2.11e-07)	(2.18e-07)
Natural Gas Production	3.39e-07	7.37e-07*	5.35e-07	3.68e-07
	(5.08e-07)	(4.42e-07)	(4.38e-07)	(4.78e-07)
Wind Potential	5.53e-07**	5.29e-07**	4.88e-07**	4.95e-07**
	(2.32e-07)	(2.17e-07)	(2.10e-07)	(2.27e-07)
Solar Potential	0.0652	0.0522	0.0530	0.0769
	(0.0874)	(0.0801)	(0.0817)	(0.0866)
Population	-4.59e-07	-3.42e-07	-2.88e-07	-4.42e-07
	(4.65e-07)	(4.19e-07)	(4.13e-07)	(4.70e-07)
Year	0.300*	0.319**	0.179	0.233**
	(0.155)	(0.126)	(0.123)	(0.108)
Constant	-607.2*	-647.2**	-365.7	-474.4**
	(310.6)	(253.5)	(247.1)	(216.9)
Pseudo R-squared	0.1667	0.1791	0.1749	0.1507
Proportional Reduction in Error	0.00%	6.67%	10.00%	0.00%
Observations	326	376	376	326

Logit coefficients in coefficient lines, Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Determinants of the Adoption of GHG Targets (Logistic Regression)

DV: Adoption by state and year	Full Model	Reduced Model 1	Reduced Model 2	Reduced Model 3
Neighbor Adoption	-0.410	-0.960		
	(1.290)	(1.093)		
Regional Adoption	2.588*		-0.000356	
	(1.534)		(0.986)	
Ideology Distance	-0.0544			-0.0479
	(0.0374)			(0.0330)
State Citizen Ideology	0.0811**	0.0719***	0.0625***	0.0848***
	(0.0358)	(0.0245)	(0.0224)	(0.0320)
Party of Governor	0.722	0.690	0.713	0.111
	(1.183)	(0.550)	(0.566)	(1.002)
Gross State Product	1.60e-05	8.11e-06	7.56e-06	1.33e-05
	(1.02e-05)	(7.46e-06)	(7.64e-06)	(9.76e-06)
C02 Production	-0.0244*	-0.0181*	-0.0174*	-0.0153
	(0.0132)	(0.0104)	(0.0103)	(0.0114)
Coal Production	5.56e-08	-5.06e-07	-4.35e-07	-2.32e-07
	(6.21e-07)	(7.04e-07)	(6.93e-07)	(6.38e-07)
Natural Gas Production	2.60e-07	8.47e-07	7.67e-07	2.50e-07
	(7.04e-07)	(5.97e-07)	(5.92e-07)	(6.44e-07)
Wind Potential	5.12e-07	-2.08e-07	-1.78e-07	2.09e-07
	(5.11e-07)	(3.82e-07)	(3.86e-07)	(4.67e-07)
Solar Potential	0.628**	-0.0737	-0.0507	0.390*
	(0.262)	(0.105)	(0.109)	(0.204)
Population	-1.67e-06*	7.22e-08	4.43e-08	-1.16e-06
	(8.70e-07)	(4.49e-07)	(4.56e-07)	(7.54e-07)
Year	0.103	0.132	0.0920	0.160
	(0.182)	(0.132)	(0.123)	(0.167)
Constant	-215.7	-272.5	-191.3	-330.1
	(364.3)	(265.2)	(246.2)	(335.7)
Pseudo R-squared	0.3758	0.2889	0.2840	0.3537
Proportional Reduction in Error	-5.88%	5.00%	5.00%	-5.88%
Observations	352	402	402	352

Logit coefficients in coefficient lines, Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Determinants of the Adoption of GHG Action Plans (Logistic Regression)

DV: Adoption by state and year	Full Model	Reduced Model 1	Reduced Model 2	Reduced Model 3
Neighbor Adoption	0.483	0.584		
	(1.092)	(0.846)		
Regional Adoption	0.333		0.506	
	(1.221)		(0.929)	
Ideology Distance	-0.0183			-0.0179
	(0.0205)			(0.0201)
State Citizen Ideology	0.0508**	0.0660***	0.0631***	0.0519**
	(0.0244)	(0.0189)	(0.0190)	(0.0239)
Party of Governor	0.538	0.779*	0.861*	0.501
	(0.756)	(0.465)	(0.487)	(0.695)
Gross State Product	3.43e-06	3.54e-06	4.25e-06	3.09e-06
	(6.97e-06)	(6.28e-06)	(6.41e-06)	(6.70e-06)
C02 Production	-0.00888	-0.00968	-0.00977	-0.00957
	(0.00733)	(0.00719)	(0.00718)	(0.00732)
Coal Production	-2.39e-07	-2.01e-07	-2.14e-07	-2.42e-07
	(3.51e-07)	(3.41e-07)	(3.44e-07)	(3.47e-07)
Natural Gas Production	-4.51e-08	3.13e-08	2.59e-08	1.41e-08
	(4.34e-07)	(4.27e-07)	(4.31e-07)	(4.26e-07)
Wind Potential	2.43e-07	1.65e-07	1.69e-07	2.23e-07
	(2.40e-07)	(2.32e-07)	(2.31e-07)	(2.37e-07)
Solar Potential	0.138	0.129	0.130	0.122
	(0.0957)	(0.0872)	(0.0891)	(0.0906)
Population	-2.78e-07	-2.67e-07	-2.97e-07	-2.23e-07
	(4.95e-07)	(4.46e-07)	(4.58e-07)	(4.75e-07)
Year	0.255*	0.306**	0.301**	0.329***
	(0.152)	(0.120)	(0.135)	(0.119)
Constant	-517.8*	-621.1**	-610.9**	-665.0***
	(305.1)	(241.4)	(270.4)	(239.7)
Pseudo R-squared	0.2283	0.2331	0.2323	0.2249
Proportional Reduction in Error	-3.45%	-13.33%	-13.33%	-10.34%
Observations	340	390	390	340

Logit coefficients in coefficient lines, Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

As indicated by Table 2 through 4, external factors seem to play a limited role in the adoption of climate change policies. For the most part, there is no relationship between adoption of these policies and neighboring and regional adoption, along with the ideology of previous adopters. The only external factors to play a modest role are the regional adoption of climate reduction policies (Table 3, Full Model), and the neighborhood adoption of GHG inventories (Table 2). For climate reduction policies, states are more likely to adopt these policies if other regional states adopt as well. This makes sense concerning many Northeastern states participate in the Regional Greenhouse Gas Initiative, which includes caps on emissions. Previous discussion through this initiative could have provoked states to talk about how to coordinate their targets with other participants. Nevertheless, these results are quite weak and should be questioned. For the GHG inventory results, one should view these results with caution because it is the weakest model in Table 2 (pseudo-R squared of 0.1667).

The strongest results come from internal state factors influencing the adoption of all three climate change policies. The strongest of these internal factors include state citizen ideology. Across all models, as states become more liberal, then they are more likely to adopt these policies. Economic factors through increase consumption of energy and gross state product are more important for states who adopt reduction goals. There is some evidence that as renewable potential increases, then the more likely a state adopts GHG inventories and reduction policies. Additionally, across three models in Table 3 there is some, but weak, evidence that states that produce smaller carbon dioxide emissions are more likely to adopt GHG targets. Also, Democratic governor are more likely to adopt climate action clans (Table 4). However, the results for carbon dioxide emissions and party of governor are not consistent across models.

Citizen ideology is the strongest indicator across climate policy and statistical model of adoption. Univariate analysis indicates that that across these policies, states with more liberal populations are more likely to adopt these climate policies rather than others.

Table 3: Average State Citizen Ideology at Policy Adoption year	
All 3 policies	63.22
Plans and Inventories	55.00
Only Inventory	45.57
No policies	39.23

As Table 3 indicates, citizen ideology separates adoption of all parts of a plan with no policies at all. The average ideology of states when adopting all policies is at 63.22 (out of 100), compared to the average ideology of states who don't adopt the policies at 39.2295 (between 2002 and 2011). This indicates that more liberal states adopt more climate change policies. There are also ideological differences in each type of policies. The average ideology of states who adopt GHG inventories is 57.41, action plans are 61.19, and reduction targets are 66.00114.

Discussion

The evidence presented here is mostly consistent with previous research: internal state politics influence climate policy outcomes. However, the results here present a slightly different picture. Previous research suggests that government ideology impacts a state's willingness to develop plans to address climate change. Yet, there is only a weak link between the adoption of these policies and the party of the sitting governor. This suggests that those who often are the initiators of these policies are responding to state government ideological pressures. This indicates that political actors mostly respond to political demands of climate change policies, despite their own political affiliation.

Also, less liberal states are willing to adopt policies to gather data concerning the problem through carbon dioxide inventories. Only more liberal states establish actual plans for action and set goals. This suggests that for the most part, rather than external ideological cues about the validity of a policy, states adopt and modify their policies to fit their own statutory and economic goals and political contexts. States may be willing to adopt policies to look at the problem of climate change, but that does not mean that they enact policies to actually mitigate the problem.

Additionally, there are still some null or inconsistent findings concerning other external and internal state factors. Those states that have neighbors or regional adopters, ideological similar to previous adopters, have more financial resources, are no more or less likely to produce plans or goals for GHG reduction. This suggests that internal politics considerations matter the most when considering adoption.

There is also inconsistent evidence that a state's ability to develop climate change policies is contingent on the development of renewable resources or traditional energy sources. While states with high potential for wind energy development are more likely to develop GHG inventories and those with higher solar potential are more likely to adopt reduction plans. There is only limited evidence that states adopt these to boost renewable energy development. Also, only in some models is there evidence that states with less carbon dioxide emissions are more likely to adopt GHG targets, which suggests that states with less severe GHG problems are the ones likely to try to set goals to solve the problem.

Conclusion

There are several theoretical, empirical, and policy implications from this chapter. First, consist with previous theoretical arguments about climate change policy. Internal factors play a larger role in the adoption of climate change policy. Internal politics (i.e. citizen ideology) mostly dominate considerations of the adoption of state climate change policies. With some exceptions, external pressures play a minimal role. The lack of external pressure to adopt these policies since these policies can cover a large portion of a state's economy and external cues about the validity of these expansive policies may be limited. Not only do states tailor their climate action plans to their own specific economic needs, the initial decision to adopt these policies in the first place depend on the ideological make-up of the public. Other factors such as financial constraints, problem severity, and renewable energy play less of a factor.

The empirical evidence also suggests that those states most likely to contribute to the problem of climate change are those states no or more less likely to adopt policies to solve the problem. Large producers of carbon dioxide emissions, like Texas and Louisiana, are more hesitant or refuse to address the problem on their own. The counter-example would be large states, like California and New York, also who adopted all three climate policies but are significant carbon producers.

The evidence presented here, along with past research, suggests the limitations of states to properly mitigate the GHGs that affect the climate. Not only is the number of states who adopt these policies limited, states may run into climate governance problems with the limited amount of financial resources and partial implementation of these tracking and reduction policies. One common criticism climate action plans, is that while states develop plans for action, often these policies lack the monetary backing necessary to properly achieve intended goals (Wheeler 2008). Additionally, Pollak et al. (2011) indicate that the non-binding nature of climate actions plans affects whether actual policy implementation mirrors the initial recommendations. They note that major shifts with economic and political environment can change the viability of the adoption of these policies. All of which may hamper states to govern on their own.

There are several limitations in this study that must be built upon into the future. New research indicates that the strictness of a policy may also influence where or not a policy is adopted (Carley and Miller 2012). Further research could further analyze the details of each climate action through an institutional grammar tool developed by Sue Crawford and Elinor Ostrom (1995). This tool could further analyze components of climate action plans to indicate plan strengths and weaknesses. This could provide further into why certain language is adopted for these types of policies by state. This could allow for further development of a strength of adoption variable which would explore beyond the dichotomous nature of these policies presented in this study.

The analysis presented here shows potential warning signs for cooperation between the federal and state governments in the future over mitigation issues. If states are reluctant to voluntarily adopt policies to address the problem of climate change, this indicates a possible contentious environment for the EPA’s mandate for states reach certain carbon dioxide emission goals. The political reality of clean air politics in some states may come into direct conflict with these ambitious goals into the future. However, what is certain is that on their own, state climate policy adoption is not enough to address the magnitude of this global issue.

References

(2014). "Climate Change Action Plans." Retrieved 3/11, 2014, from http://epa.gov/statelocalclimate/state/state-examples/action-plans.html.

(2014). "Greenhouse Gas Inventories." Retrieved 3/14, 2014, from http://epa.gov/statelocalclimate/state/state-examples/ghg-inventory.html#all.

Barrilleaux, C. J. and M. E. Miller (1988). "The political economy of state Medicaid policy." The American Political Science Review: 1089-1107.

Bassett, E. and V. Shandas (2010). "Innovation and climate action planning: Perspectives from municipal plans." Journal of the American Planning Association 76(4): 435-450.

Berry, F. S. and W. D. Berry (1990). "State lottery adoptions as policy innovations: An event history analysis." The American Political Science Review: 395-415.

Berry, F. S. and W. D. Berry (1992). "Tax innovation in the states: Capitalizing on political opportunity." American Journal of Political Science: 715-742.

Berry, W. D. (2011). A New Measure of State Government Ideology, and New Evidence that an Old Measure Performs Well, Indiana State University.

Boswell, M. R., et al. (2010). "An assessment of the link between greenhouse gas emissions inventories and climate action plans." Journal of the American Planning Association 76(4): 451-462.

Carley, S. and T. R. Browne (2012). "Innovative US energy policy: a review of states' policy experiences." Wiley Interdisciplinary Reviews: Energy and Environment.

Chandler, J. (2009). "Trendy solutions: why do states adopt sustainable energy portfolio standards?" Energy Policy 37(8): 3274-3281.

Coley, J. S. and D. J. Hess (2012). "Green energy laws and Republican legislators in the United States." Energy Policy 48: 576-583.

Crawford, S. E. and E. Ostrom (1995). "A grammar of institutions." American Political Science Review 89(03): 582-600.

Drummond, W. J. (2010). "Statehouse Versus Greenhouse: Have State-Level Climate Action Planners and Policy Entrepreneurs Reduced Greenhouse Gas Emissions?" Journal of the American Planning Association 76(4): 413-433.

Fowler, L. and J. Breen (2013). "The Impact of Political Factors on States' Adoption of Renewable Portfolio Standards." The Electricity Journal.

Haider-Markel, D. P. (2001). "Policy diffusion as a geographical expansion of the scope of political conflict: Same-sex marriage bans in the 1990s." State Politics & Policy Quarterly 1(1): 5-26.

Hays, S. P. and H. R. Glick (1997). "The role of agenda setting in policy innovation." American Politics Research 25(4): 497-516.

Kontokosta, C. E. (2011). "Greening the regulatory landscape: the spatial and temporal diffusion of green building policies in US cities." The Journal of Sustainable Real Estate 3(1): 68-90.

Krause, R. M. (2011). "Policy innovation, intergovernmental relations, and the adoption of climate protection initiatives by US cities." Journal of Urban Affairs 33(1): 45-60.

Krause, R. M. (2011). "Symbolic or substantive policy? Measuring the extent of local commitment to climate protection." Environment and Planning C: Government and Policy 29(1): 46-62.

Lester, J. P. (1980). "Partisanship and Environmental Policy The Mediating Influence of State Organizational Structures." Environment and Behavior 12(1): 101-131.

Matisoff, D. C. (2008). "The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants?" Review of Policy Research 25(6): 527-546.

Pollak, M., et al. (2011). "Reducing greenhouse gas emissions: Lessons from state climate action plans." Energy Policy 39(9): 5429-5439.

Rabe, B. G. (2008). "States on steroids: the intergovernmental odyssey of American climate policy." Review of Policy Research 25(2): 105-128.

Stoutenborough, J. W. and M. Beverlin (2008). "Encouraging Pollution-Free Energy: The Diffusion of State Net Metering Policies*." Social Science Quarterly 89(5): 1230-1251.

Tang, Z., et al. (2011). "Examining locally driven climate change policy efforts in three Pacific states." Ocean & Coastal Management 54(5): 415-426.

Tang, Z., et al. (2010). "Moving from agenda to action: evaluating local climate change action plans." Journal of environmental planning and management 53(1): 41-62.

Urpelainen, J. (2009). "Explaining the Schwarzenegger phenomenon: local frontrunners in climate policy." Global Environmental Politics 9(3): 82-105.

Wheeler, S. M. (2008). "State and municipal climate change plans: the first generation." Journal of the American Planning Association 74(4): 481-496.

Yi, H. (2012). "Policy Networks, Environmental Impacts And Economic Consequences Of Clean Energy In The Us: A National, State And Local Investigation."

Appendices

Variable List	
Name	**Description**
State Climate Action Plans	0= Not Adopt, 1=Adopt. http://epa.gov/statelocalclimate/state/state-examples/action-plans.html#all
State Greenhouse Gas Inventories	0= Not Adopt, 1=Adopt. http://epa.gov/statelocalclimate/state/state-examples/ghg-inventory.html#all
State Reduction Goals	0= Not Adopt, 1=Adopt. http://www.epa.gov/statelocalclimate/state/tracking/targets-caps.html#a03
Neighboring Adoption	Whether or not a state's neighbor has adopted a relevant policy (EPA).
Regional Adoption	Whether or not a state in an adopter's EPA region has adopted a relevant policy
Ideological Distance	Distance of state from previous climate change policy adopters.
Citizen Ideology	0-100 scale. 0= Very Conservative. 100= Very Liberal. Adapted from Berry et al. (2007). Years 2001-2011 are 2006 repeated. Berry et al. 2007.
Governor	Party of governor. 0=Republican, 1= Democratic.
GSP	Gross State Product per capita 2002-2011. Bureau of Economic Analysis.
C02	CO2 Emissions from Fossil Fuel Combustion - Million Metric Tons CO2. * Emission estimates are based on energy consumption data from EIA's State Energy Consumption, Price, and Expenditure Estimates (SEDS). 2002-2011. http://www.eia.doe.gov/emeu/states/_seds.html).
Fossil Fuel Production	Coal Production and Natural gas marketed production. Billion Btu. from EIA's State Energy Consumption, Price, and Expenditure Estimates (SEDS) . 2002-2011.
Solar Potential	National Renewable Energy Laboratory. Total Roof top PV Giga Watts per state. http://www.nrel.gov/gis/re_potential.html.
Wind Potential	State Wind Potential Annual Generation. Terawatt-hours (TWh). http://www.pnas.org/content/106/27/10933.full.pdf
Population	Raw population numbers by state.
Year	Year of each case

Chapter 2: Siting of New Coal-based Power

Responding to Clean Air Federalism: The Impact of a State's Regulatory Environment on the Siting of New Coal-based Power

In March 2012, the Obama administration proposed the first national limits on greenhouse gases from new power plants/stations. This decision met great resistance from some Republicans who argued that increasing costs on power plants would ultimately lead to blackouts and an upsurge in electricity rates. Conversely, many within the environmental movement believed this decision did not go far enough in combatting climate change, arguing that the decision only applied to new power plants and gave old coal-fired power plants years to comply with these standards (Associated Press 2012). Observers in the media suggested that the rule would have market implications and significantly limit the construction of new coal power plants until 2020 (Daily 2012).

Despite forecasts of the decline and the negative properties of new coal-fired power plants, coal remains the dominant resource in the U.S. energy market for both production and consumption. In 2010, forty-three percent of all electricity came from coal. Coal continues to be a vital, portable, and non-renewable resource for U.S. electricity production. The U.S. coal industry produces the second most coal in the world (only behind China) with over a billion tons extracted each year (EIA 2011). While coal is important economically-coal power plants produce fifty-nine percent of the nation's sulfur dioxide, eighteen percent of nitrogen oxide, fifty percent of particle pollution, forty percent of carbon dioxide, and contribute significant amounts of mercury and hazardous toxins into the environment (Sueyoshi and Ueno 2010). Most scientists agree that the pollutant emissions from coal-fired power plants are a significant contributor to anthropogenic climate change and negatively affect the health and environment.

Over time, federal and state governments developed policies to address both the over reliance on and negative health implications of coal.

Overall, the federal government has a mixed record on combatting air pollution. Many attribute the reduction of CAA air pollutants and improving the efficiency of *c*oal powered plants to the Clean Air Act (CAA) of 1963 (Sueyoshi and Goto 2012). However, the U.S. Congress failed to address the problem of escalating Greenhouse Gas (GHG) emissions—considered the root problem of anthropogenic climate change. The U.S. failed to ratify the Kyoto Treaty in 1998 and to implement "cap and trade" legislation in 2009 (Rabe 2004). While the federal government was successful in reducing some air pollutants, they were unable to reduce GHG emissions. Consequently states responded by making their own commitments to combat this problem through the development of climate change policies.

With the rise of state policy development on climate change, scholars began to study state climate change policy, but they under-address the regulatory regime's impact on traditional energy sources. Scholarship expanded to climate change related issues such as the development of state alternative energy policy (e.g. Byrne et al. 2007; Mazmanian 2008; Menz and Vachon 2006; Stoutenborough and Beverlin 2008; Weiner and Koontz 2010; Matisoff 2008), state reduction of greenhouse gases (e.g. Keeler 2007; Lutsey and Sperling 2008; Rabe 2004), and similarly, a robust collection of literature explains what state characteristics influence the adoption of more pro-environmental legislation (e.g. Bacot and Dawes 1997; Lester 1995; Matisoff 2008; Ringquist 1993; Potoski and Woods 2001; Koontz, 2002). However, only a few scholars directly consider how policy influences the use of traditional sources of energy (e.g. Peterson and Rose 2006; Horiuchi 2007; Hedge and Scicchitano 1994; Ringquist 1993), and examine the impact of CAA regulations on coal-fired power plant environmental and economic efficiency across states (Sueyoshi and Goto 2010; Sueyoshi et al. 2009; Fleishman et al. 2009).

Surprisingly, there remains a gap in the policy literature explaining how regulation affects the siting coal power plants.[8] States can place caps on carbon emissions, develop policies to encourage renewable energy, and make state air quality standards more stringent than national standards. Yet unexpectedly, the response of owners of power plants to this uneven regulatory context remains mostly a mystery. Did these state air regulations influence the siting of new coal-fired power by owners? More specifically, do strict, environmentally-friendly air quality standards under the CAA and the state regulatory context prevent the development of coal power in a state?

The case of coal-based power presents an opportunity in which to explore and address the "Race-to-the Bottom" (RTTB) hypothesis and clarify some of the past methodological problems. Since coal-based power is a high polluting industry and subject to many environmental regulations, the RTTB framework provides a lens to analyze private-enterprise decision-making. Policy scholars have found mixed evidence when they examined whether state governments reduce environment regulations or compliance in response to interstate economic competition as RTTB would suggest (Millimet 2003; Konisky 2009; Potoski 2001; Woods 2006; Konisky 2008). Economists have found unclear evidence about whether businesses respond by siting in states with less-stringent environmental standards *(*Levinson 1996; Fleishman et al. 2009). However, with new data on the permitting process for power plants and a better methodological

[8] A variety of public and private entities own and operate power generation facilities. From now on the term "owner" will refer to a mixture of these organizations.

approach of looking at business behavior at the beginning of the regulatory process, rather than the end, clarifies the consistencies with past research on this hypothesis.

Through the analysis of applications for air quality permits under the New Source Review (NSR) process, this study explains the variation of industry's behavior in response to diverse state air quality standards under the CAA. I review the history and detail of regulatory standards for new sources of pollution set by the CAA and I investigate how policy scholars evaluated energy policy on the national and subnational level. I then outline my expectations for how industry and states have likely responded to environmental regulations through the lens of the "Race-to-the-Bottom" effect. Through my statistical analysis, I highlight empirical evidence that suggests that the strictness of air quality regulations and the ideology of a state's citizenry guide the behavior of owners in the number of applications and size of proposed coal power during the permitting process. The evidence indicates that coal plant siting is a case in which certain kinds of states limit the effectiveness environmental standards.

<u>Literature Review</u>

Environmental Federalism and the Clean Air Act

Since the late 1970s and 1980s, the United States Environmental Protection Agency (EPA) devolved certain powers to state environmental agencies, and as a result, these subnational agencies were given more autonomy in the implementation and decision-making process of traditionally federally governed environmental programs. The Environmental Council of the States (ECOS) estimates that by 1998, the EPA gave states authority over 757 federal environmental programs, up from 434 in 1993, which also included eighty-two percent of all programs related to the Clean Air Act (Vig and Kraft 2003). By 2004, states issued ninety percent of all environmental permits, and three-fourths of all enforcement of environmental laws (Rabe 2004). The rise of the states in environmental policy-making also translated a rise in their authority over air quality.

Similarly, most of the air quality regulations in the United States originate from the CAA, but each state developed their own air quality regulations based on minimum requirements developed by the EPA. In this cooperative relationship, the EPA sets minimum standards for state air quality, ambient air standards, and the issuing of permits, as well as overlooks and approves state monitoring and enforcement programs. Through State Implementation plans (SIP), states define how they meet federal standards. If the EPA determines the SIP did not meet federal guidelines, then the EPA can "pre-empt" the state clear air programs and implement all or part of the program. Most states have their SIPs approved, and most programs met or exceed the EPA standards (Potoski 2001; Konisky and Wood 2010). This cooperation between the two set a minimum regulatory standard, but allowed for a great deal of regulatory variation across states.

In coordination with each other, both the federal government and states develop air quality programs, which consist of air quality standards, new source pollution standards, and monitoring systems. The EPA developed the National Ambient Air Quality Standards (NAAQS) for sulfur dioxide, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. These EPA standards dictated how much of each pollutant can been released into the air without posing a significant risk to the public's health (Potoski 2001). Based on those NAAQ standards, the state government then developed ambient air quality standards, which determines the standards for the allowable increases of pollution in an area (EPA 2012). With new sources of pollution, states developed New Source Performance Standards (NSPS). These standards govern new sources of emissions and their allowable concentration. Sources under NSPS are required to demonstrate initial performance tests to determine compliance (EPA 2012). To monitor industry's compliance, the states are required to develop an ambient monitoring standard to measure both the type and quantity of air contaminates (EPA 2012). The EPA mandates that states implement an air-monitoring program with a certain number of monitoring stations. States can choose whether to increase the number of monitoring stations in their program (Potoski 2001).

Companies go through an application process through state environmental agencies to build a new source/ expand upon existing coal power and provide information for different permits to meet these regulatory standards. One important stage for the permitting process is the pre-construction phase where new major sources of pollutants are subjected to the New Source Review (NSR). This review process consists of two rules: Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NSR). Power plants are subjected to these either/both these rules based location of the new source. The main difference is nonattainment NSR applies to nonattainment pollutants whereas PSD applies to attainment pollutants.[9] The EPA or a delegated state or local agency a state under an approved SIP issue PSD and NSR permits. Most states have their own SIP, and therefore state regulators issue permits.

While the federal government develops minimum standards for this application process, the stringency of state air quality regulatory process depends on the characteristics of the state. Potoski (2001) indicates that states with larger environmental groups, public support for environmental protection, and legislative professionalism are more likely to have more strict ambient air standards, while only environmental groups influence emission standards and

[9] For more information concerning the differences between the two rules see http://www.epa.state.il.us/air/new-source-review/new-source-review-part-1.html.

ambient monitoring. Therefore, variations of regulations exist for coal-fired power plants depending on the state.

Scholars are unclear as to whether more stringent air quality programs under the CAA negative impact the economics underlying the operation of a coal-fired power plant. Some scholars are more optimistic about influence of the CAA regulations on coal-fired power plant efficiency (Sueyoshi and Goto 2012), while others find the mixed results of regulations on an operator of a power plant to keep plant costs down while reducing air pollution and increasing electricity generation (Fleishman et al 2009). Some scholars suggest a link between the power of the regulated industry and oversight. Hedge and Scicchitano (1994) find that size of the relevant industry within a state can influence the Clean Air Act's regulatory oversight by federal officials. However, this is only a measure of the effect of the industry's power on oversight, rather than written standards.

Consequently, the literature provides unclear evidence concerning the influence of air quality regulation on owners of coal-fired power plants. It suggests that air quality regulations at the state level may incur significant costs that operators may want to avoid through the siting of expansion of coal power. However, it is unclear if these costs affect the profits of power plant owners when the federal government heavily subsidizes the fossil fuel industry (Morales 2010).

Each state's environmental regulatory agency, legislature, and public utility commission (PUC) have diverse powers to influence coal-based electricity. State environmental agencies regulate air emissions, utility cost recovery, power plant siting, and utility power portfolios, as well as issue new source operating and air quality permits. State legislatures can modify state statute to influence many of these regulatory powers. PUCs can influence the state's electricity supplier whose responsibility is to provide low-cost, safe, reliable, and adequate power to consumers and accomplish other policy demands (Cowart et al. 2008). This suggests that the variation of a state's regulatory environment influences its own energy market.

"Race to the bottom" (RTTB) Effect

Economists and policy scholars disagree over whether the regulatory costs imposed on industry creates a RTTB effect. Some scholars contend that government officials lower environmental regulations in order to decrease costs on existing and future businesses to compete with other states in attempt to lure industry to the state. Industry will cite in states with less stringent regulatory environments to decrease costs.

Public policy scholars find mixed results in their response to interstate economic competition in enforcement and regulatory actions. State environmental regulators are concerned about the impressions air regulation standards give to industry and about the effect regulations and practices--such as the flexibility of state officials to work with officials, the timing/expense of permits, the stringency of written standards, pollution control incentives, and the stringency of written enforcement have on siting decision-making (Konisky 2007) . In the case of surface mining enforcement, Woods (2006) finds that state competition influence state official's enforcement if neighboring state enforcement levels are lower than their own. However, Konisky (2009) finds little evidences that officials in states more susceptible to interstate economic competition are more likely to change their regulatory enforcement behavior in response to other state's regulatory behavior. Also, there is no evidence that states race to the bottom on CAA air quality standards. In fact, Potoski (2001) finds that states develop standards more stringent than set national CAA standards and states that are more economically reliant on polluting industries are not more or less likely to exceed standards than those that are not.

The siting of coal-fired power presents a unique opportunity to study a gap in the economics of the RTTB phenomenon. Economists investigate the siting of an assortment of industries such as hazardous waste sites (Levinson 1999), textiles, electronics, chemicals, and the production of petroleum/coal (Levinson 1996), as well as other industries (Bartike 1988; Brunnermeier 2004) in jurisdictions with more stringent tax and environmental regulations. While this literature covers industrial products, it does not cover production of electricity. Generation of coal-based power shares the following similar characteristics to previously examined industries: high levels of pollution subject to state air regulations, movable resources for production of a commodity, potential for local economic growth and the export of a product(s). It is also unique because of the immobile nature of existing facilities to produce electricity (Potoski 2001), since other facilities, such as factories, are more mobile. The transmission of electricity occurs over long distances and is not constrained by state boundaries, and provides a unique situation in which to understand the race to the bottom phenomena. Conceptually, firms may be especially sensitive to regulatory environments if the mobility of facilities is limited.

Traditionally, economists and public policy scholars studying the RTTB effect on industry behavior ignore the permitting process. Normal indications of an industry's response to environmental regulations include plant births, inbound and outbound foreign direct investments, and net exports (Brunnermeier 2004). Through surveys of actors within industry scholars indicate marginal to no evidence that environmental regulations play a major part in location decisions (Davis 1992; Epping 1986). However, this scholarship ignores the initial point in which industry interacts with regulators via the permitting process. The permitting process for electricity generation is ripe for investigation and may yield important results because heavy-polluting industries require approval for a variety of permits for the siting of new facilities.

State Energy Policy

The state energy and climate change policy literature explains a lot of the reasons behind the adoption of alternative energy policies, but much is unknown about state policy toward traditional forms of energy such as coal. Scholars explain much about what influences the development of state alternative energy policy (Byrne et al. 2007; Mazmanian 2008; Menz and Vachon 2006; Stoutenborough and Beverlin 2008; Weiner and Koontz 2010; Matisoff 2008), state reduction of greenhouse gases (Keeler 2007; Lutsey and Sperling 2008; Rabe 2004), and the effect of state characteristics' influence on the adoption of more pro-environmental legislation (Bacot and Dawes 1997; Lester 1995; Matisoff 2008; Ringquist 1993; Potoski and Woods 2001; Koontz 2002). Despite a focus on newer "green" forms of energy, the literature is less robust concerning traditional, more widely utilized sources of electricity (e.g. coal, natural gas, and oil). Only a few scholars take into consideration the impact of climate change and energy policy on fossil fuels. Some explore the impact of renewable energy policy on fossil fuel consumption and the interaction between state climate change policy and energy policy (see: Peterson and Rose 2006; Horiuchi 2007). While other scholars have examined the impact of Clean Air Act regulations on coal-fired power plant environmental and economic efficiency across states (Sueyoshi and Goto 2010; Sueyoshi et al. 2009; Fleishman et al. 2009), the level of analysis has been on individual plant outputs in response to regulation.

Methods

Overview and Dependent Variables

I analyze submissions of application for permits to state environmental agencies between 1999 and 2009 under the New Source Review (NSR) process. Specifically, it measures the number of applications and the size of the proposed new coal-fired power in that application. To be clear: this study is not concerned with the ultimate result of the permitting process. It focuses only on the initial interest by owners by formally applying for permission for air quality permits for new coal power projects by state and year.

The dependent variables are based on the number and size of new coal-fired power applications for air quality permits. The national coal project dataset provides information on the state, year of first draft of these applications, size of added capacity, and other useful information on the application process for new coal power. This study uses applications with dates and the number of added megawatt power. Conceptual projects, incomplete applications and pre-applications for construction are also not included. However, this study does include applications that were submitted but later withdrawn. In most cases, if a permit does not have an application date it is only conceptual and or speculation on an application.

While many of the variables in this study shift temporally, some of these measures are time invariant due to the availability of data (only air regulation variables and rail mileage are time invariant). This study utilizes negative binomial statistical analysis of the number of applications by state and year. Negative binomial is a count model that takes into account over-dispersion of dependent variables. Tests indicate an over dispersion of the number of applications submitted per year. Statisticians argue that models with dependent variables over a dispersion above 1 should utilize a negative binomial model instead of Poisson. For the size dependent variable, the natural log (due to the abnormal distribution of the data) of the size of the proposed coal power expansion by year and state is analyzed using Ordinary Least Squares.[10]

Independent Variables and Hypotheses

This study investigates four independent variables that measure relation to strictness of regulations and state citizen ideology. [11] These include Air Quality Standards (AAQS), New Source Performance Standards (NSPS), and Ambient Monitoring. The New Source Review utilizes these standards when analyzing permit applications. This study measures these variables similarly to the 1998 State Air Pollution Control Survey (SAPCS) presented in Potoski (2001).[12]

Hypothesis 1a: States with stricter AAQS receive fewer applications for new sources of coal power per year.

Hypothesis 1b: States with stricter AAQS receive coal power applications with smaller electricity capacity per year.

Hypothesis 2a: States with stricter New Source Performance Standards receive fewer applications for new sources of coal power per year.

Hypothesis 2b: States with stricter New Source Performance Standards receive coal power proposals with smaller electricity capacity per year.

Hypothesis 3a: States with stricter Ambient monitoring standards receive fewer applications for a new source of coal power per year.

Hypothesis 3b: States with stricter Ambient monitoring standards receive coal power applications with smaller electricity capacity per year.

Consistent with the RTTB phenomenon, these hypotheses assert that future coal development in a state is a result of fewer costs imposed by CAA regulations. The concentration of major pollutants that affect the health of the public and environment set by AAQS, NSPS, and ambient monitoring reflect a commitment to protecting the health of the public and the

[10] This significantly limits the number of applications analyzed to around sixty (all zero values are dropped).

[11] For a quick look at all variables, consult the Variable Table in the Appendices.

[12] For more information please reference Potoski (2001) or the SAPCS 1998 survey. Unfortunately this survey has not been updated since 1998.

environment from criteria pollutants, and therefore deter future development of coal based power in a state. Despite this argument, these regulations may only matter after the fact. Since the EPA or state agency performs air quality analysis and determines if the proposal violates any rules, companies may leave it to the state agency to determine the proposal's viability, rather than spending time doing it themselves.

New Source standards directly apply to new coal power and the extra costs imposed on companies to clean up emissions can be unattractive for companies and will be less likely to invest in both size and number of coal power due to costs. Some scholars indicate that CAA regulations improve plant efficiency, and therefore may be less concerned about these regulatory impacts on costs (Sueyoshi and Goto 2012). Companies may recognize this as positive development and be less concerned with the price of regulations. Yet, others indicate that costs of regulations influence decision-making when complying with CAA regulations (Fleishman et al 2009).

Similar to AAQS, ambient monitoring should also determine an overall commitment of a state to minimize the impact of emissions from major sources of pollution and protect the environment—specifically to monitor that commitment. Therefore, companies may avoid not only states that signal a standard set for overall air pollution, but also indicate their willingness to monitor and enforce other relevant regulations.

Hypothesis 4a: States with more liberal citizens receive fewer applications for new sources of coal power.

Hypothesis 4b: States with more liberal citizens receive new coal power applications with smaller electricity capacity per year.

This study also evaluates a state's ideological influence on firm decision-making as a proxy for evidence of the RTTB phenomenon. The political context, as measured by citizen ideology and party control of the legislature, reflects a state's commitment to pro-environmental policy (Matisoff 2008; Ringquist 1993; Potoski 2001). The political makeup of a state government influences regulation and can promote alternative forms of energy. Yin and Powers (2010) find that Renewable Portfolio Standards do promote renewable energy within a state, and states with more Democratic legislatures are more likely to adopt RPS policies (Lyon and Yin 2008). Consequently, owners could worry about the potential for new pro-environmental state air regulations in more liberal states, and alternative energy promotion may affect an owner's decision not to further develop coal-generated electricity. Additionally, these new or existing air quality regulations may ultimately impact these firms' bottom line.

In addition, a state's political climate should also influence the reaction of owners of these facilities to regulatory oversight. Hedge and Scicchitano (1994) indicate in a study of the Office of Surface Mining that a state's political environment or commitment to regulation influences the flexibility of federal regulators in their oversight of industry. States with a more liberal population or government should be more committed to enforcing regulations, and oversight by federal regulations should be stricter. Therefore, utilities should apply in conservative states, where oversight is more flexible.

Control variables

I employ a number of state economic variables to account for the economic effects of the siting of new coal fired power. Previous literature indicates important measures to compare state energy policy and their commitment to climate change (Peterson and Rose 2006). Peterson and Rose 2006 use a variety of state demographic/ economic indicators, such as state population, GSP (per capita Gross State Product), GSP from manufacturing, to compare energy policy across states. State population is important in understanding the increase in demand for electricity, but also concerns for the distribution of costs on the population for combatting climate change, which Peterson and Rose (2006) indicate is an issue with the development of state energy policy.

Furthermore, state commitment to the production and consumption of coal indicates a previous reliance on a certain amount of greenhouse gases in a state's energy policy (Peterson and Rose 2006). If a state produces more coal, then they are likely to develop it in the future and/or less likely to develop climate change policy. The production of coal may also be important to the development of new coal power because of the availability of the resource and cheap transportation costs.

I also control for the ability for owners to access coal for production of electricity. Previously, scholars found a relationship between a state's infrastructure and new industrial development (Levinson 1996; Brunnermeier and Levinson 2004). While most of this literature utilizes the measure of highways, I use total state railway mileage to capture the influence of infrastructure. The transportation of coal to power plants is an important element of the production of electricity because almost half of the commodities carried by the U.S. freight railroad industry are coal (AAR 2011). States with more railway infrastructure should be more appealing for the new construction/expansion of a coal power.

Electricity prices are also important in the development in new coal power. Studies of policy development indicate that the price of electricity in states may promote alternative energy because of price volatility (Byrne et al. 2007). Yet others suggest that the price of electricity is of low priority in the reasons for wind energy development (Wiener and Koontz 2010). While these are state policy studies, this should be applicable to industry decisions because public utility commissions regulate utility companies' rates to keep their prices affordable (Cowart et al. 2008), and companies may develop new energy sources to fulfill this task.

Finally, siting of facilities could be based upon past trends of behavior. Levinson (1996) argues that measures of existing manufacturing could indicate unobserved factors that make a state more attractive to industry. This measure of existing coal power also ensures to separate conditions for past economic behavior that lead to the construction of those plants, compared to the conditions measured by the other variables.

Results/ Discussion

Table 5: Factors that influence siting of increased coal megawatt capacity (based on permit applications)

DV: Increase in Megawatt Capacity in a State/Year	Full Model	Reduced Model 1	Reduced Model 2	Reduced Model 3	Reduced Model 4	Reduced Model 5	Reduced Model 6
Ambient Air Quality	-0.134		-0.102	-0.135*	-0.135		
	(0.0954)		(0.0781)	(0.0757)	(0.0943)		
New Source Pollution	-0.491		-0.858*	-0.654	-0.464		
	(0.585)		(0.474)	(0.460)	(0.575)		
Ambient Monitoring	0.243		0.206	0.170	0.230		
	(0.328)		(0.244)	(0.233)	(0.323)		
Gross State Product	-3.38e-06	-5.18e-07			-2.53e-06	-1.28e-06	
	(4.08e-06)	(2.68e-06)			(3.55e-06)	(2.44e-06)	
Population	7.58e-08	-1.11e-08	3.66e-08*	4.28e-08**	4.98e-08	1.71e-08	3.92e-08**
	(1.54e-07)	(1.13e-07)	(1.96e-08)	(1.89e-08)	(1.40e-07)	(1.06e-07)	(1.59e-08)
Coal Production	-7.92e-07	-1.21e-06			-1.02e-06	-8.43e-07	
	(3.22e-06)	(2.16e-06)			(3.14e-06)	(2.09e-06)	
Electricity Price	0.0449	0.0299			0.0414	0.0263	
	(0.0570)	(0.0422)			(0.0558)	(0.0417)	
Citizen Ideology	-0.0257	-0.0293**		-0.0319**	-0.0290*	-0.0265**	-0.0244***
	(0.0173)	(0.0112)		(0.0139)	(0.0155)	(0.0105)	(0.00906)
Railway	2.57e-05	0.000138			3.04e-05	0.000133	
	(0.000139)	(8.37e-05)			(0.000137)	(8.31e-05)	
Existing Coal Power	-0.00452	0.00494	0.00154	0.00477			0.00572
	(0.0104)	(0.00699)	(0.00791)	(0.00767)			(0.00506)
Manufacturing GSP	1.80e-05	5.48e-06			1.52e-05	7.88e-06	
	(1.41e-05)	(9.15e-06)			(1.24e-05)	(8.47e-06)	
Constant	7.525***	6.622***	7.348***	8.822***	7.653***	6.661***	7.209***
	(1.473)	(0.834)	(0.609)	(0.868)	(1.427)	(0.829)	(0.440)
Observations	47	75	47	47	47	75	78
R-squared	0.340	0.229	0.181	0.276	0.336	0.223	0.152

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Factors that influence siting of number of coal power projects (based on number permit applications)

DV: Number of Permit Application in a State/Year	Full Model	Reduced Model 1	Reduced Model 2	Reduced Model 3	Reduced Model 4	Reduced Model 5	Reduced Model 6
Ambient Air Quality	0.0781		0.0710	0.0569	0.108		
	(0.0767)		(0.0764)	(0.0761)	(0.0760)		
New Source Pollution	-0.942*		-0.862*	-0.838*	-1.309**		
	(0.570)		(0.507)	(0.495)	(0.549)		
Ambient Monitoring	0.143		0.334	0.305	0.0784		
	(0.230)		(0.227)	(0.227)	(0.224)		
Gross State Product	4.81e-06	5.84e-06**			4.51e-06*	2.76e-06	
	(2.95e-06)	(2.50e-06)			(2.56e-06)	(2.33e-06)	
Population	-1.75e-07	-1.78e-07*	7.02e-08***	7.49e-08***	-1.54e-07	-7.56e-08	5.54e-08***
	(1.16e-07)	(1.01e-07)	(1.89e-08)	(1.91e-08)	(1.09e-07)	(9.78e-08)	(1.57e-08)
Coal Production	1.08e-06	3.85e-08			1.96e-06	1.30e-06	
	(2.72e-06)	(1.89e-06)			(2.68e-06)	(1.78e-06)	
Electricity Price	0.0184	-0.0296			-0.00754	-0.0533	
	(0.0395)	(0.0366)			(0.0316)	(0.0334)	
Citizen Ideology	-0.0214	-0.0263**		-0.0219*	-0.0123	-0.0137	-0.0290***
	(0.0153)	(0.0113)		(0.0129)	(0.0136)	(0.0104)	(0.00898)
Railway	0.000283***	0.000300***			0.000291***	0.000337***	
	(0.000108)	(8.43e-05)			(0.000107)	(8.45e-05)	
Existing Coal Power	0.0137	0.0251***	0.0132*	0.0141*			0.0243***
	(0.00917)	(0.00704)	(0.00764)	(0.00762)			(0.00537)
Manufacturing GSP	-7.81e-06	-1.58e-05*			-4.96e-06	-5.66e-06	
	(1.04e-05)	(8.89e-06)			(9.70e-06)	(9.08e-06)	
Constant	-2.138*	-1.312*	-2.819***	-1.676*	-1.583	-1.065	-1.246***
	(1.193)	(0.760)	(0.689)	(0.915)	(1.035)	(0.732)	(0.455)
Observations	351	516	352	352	373	538	528
Pseudo R-squared	0.1102	0.1184	0.0682	0.0764	0.1144	0.1049	0.0806

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The statistical modeling presented in Table 1 and 2 indicate my overall analysis strategy. [13] [14] Both of these tables first present full models that include all variables. However, since variables such as citizen ideology and ambient air quality standards, new source pollution standards, and ambient air quality are correlated (Potoski 2001), the reduced models eliminate some variables to reduce collinearity in the models. Additionally, since the variables that could promote the construction of new coal power (like GSP, coal production, electricity prices, total railway, and manufacturing from GSP) could correlate with the number of existing coal power units, they are presented in different reduced models. This is especially important since none of the variables are statistically significant in the full model in Table 1.

These results indicate that more stringent state New Source Performance Standards influence the number of applications filed in a state, but other state air quality regulations are not associated with new coal power. Across all models in Table 2, as the stringency of New Source Performance Standards increases, the number of applications submitted in a state decreases. The evidence for this relationship and the coal power capacity in an application is less clear because, as Table 1 indicates, only Reduced Model 2 replicates a similar finding. Despite evidence of state NSPS associated with new coal power applications, for the most part there is no association between a state's ambient air quality standards (Table 1, Reduced Model 3 only meets hypothesis expectations), and ambient monitoring.

[13] Note that the sample size in each model for both tables because related Clean Air Act regulations data does not apply to all 50 states.

[14] All reduced models are all possible combinations of the variable existing power units, CAA regulations (AAQ, Ambient Monitoring, and NSP), economic variables that explain coal siting, and citizen ideology. Since there is a possibility of correlation between all of these variables, all possible combinations were presented for both dependent variables. Only the population variable is controlled for in all models to account for state size and normalize states for proper comparison.

There is also some evidence that more liberal states receive fewer coal power applications and smaller increases in proposed capacity. Table 1 indicates strong evidence of citizen ideology influencing the size of the proposed new coal applications. More liberal states are associated with applications containing fewer megawatts. However, there is only modest evidence that the number of applications in a state per year is associated with state citizen ideology. Only three of the six models in Table 2 indicate that more liberal citizenry correlates with the number of permits in a state per year.

The analysis presented here provides some empirical evidence that firms intentionally apply for new coal power in states with weaker state air quality standards, which confirms a portion of the RTTB hypothesis. The strongest evidence is confirmed when firms apply less in states with stronger New Source Pollution standards. Additionally, firms target more conservative states with their larger coal power projects. This suggests that firms are concerned with the regulatory environment for their facilities and wish to site in jurisdictions which cost less to comply with environmental standards.

Limits to Research/Future Directions

Organizations that generate coal power consist of both private and public entities, which limit some of the explanatory power of this analysis. Private investors, independent power producers, cooperatives, the federal government and public utility firms all own power plants. Despite this limitation, in 1995 almost seventy-five percent of utility sales and total generation comes from investor-owned utility companies (Warkentin 1998). In 2010, almost eighty percent of all generated electricity comes from non-public entities, such as investor-owned utilities and independent power producers, while only around twenty percent of electricity came from cooperatives, public utilities, and the federal government (American Public Power Association 2012). This suggests that power generation is mostly controlled by for-profit entities that are not necessarily constrained by state or county borders like public utilities or cooperatives. However, it is revealing that, while there is a mixture of private and public entities utilizing coal for power, regulatory contexts still matter no matter the type of owner. Future studies should further dissect the relationship between type of owner and their response to regulatory environments.

The role of differing parts of state government and the public also needs to be investigated. Future studies need to delineate how the legislature, executive, interest groups, and the bureaucracy influence the NSR process. Previous scholars indicate the ability of industry to work with bureaucrat officials. The question remains: is cooperation uniform across the ideological spectrum of regulators? Also, public comments or hearings on the new source permits are available to the public. Scholars have noticed the variety of public participation that occurs with various types of open public access for participation in administrative decision-making, and fear that only interest group members attend certain forms of participation (Fiorino 1990). How does the layout of a public utility commission influence the application process? What about a governor's appointment of a head of a state environmental agency? How does the public- through the help of interest groups- interact with this process, and do they have any influence? All these questions need to be addressed to fully understand how state politics and regulation influence owners' decision-making.

Finally, applications for permits may be the answer to why there is such a lack of past evidence for the RTTB hypothesis, which may suggest a research path forward. As the review process for application progresses, proposals may drift away from the original intention. Interest groups can get involved in the public commenting process on the permit, economics shift, or industry revises the application for other reasons. This variation in the permitting process alone indicates that industry's decision-making is not necessarily best represented by the final result of this fluid process. Future research needs to explore this process to fully explain firm behavior.

Conclusion

Research indicates that states do not uniformly "race-to-the-bottom" on environmental regulations to attract businesses and when left to their own devices do improve air quality regulations (Potoski 2001). My findings complicate this narrative and provide evidence that utility companies do invest in coal power in states with less strict written regulations or potential for further regulations. States that increase their standards on new sources of pollution have an effect on the decision-making process at least in the initial stages of coal power development. Despite certain CAA regulations having little influence on siting decisions, considerations are taken for rules that directly influence a power plant's emissions. The RTTB literature indicates a variety of results, but this study adds further evidence that the regulatory environment created by a state does affect industry's decision-making. The investigation of electricity provides a chance to investigate the RTTB phenomenon with a product where the location of the facility is fixed, but produces a commodity that can travel hundreds of miles. Information from the permitting process of business provides a different investigation of industries' behavior. Past regulatory behavior of standard influences plans for new power.

This evidence also suggests that state citizen ideology also influences owners' decision-making. Officials in liberal states are more likely to develop policy viewed as pro-renewable/anti-fossil fuel and/or further develop it in the future, or they are less flexible enforcing regulations. This suggests that businesses are aware of the political environment in which they site new investments. Additionally, firms view more politically liberal states as potentially incurring more costs through the permitting process, existing and future environmental regulations, and they will modify their behavior to respond to these costs.

There has been optimism concerning the ability for states to experiment, exceed federal standards, and enforce their own environmental regulations, and potentially produce better air quality by the states; but this claim warrants more pessimism. When given the opportunity, utilities essentially bypass those states that impose perceived costs upon their investments. The ability for public and private companies to move their product and/or production facilities across borders allows for a targeted strategy, which could neutralize the goal of reducing pollution by the adoption of a stricter regulatory environment. States can adopt strict pollution standards but still obtain a tangible benefit (i.e. electricity) from neighboring states with coal-fired power plants. However, this suggests the limits of state regulation to improve state air quality. If regulations push coal-fired power plants to neighboring states, this potentially negates any gains from some states adopting more strict standards in the first place.

References

American Public Power Association. 2012. 2012-2013 Annual Directory & Statistical Report. http://www.publicpower.org/files/PDFs/USElectricUtilityIndustryStatistics.pdf. Accessed: May 22, 2012.

American Railroad Association. 2011. http://www.aar.org/AAR/KeyIssues/Railroads-States.aspx). Accessed: May 22, 2012.

Associated Press. "Administration Proposes New Power Plant Rules." http://www.npr.org/2012/03/27/149461645/administration-to-propose-new-power-plant-rules.

Bacot, A.H., and R.A. Dawes. 1997. "State Expenditures and Policy Outcomes in Environmental Program Management." Policy Studies Journal 25: 355-70.

Bartik, T.J. 1988. "The Effects of Environmental Regulation on Business Location in the United States." Growth and Change 19: 22-44.

Berry, William D., Evan J. Ringquist, Richard C. Fording, Russell L. Hanson. 2007. "Replication data for: Measuring Citizen and Government Ideology in the American States, 1960-93", http://hdl.handle.net/1902.1/10570 UNF:3:o58RA2kgCzZ+vIm+Q7arPA== Richard C. Fording [Distributor] V1 [Version].

Berry, W.D., R.C. Fording, E.J. Ringquist, R.L. Hanson, and C.E. Klarner. 2010. "Measuring Citizen and Government Ideology in the Us States: A Re-Appraisal." State Politics & Policy Quarterly 10: 117-35.

Brunnermeier, S.B., and A. Levinson. 2004. "Examining the Evidence on Environmental Regulations and Industry Location." The Journal of Environment & Development 13: 6-41.

Byrne, J., K. Hughes, W. Rickerson, and L. Kurdgelashvili. 2007. "American Policy Conflict in the Greenhouse: Divergent Trends in Federal, Regional, State, and Local Green Energy and Climate Change Policy." Energy Policy 35: 4555-73.

Cowart, Richard; Shanna Vale; Joshua Bushinsky ; Pat Hogan. 2008. "State Options for Low-Carbon Coal Policy " Coal Initative Reports: White Paper Series. http://www.c2es.org/docUploads/StateOptions-02-20-08.pdf. (May 22, 2012).

Daily, Matt. 2012. "Analysis: Epa Rule a New Setback for New Coal Plants." http://www.reuters.com/article/2012/03/28/us-coal-epa-idUSBRE82R08120120328. (4/1/2012).

Davis, C. 1992. "State Environmental Regulation and Economic Development: Are They Compatible?". Review of Policy Research 11: 149-57.

Ducsik, D.W. 1981. "Citizen Participation in Power Plant Siting Aladdin's Lamp or Pandora's Box?". Journal of the American Planning Association 47: 154-66.

Energy Information Administration. 2011. “Electricity tends to flow south in North America.” http://www.eia.gov/todayinenergy/detail.cfm?id=4270. Accessed: June 8, 2012.

Environmental Protection Agency. "New Source Review." http://www.epa.gov/nsr/index.html. Accessed: May 22, 2012.

Epping, M. 1986. "Tradition in Transition: The Emergence of New Categories in Plant Location." Arkansas Business and Economic Review 19: 16-25.

Fiorino, D.J. 1990. "Citizen Participation and Environmental Risk: A Survey of Institutional Mechanisms." Science, technology & human values 15: 226-43.

Fleishman, R., R. Alexander, S. Bretschneider, and D. Popp. 2009. "Does Regulation Stimulate Productivity? The Effect of Air Quality Policies on the Efficiency of Us Power Plants." Energy Policy 37: 4574-82.

Horiuchi, C. 2007. "One Policy Makes No Difference?". Administrative Theory & Praxis 29: 432-49.

Hedge, D.M., and M.J. Scicchitano. 1994. "Regulating in Space and Time: The Case of Regulatory Federalism." Journal of Politics 56: 134-53.

Keeler, A.G. 2007. "State Greenhouse Gas Reduction Policies: A Move in the Right Direction?". Policy Sciences 40: 353-65.

Konisky, D.M. 2009. "Assessing Us State Susceptibility to Environmental Regulatory Competition." State Politics & Policy Quarterly 9: 404.

———. 2008. "Regulator Attitudes and the Environmental Race to the Bottom Argument." Journal of Public Administration Research and Theory 18: 321-44.

Konisky, D.M., and N.D. Woods. 2010. "Exporting Air Pollution? Regulatory Enforcement and Environmental Free Riding in the United States." Political Research Quarterly 63: 771.

Koontz, T.M. 2002. "State Innovation in Natural Resources Policy: Ecosystem Management on Public Forests." State & Local Government Review: 160-72.

Kosuke Imai, Gary King, and Oliva Lau. 2007. ”negbin: Negative Binomial Regression for Event Count Dependent Variables” in Kosuke Imai, Gary King, and Olivia Lau, ”Zelig: Everyone’s Statistical Software,”http://gking.harvard.edu/zelig.

Lester, J.P. 1995. "Federalism and State Environmental Policy." Environmental politics and policy: Theories and evidence: 39-60.

Levinson, A. 1996. "Environmental Regulations and Manufacturers' Location Choices: Evidence from the Census of Manufactures." Journal of Public Economics 62: 5-29.

Linn, J., Mastrangelo, E. and Burtraw, D.,2011.RegulatingGreenhouseGasesfrom Coal PowerPlantsundertheCleanAirAct.DiscussionPaper11-43.Washing- ton, DC, Resources for the Future.

Lutsey, N., and D. Sperling. 2008. "America's Bottom-up Climate Change Mitigation Policy." Energy Policy 36: 673-85.

Lyon, T.P., and H. Yin. 2008. "Why Do States Adopt Renewable Portfolio Standards?: An Empirical Investigation." Ann Arbor 1001: 48109.

Matisoff, D.C. 2008. "The Adoption of State Climate Change Policies and Renewable Portfolio Standards: Regional Diffusion or Internal Determinants?". Review of Policy Research 25: 527-46.

Mazmanian, D.A., J. Jurewitz, and H. Nelson. 2008. "California's Climate Change Policy." The Journal of Environment & Development 17: 401.

McCarthy, J.E. 2006. "Mercury Emissions from Electric Power Plants: States Are Setting Stricter Limits." Washington, DC: Congressional Research Service.

Menz, F.C., and S. Vachon. 2006. "The Effectiveness of Different Policy Regimes for Promoting Wind Power: Experiences from the States." Energy Policy 34: 1786-96.

Millimet, D.L. 2003. "Assessing the Empirical Impact of Environmental Federalism." Journal of Regional Science 43: 711-33.

Morales, A. 2010. "Fossil Fuel Subsidies Are Twelve Times Renewables Support." Bloomberg Businessweek 29.

Peterson, T.D., and A.Z. Rose. 2006. "Reducing Conflicts between Climate Policy and Energy Policy in the Us: The Important Role of the States." Energy Policy 34: 619-31.

Potoski, M. 2001. "Clean Air Federalism: Do States Race to the Bottom?". Public Administration Review 61: 335-43.

Rabe, Barry George. 2004. Statehouse and Greenhouse : The Emerging Politics of American Climate Change Policy. Washington, D.C.: Brookings Institution Press.

Ringquist, E.J. 1993. Environmental Protection at the State Level: Politics and Progress in Controlling Pollution: ME Sharpe.

Saleska, S.R., and K.H. Engel. 1998. "Facts Are Stubborn Things: An Empirical Reality Check in the Theoretical Debate over the Race-to-the-Bottom in State Environmental Standard-Setting." Cornell JL and Pub. Pol'y. 8: 55.

Stoutenborough, J.W., and M. Beverlin. 2008. "Encouraging Pollution-Free Energy: The Diffusion of State Net Metering Policies*." Social Science Quarterly 89: 1230-51.

Sueyoshi, T., and M. Goto. 2012. "Returns to Scale Vs. Damages to Scale in Data Envelopment Analysis: An Impact of Us Clean Air Act on Coal-Fired Power Plants." Omega.

Sueyoshi, T., M. Goto, and T. Ueno. 2010. "Performance Analysis of Us Coal-Fired Power Plants by Measuring Three Dea Efficiencies." Energy Policy 38: 1675-88.

Vig, Norman J., and Michael E. Kraft. 2003. Environmental Policy : New Directions for the Twenty-First Century. 5th ed. Washington, D.C.: CQ Press.

Warkentin-Glenn, Denise. 1998. Electric Power Industry in Nontechnical Language. Tulsa, Okla.: Pennwell Publishing.

Wiener, J.G., and T.M. Koontz. 2010. "Shifting Winds: Explaining Variation in State Policies to Promote Small-Scale Wind Energy." Policy Studies Journal 38: 629-51.

Woods, N.D. 2006. "Interstate Competition and Environmental Regulation: A Test of the Race-to-the-Bottom Thesis*." Social Science Quarterly 87: 174-89.

Potoski, M., and N.D. Woods. 2001. "Designing State Clean Air Agencies: Administrative Procedures and Bureaucratic Autonomy." Journal of Public Administration Research and Theory 11: 203-22.

Yin, H., and N. Powers. 2010. "Do State Renewable Portfolio Standards Promote in-State Renewable Generation." Energy Policy 38: 1140-49.

Appendices

Table 7: Variable Table

Variable	Measurement
Number	Number of applications in a state for construction of coal power plant, boiler or unit. Included if there is a data of application, which means that the EPA received the application. Based on a modification of EPA's National Coal Project. The following link is in active, but the dataset is available upon request. http://www.epa.gov/region07/air/nsr/spreadsheets/national_coal_projects.xls
Size	Size of proposed plant, boilers or units in application by state and year by megawatt electrical (natural log). Based on a modification of EPA's National Coal Project. Included if there is an increase in capacity for each application. The following link is in active, but the dataset is available upon request. http://www.epa.gov/region07/air/nsr/spreadsheets/national_coal_projects.xls
Ambient Air Quality Standards	Ambient Air Quality Standards (0-6). Sum of 6 pollutant measures. 0=Minimum national standards across all pollutants, 6 = states more restrictive pollutants. Data adapted from Potoski (2001).
New Source Performance Standards	State NSPS Standards. 0= EPA regulates (state awaiting USEPA authority) or state standards identical to USEPA, 1=state standards more restrictive. Data adapted from Potoski (2001).
Ambient Monitoring	State Ambient Monitoring Standards. 1= Identical to USEPA standards, 2= Somewhat more extensive, 3= Much more extensive. Data adapted from Potoski (2001).
Gross State Product	Gross State product by state from 1999 to 2009. Bureau of Economic Analysis.
Population	Number of people. 1999-2009 by state. Census Bureau. State Intercensal Estimates (2000-2010). Population Estimates. http://www.census.gov/popest/data/intercensal/state/state2010.html
Coal Production	Coal Production(thousand short tons) from 1999-2009. EIA. 2010. State Energy Data System.
Electricity Price	Electricity average price, all sectors. Dollars per million Btu by state from 1999-2009. Energy Information Administration.
Citizen Ideology	0-100 scale. 0= Very Conservative. 100= Very Liberal. Adapted from Berry et al. (2007). Years 2007-2009 are 2006 repeated. Berry et al. 2007.
Railway	Total rail miles in 2009 by state. Association of American Railroad's Profiles of U.S. Railroads.
Number of Existing Coal Power Units	Total number of facility units with the primary fuel type of coal. 1999-2009.
Manufacturing GSP	Gross State product from Manufacturing by state from 1999 to 2009. Bureau of Economic Analysis.

Table 8: Descriptive Statistics

VARIABLES	Sample	Mean	Standard Deviation	Minimum	Maximum
Number	550	0.205	0.615	0	7
Gross State Product	550	236,516	286,336	15,722	1.912e+06
Population	550	5.837e+06	6.409e+06	479,602	3.696e+07
Citizen Ideology	550	52.47	15.80	8.450	95.97
Coal Production	539	22,759	62,375	0	467,644
Ambient Air Quality Standards	418	6.395	2.087	0	12
New Source Performance Standards	385	1.086	0.439	0	2
Ambient Monitoring	407	1.811	0.730	0	3
Railway	550	2,793	1,922	0	10,405
Electricity Price	549	23.73	8.838	11.72	85.78
Number of Existing Coal Power Units	528	22.27	20.62	0	83
Size	78	6.517	0.942	3.761	9.196
Manufacturing GSP	550	29,858	33,792	771	217,384

Chapter 3: Effectiveness of state GHG Targets

Livin' on a Prayer? Gauging the effectiveness of State GHG Emission Reduction Policies

Over the past two decades, states adopted important climate change policies to reduce state carbon dioxide emissions. State reduction targets were adopted by states as one policy tool to move toward mitigation. Twenty states adopted emission targets for emitters of GHGs which included an emission baseline to gauge performance, a percentage of emissions goal benchmark based on that baseline, and a year in which to meet that goal. These policies are used to gauge the performance of public and private actors in the mitigation of the major contributions to climate change.

However, the importance of "target" policies extends beyond the U.S. governance of the climate, and this type of goal structure remains common in gauging the effectiveness of both private and public actors in protecting the environment and achieving public policy goals. Often governments set up statutory "goals" or "targets" to encourage mitigation efforts. Previous international treaties, like the Kyoto treaty, set up GHG targets for member countries to achieve by a certain year. Similarly, the United States federal government proposed and adopted a Clean Power Plan in 2014 to decrease carbon pollution from power plants by thirty percent of 2005 levels by 2030. Part of this plan sets different goals for each of the states to reduce pollution from their power sector.[15]

[15] Please note: these power plant emission goals are different than the reduction policies in question in this research. http://www2.epa.gov/carbon-pollution-standards/fact-sheet-clean-power-plan-framework http://www.c2es.org/federal/executive/epa/carbon-pollution-standards-map Additionally, these types of targets are distinct from targets for certain facilities and firms. For example, many Renewable Portfolio Standards place mandates in large utility companies to achieve certain renewable energy goals by a certain time. Individual firms are held accountable for their behavior. The current GHG targets only set general goals for pollution reduction.

To further understand the role of targets in public policy and policy analysis, this study answers several interrelated questions. While target policies are used to gauge the performance of private and state actors in the mitigation of factors contributing to climate change, do these policy goals have an impact on how individuals behave? Specifically, do more ambitious state GHG emissions targets spur reductions in GHGs from states across economic sectors?

Utilizing a combination of data from the Greenhouse Gas Reporting Program (GHGRP) and the Center for Climate and Energy Solutions (C2ES), this study analyzes the relationship between targets and reductions in carbon dioxide emissions. I create an 'ambitiousness' measure to gauge the extent of each state's target emission reductions per year. Controlling for state economic and political conditions, and past carbon dioxide emissions, this study finds that more ambitious state GHG targets are associated with lower state-level carbon dioxide emissions. However, this relationship is absent when evaluating at the facility-level.

Literature Review

Regulation of Air quality and Carbon Dioxide in the United States

Historically, federal and state governments governed the air quality through collaboration; however, greenhouse gases remained outside this regulatory regime. Under the Clean Air Act of 1970, both the federal and state governments developed and implemented air quality regulations, which apply to the six criteria pollutants common in the United States (Ringquist 1993). However, the EPA did not include carbon dioxide in this initial list of regulated pollutants. As scientific and political concerns over the problem of carbon dioxide and other greenhouse gases came to fruition in the Nineties, many scientists and politicians called for the federal government to join an international treaty to address the problem of global climate change.

Despite initial efforts to establish mitigation programs and targets, federal efforts fell short. By the late Nineties, President Clinton signed the Kyoto Protocol, an international agreement that would have required the United States to reduce its Greenhouse Gases by seven percent below 1990 emission levels by 2012. However, the Kyoto protocol was considered "dead on arrival" in the US Senate, and the United States failed to ratify the treaty. Under the Bush administration, the president continued to push for voluntary approaches, and disengaged from the Kyoto Protocol in 2001 by deciding that the U.S. would not take steps to ratify and implement the treaty targets by 2012 (Clémençon 2008).

Federal climate change policy consisted mostly of voluntary mechanisms in the Nineties and early 2000s, states decided to take their own policy routes. Many officials saw the federal policies to address climate change as inadequate, and many regional, state, and local actors adopted policies in a "bottom-up governance" approach to climate mitigation policy (Rabe 2004). After the federal government pulled out of the Kyoto protocol, many states adopted their own policies and goals for GHG reductions.

Between 2001 and 2011, states adopted climate action plans or non-binding portfolios of policy recommendations to fit their state's environmental and economic needs. These policies consisted of five different processes: calculating emissions, adopting targets, developing policies, implementing measures, and monitoring results (Wheeler 2008). To meet targets, states adopted different strategies that included increasing building efficiency, expanding renewable energy, the creation of forests and soil protection programs, promotion of more efficient vehicle use, more efficient power plants, improved waste management, and develop biomass and nuclear fuels (Pollak et al. 2011). Within these climate action plans, some states adopted climate GHG targets or goals, which set certain reduction expectations.

Each state adopted unique GHG targets through different governmental processes and rates and tailored to their different climate reduction objectives. Many states adopted these goals through state executive orders, executive directives, or the legislature. All states who adopted reduction goals, adopted climate action plans. However, not all states with climate action plans set emission reduction goals. By 2009 32 states had adopted climate action plans, of which only 20 had adopted specific state reduction goals. These reduction goals consist of one to three reduction phases in the future (often the year 2020 or 2050), based on a past emissions baseline (often the year 1990 or 2000). For example, in 2006 Arizona adopted an executive order which established a statewide goal to reduce Arizona's GHG emissions to 2000 levels by 2020, and 50 percent below 2000 levels by 2040.

While states took an active approach in the adoption of climate mitigation policies, the empirical evidence of the effectiveness across all states is quite limited. While there is a robust collection of literature evaluating the effectiveness of international treaties on air pollution in general (see: Aichele and Felbermayr 2013; Al Doyaili and Wangler 2013) and sulfur dioxide emissions (see: Ringquist and Kostadinova 2005), there is little research on the effectiveness of American public policy on carbon dioxide emissions. Only Drummond (2010) investigates state climate change policies and carbon dioxide emission reductions, and Barbour and Deakin (2012) investigate the influence of California's Senate Bill 375 on the state's reductions efforts.

Drummond (2010) provides the best evidence evaluating the effects of state policy on nationwide emissions, but this previous research is limited for several empirical and methodological reasons. First, it omits industrial-based carbon dioxide emissions from analysis. Second, the data used in this study through the Energy Information Administration is based only on indirect estimates of only two-thirds of state carbon dioxide emissions. Finally, GHG targets in Drummond (2010) are measured dichotomously, when there is variation in the expectations for these state policies. For example, a reduction of 20% in California is different than a 20% reduction in Vermont. The Energy Information Administration reports that in 1990, Vermont's total carbon dioxide emissions were 5.49 million metric tons per year, while California's were 363 million. Treating each of these reduction goals as equals does not provide an effective cross-comparison.

Program evaluation

Beyond the immediate question of whether GHG targets are effective in the reduction of carbon dioxide emissions, it is important to embed GHG target reduction policies within the broader literature of program evaluation and public policy to understand their purely voluntary and evaluative role. Vedung (2008) describes evaluation as a time in which officials determine how well the administrative process is turning out, whether outcomes are obtained by intervention, and whether more cost-efficient ways can assist in reaching a goal. Essentially, evaluation is a time for learning and adjustment. During this time of reflection and change, individual behavior may change in response to policies before future intervention or changes occur (Vegung 2008).

GHG targets qualify as evaluation policies adopted to evaluate the progress of each state, and therefore reflect an interest from state actors in determining whether or not the state is progressing as planned. Higher expectations in GHG targets during the evaluation process could indicate more desired outputs in the policy process, mainly due to the role of information in producing outcomes for private actors. Therefore, businesses may act even before mandatory or voluntary programs intervene in the emission of GHGs because targets may be a signal to businesses of the inevitability or strength of future GHG regulations. So, in essence, targets could be used as reference points in order to adopt or modify existing/future climate change policies or modify polluting behavior.

Hypotheses

This study evaluates two related hypotheses concerning GHG targets and emissions in order to unravel the conflicting evidence that suggests the effectiveness of state reduction plans. On one hand, the underlying programs attempting to meet these reduction goals might be flawed. Scholars have criticized state officials for making inadequate policy recommendations, being unable to fully implement existing recommendations, and failing to fully provide resources for climate action plans (Wheeler 2008). There is reason to believe that while states may adopt ambitious goals for reduction, a state may have no direct policy mechanisms to reduce emissions.

On the other hand, other evidence indicates state GHG targets produce emission changes. Drummond (2010) finds empirical evidence that states with reduction plans reduce more non-industrial emissions than those who do not have these targets. Additionally, Aichele and Felbermayr (2013) indicate that the Kyoto Protocol produced reductions in carbon dioxide emissions despite the voluntary, non-enforceable nature of the agreement.[16] This is due to member countries summarizing and reporting their emissions annually, which impacts the country's political process and encourages reduction results.

Hypothesis #1a: States with more ambitious reduction policies have lower carbon dioxide emissions than those with less ambitious ones.

Hypothesis #1b: Facilities in states with more ambitious reduction policies have larger carbon dioxide emission reductions than those with less ambitious ones.

Dataset, Methods, and Variables

This study uses two different types of statistical analysis for two levels of carbon dioxide data. For state-level analysis, this study uses Pooled Cross-Sectional Time Series Analysis because there are time variant and invariant variables. Since there is a chance for a correlation between standard errors across time and space I correct for this statistical problem with panel-corrected standard errors. The second level of analysis is facility-level. Since facility-level data aggregated to the state-level is limited in variation and explanatory power, this study uses Ordinary Least Squares to analyze *change* in emissions from 2011 and 2013 at the facility-level.

The following variables measure the influence of GHG targets on carbon dioxide emissions (for both levels). Figure 1 provides a conceptual framework in order to provide clarity.

[16] The Kyoto Protocol legally bound member states to reduce carbon dioxide emissions. However, Aichele and Felbermayr (2013) note that these requirements were less stringent than presented on paper.

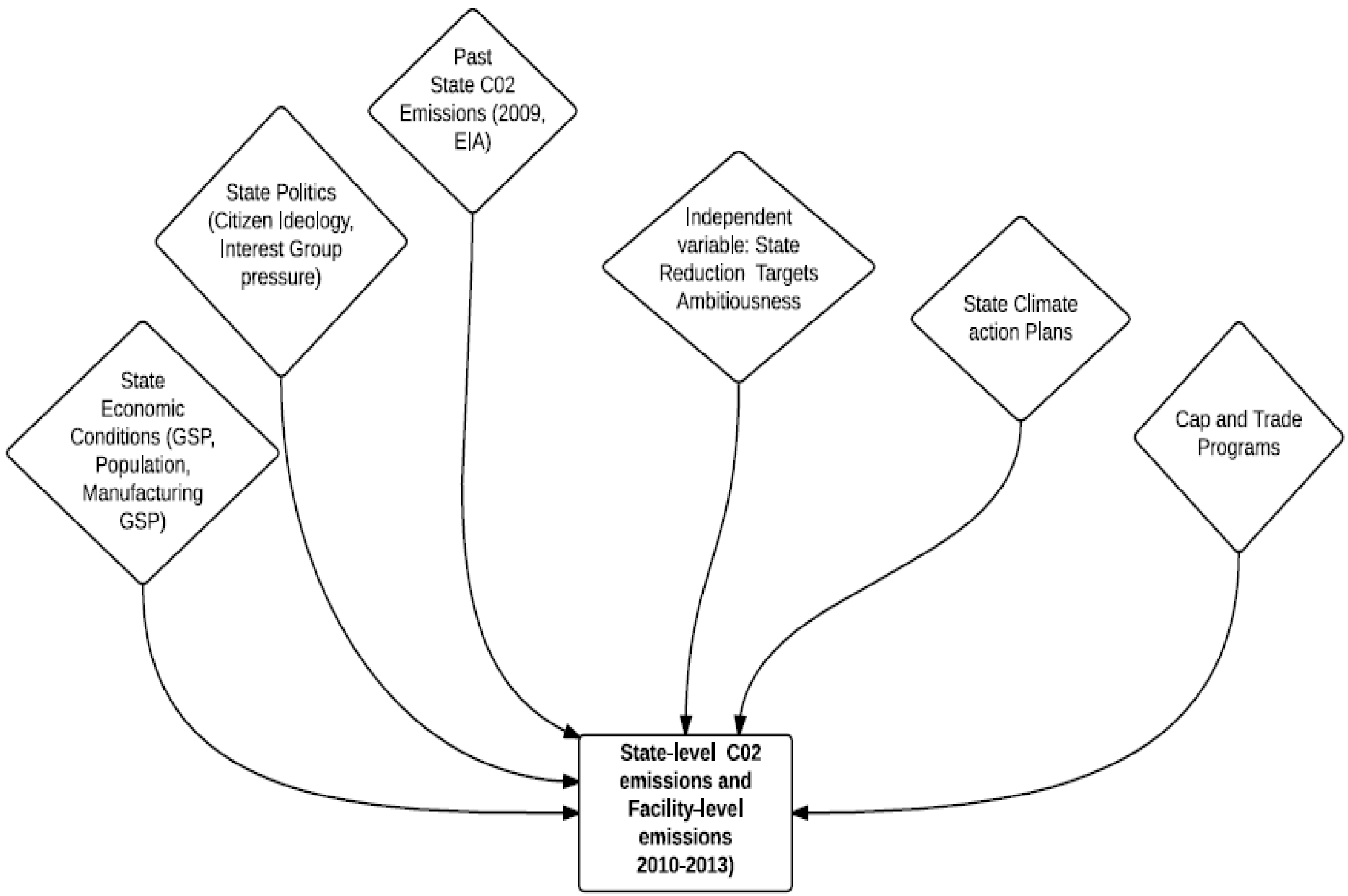


Figure 2: Conceptual Mode for influence of numerous state level variables on state C02 emissions

Dependent variables

I use two different dependent variables to understand the relationship between ambitious GHG targets and carbon dioxide emissions.[17] First, facility emissions are aggregated to the state level from 2010 to 2013 from the GHGRP. Second, I investigate the change in facility-level emissions from 2011 to 2013 from the same dataset. This dataset covers direct emissions data from over 7,000 facilities across nine economic sectors (power plants, petroleum and natural gas, refineries, metals, chemicals, waste, and other facilities). This is superior to previous carbon dioxide data in that it covers over eighty to ninety-five percent of all GHGs emissions, provides direct emission counts, and is reported at the facility-level. While previously Drummond (2010) only utilizes state-level carbon dioxide estimates from the Energy Information Administration, which is limited in scope and level of analysis.[18]

Independent variables

While it is typical of past policy research to operationalize policy adoption or policy implementation in strictly dichotomous terms, this study joins other scholars who move beyond this limited type of measure. Other studies incorporate key policy designs to build metrics of policy stringency when dealing with Renewable Portfolio Standards (RPS) (see: Carley and Miller 2012; Wiser and Barbose 2008; Fischlein 2010). The approach of Carley and Miller (2012) is the most straight forward and intuitive way in which to address stringency. Carley and Miller (2012) develop a RPS stringency measure based on 1) if a state has adopted a RPS policy,

[17] For more information on each variable, see the Variables chart in the appendices.
[18] EIA data is based solely on estimates of carbon dioxide emissions from residential, commercial, and electricity sources from 1990 to 2013. This state data does not provide direct measurements of major polluters. So, this level of analysis restricts variation since its calculation is at the state-level, instead of the facility-level.

2) whether the policy is voluntary/non-binding or mandatory, 3) the stringency based on the final RPS mandate minus the starting RPS mandate, divided by the number of years between the final mandate year and the starting mandate year, multiplied by the RPS coverage of the state's energy market.

I also construct an ambitiousness index based on portions of this measure from Carley and Miller (2012).[19] This measure is built from state carbon emissions data from the Energy Information Administration from 1990 to 2010 and information from C2es concerning the adoption year and emission baseline years.[20] GHG emission targets designate an emissions baseline to compare future changes to emissions, a percentage by which to reduce emissions, and a year to meet that deadline—often across different phases for reduction. The following formula represents the percentage of emission reductions per year, averaged across phases.

$$\Big(\Big((AdoptionEmissionsLevels) - (BaselineEmissionLevels * PercentGoal)\Big) \div (\text{\# of years between adoption and goal})\Big) \div (\text{EmissionLevels at time of adoption})$$

Table 1 indicates the final average amount of reductions per year for each state (averaged across phases) to meet each state goal (organized from largest to smallest).[21]

[19] This measure differs in that it does not include voluntary versus mandatory reductions, and it also averages across multiple phases. Some may argue that the California GHG emission target is a mandatory target—requiring emission reductions and enforcing non-compliance. However, this policy does not put individual targets on facilities—so compliance is only mandated through other rules adopted by California Air Resources Board.

[20] Since the GHGRP only goes back to 2010, I use EIA to construct this measure. While EIA is flawed, it still provides the necessary data to approximate the ambitiousness of each state GHG targets because it covers the temporal scope of both the adoption years of GHG targets and the emission baseline years mentioned in each policy.

[21] Raw outputs in descriptive statistics vary from this table mainly because zeroes are dropped to clarity purposes.

Table 9: State GHG Target Goals Standardized

State	Average Percent Change Per Year (across all phases)
Connecticut	4.8428
Colorado	4.2109
Vermont	3.6256
Maine	3.5428
Oregon	2.3522
Rhode Island	2.0201
Minnesota	1.763
Maryland	1.6941
Illinois	1.5829
New Jersey	1.5806
Florida	1.4151
Arizona	1.3397
New Hampshire	1.3225
Michigan	1.1938
Washington	1.1816
Massachusetts	0.9366
New Mexico	0.9062
California	0.8965
Hawaii	0.8636
New York	0.1141

Controls

There are also several economic, political, policy, and past emission measures to control for other influences on carbon dioxide emissions. To start, state economic conditions are important indicators of the emission of carbon dioxide.

Gross State Product (GSP). Previous literature on the Kuznets curve indicates that there is a curved relationship between carbon dioxide emissions per capita and the Gross Domestic Product (GDP) of nations. While initially GDP increases carbon dioxide emissions, there is a point when economic expansion decreases carbon dioxide emissions at the national level (Aichele and Felbermayr 2013). The basic premise is this: as economies grow, so does air pollution. However, after a point, nations begin to invest in air pollution controls. Using similar reasoning, this study uses Gross State Product to control for this effect at the subnational level. States and facilities within states with larger GSP should correlate with decreases in the total emissions and increase reductions.

GSP from Manufacturing. While there is a complicated relationship between GDP and emissions, manufacturing is much more carbon intensive (Aichele and Felbermayr 2013). Therefore states and facilities with more carbon intensive industries should correlate with higher levels of emissions and smaller reductions. This study controls for manufacturing though GSP from manufacturing to take into account economic dependency of carbon intensive industries.

Population. To control for the state size of population and surrounding changes in population, this study controls for state population size. Aichele and Felbermayr (2013) find that there is a correlation between increases in population and carbon dioxide emissions. With more population, demands for energy and economic development increase. Similarly, we use state population estimates by year to control for these population shifts and to compare across states.

Citizen Ideology. Political factors should also play a role in amount of carbon dioxide emissions. Previous scholars find a correlation between state carbon dioxide emissions and the percent of voters for a Democratic presidential candidate, primarily because this indicates a public concern for the environment, and thus pressures a reduction in carbon dioxide emissions (Drummond 2010). Similarly, this study uses a citizen ideology measure to gauge public concern for climate change and the mitigation of carbon dioxide emissions. A state with a more liberal citizenry should be associated with lower state carbon dioxide emissions and larger facility reductions.

Number of Environmental Groups. Environmental interest groups could influence carbon dioxide levels and the magnitude of reductions. Past scholars indicate that number of green groups in a state could influence air quality policy (Potoski 2001). Therefore, interest group pressure could impact firm emission behavior directly through utility lobbying pressure or indirectly through state regulators, and as a result the more environmental interest groups registered in a state should result in fewer carbon dioxide emissions. This study uses a measure constructed by adding all the C-20 (pollution abatement and control) registered groups in a state from 2012 to 2014.

Climate action plans. Additionally, a state's regulatory environment through major voluntary and mandatory climate policies should impact emissions. Proponents argue that voluntary programs are more pragmatic and elastic in achieving environmental gains, while opponents argue that these programs are barriers to more effective and strict, mandatory programs (Pizer, Morgenstern, and Shih 2008). However, the previous empirical evidence indicates that climate action plans, a voluntary approach, should produce pollution reductions. Drummond (2010) finds a relationship between the adoption of state action plans and reduction of state per capita carbon dioxide emissions across residential, commercial, and transportation sectors. In a similar vein, this study uses a measure that indicates whether a state adopted a climate action plan or not.

Mandatory "Cap and Trade" Programs. Many states adopted policies to place specific limitations on certain industries that contribute to GHG emissions. The most significant way states attempted to limit greenhouse gas emissions is through state mandatory "cap and trade" programs for the power industry. These programs set strict limits on the amount of allowable GHG emissions from power plants, and creates a trading system of pollutant allowances. Past scholars indicate that the Acid Rain Program, which used a market-based "cap and trade" mechanism, significantly reduced sulfur dioxide emissions in the United States (Schmalensee and Stavins 2012). Therefore, similar "cap and trade" programs should have a similar impact on state carbon dioxide emissions.

Previous C02 emissions. Finally, past state and facility emissions behavior should influence the behavior of future carbon dioxide emission levels. The current analysis omits facility level controls, which could potentially miss a large predictor of changes in past polluting behavior. To compensate for this lack of facility-level variables, this study includes estimates of state-level carbon dioxide before the start of analysis.[22]

[22] For the state-level analysis, I use data from the EIA from 2009 in order maximize the amount of variation on the dependent variable for years 2010 to 2013.

Results

Table 1: Ambitiousness of GHG Targets and Aggregated State C02 emissions

DV: State-level C02 emissions	Model 1: All States (2010-2013)	Model 2: Only States w/ Targets (2010-2013)
Emissions-EIA (2009)	1,091**	1,340
	(423.9)	(807.8)
Ambitiousness Target	-4.798e+06***	-2.821e+06***
	(1.039e+06)	(1.035e+06)
Climate Action Plan	-35,687	
	(47,819)	
Manufacturing	-1.967***	-2.268***
	(0.744)	(0.713)
Population	0.0727***	0.0490***
	(0.00973)	(0.0138)
Cap and Trade	-65,144*	
	(35,379)	
Citizen Ideology	1,140	-6,925***
	(1,335)	(1,818)
Environmental Groups	-62.36	-165.0
	(90.85)	(158.4)
Gross State Product	-1.293***	-0.770***
	(0.150)	(0.120)
Constant	424,626***	815,384***
	(55,756)	(145,821)
Observations	200	80
R-squared	0.452	0.755

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 1 reports the analysis of facility emissions aggregated to the state-level. The results from Model 1 indicate that ambitiousness is strongly negatively correlated with fewer carbon dioxide emissions—as the GHG target ambitiousness increases, state carbon dioxide emissions decrease. Most economic controls meet expectations—except for manufacturing. Increases in

GSP correspond with decreases in emissions, and increases in population increase emissions. However, contrary to expectations, manufacturing is associated with decreases in emissions. The policy controls indicate that while “cap and trade” policies, which are mandatory reduction policies, are associated with lower carbon dioxide emissions, climate action plans are not associated with lower emissions. As expected, past emissions in state correspond with future emissions activity, and increases in reported state emissions from 2009 increase with emissions from 2010 to 2013.

Model 2 investigates emissions from the only states that have GHG targets to check if the results deviate significantly from the first model. These results almost mirror the ones from the first model.[23] Amongst states with targets, the more ambitious states correlate with less carbon dioxide emissions. Also, while there is no statistically significant relationship between EIA emissions and aggregated state GHGRP emissions, the more liberal states among those that have adopted GHG targets emit less total emissions.

Despite the strong results from Table 1, there is difficulty determining the causal direction between carbon dioxide emissions and ambitious GHG targets.[24] The state-level analysis fails to answer whether states with more ambitious targets emit less carbon dioxide emissions or if states with lower carbon dioxide emissions adopt more ambitious GHG targets.

[23] Both “Cap and Trade” and “Climate Action Plans” are dropped due to collinearity. Almost all states who have adopted GHG reduction targets adopted climate action plans and/or cap and trade policies.
[24] Previous chapters indicate a modest relationship between the adoption of GHG reduction targets and carbon dioxide production.

Table 2: Ambitiousness of GHG Targets and Facility C02 emissions

DV: Facility-level Carbon Dioxide Emissions	Model 3: Change in Emissions w/ previous emissions (2011-2013)	Model 4: Change in Emissions (2011-2013)
Carbon Dioxide Emissions (2010)	-0.0643***	
	(0.00270)	
Ambitiousness Target	771,708	979,253*
	(585,416)	(576,403)
Climate Action Plan	6,162	3,181
	(14,190)	(13,807)
Manufacturing (2011)	0.176	0.174
	(0.229)	(0.229)
Population (2011)	-0.00856*	-0.0153***
	(0.00471)	(0.00472)
State Cap and Trade	-43,088*	-43,815*
	(26,151)	(26,025)
Citizen Ideology	-671.7	-659.6
	(553.9)	(545.2)
Number of Environmental Groups	56.08*	70.42**
	(30.09)	(29.77)
Gross State Product (2011)	0.126	0.239***
	(0.0873)	(0.0874)
Constant	19,297	-9,625
	(22,386)	(21,842)
Observations	5,254	5,781
R-squared	0.101	0.004

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Further facility-level analysis presented in Table 2 indicates a more complex relationship between GHG targets and facility-level emissions. In Model 4, there is a modest relationship between states with more ambitious GHG targets carbon dioxide emissions—however, in the *opposite* direction of the expected result (negative relationship indicates larger reductions). Additionally, Model 3 indicates, with the inclusion of past emissions behavior, ambitiousness no longer correlates with reductions in carbon dioxide emissions.

Additionally, facility-level controls present a different outcome than the previous models. Model 3 and 4 indicate no relationship between manufacturing, climate action plans, and citizen ideology and reductions in carbon dioxide emissions. Also, the models indicate a relationship between number of environmental groups and GSP, and facility emission reductions are smaller in states with more environmental groups and GSP--which is contrary to expected results. However, facilities reduce more carbon emissions if they are located a state with a "cap and trade" program.

Discussion

The results here indicate that at first glance, GHG targets seem to correlate with lower state carbon dioxide emissions. However, there is reason to question this assessment. The more rigorous model (Table 2, Model 1), which uses facility-level emissions while controlling for past facility behavior is better because it explains much more of the variation of the dependent variable (.101 in Model 3 compared to .004 in Model 4). Additionally, it incorporates variables beyond the state-level and provides measures for facility-level activity. The more rigorous model suggests that there is no relationship between the ambitiousness of GHG targets and emission reductions. However, using such a conservative estimate may underestimate the role of GHG targets, and one must view these results with caution (see: Limits to Research for more). If one were to accept the idea that GHG targets produce no tangible emissions reductions, then conceptually it makes sense to view those states with more ambitious targets as adopting plans because there is a smaller problem (i.e. lower carbon dioxide emissions) to address.

Overall, these results indicate a difference in emission reduction performance between state mandatory and voluntary policies. This evidence suggests that the voluntary mechanisms through climate action plans intended to meet reduction goals are not adequate in decreasing emissions. The failure to find any relationship between adoption of climate action plans and carbon dioxide emissions runs contrary to some past empirical evidence (Drummond 2010). However, considering previous criticisms, it should not be surprising. As previously mentioned, these climate action plans often are "low-hanging" voluntary policies, mainly adopted to improve economic opportunities, and these policies suffer from a lack of resources and full implementation (Wheeler 2008). However, the temporal scope of this analysis may prevent a full assessment of the effectiveness of these measures, and further research is needed.

On the other hand, while one may question the effectiveness of both climate action plans and reduction targets, the evidence here suggests that state "cap and trade" programs do produce changes in firm polluting behavior. Although, it is entirely possible that both of these variables are rather blunt, future research should add more nuance to explain the relationship between these policies and emissions.

Limitations and future research

There are several methodological and empirical challenges that should be addressed in future drafts of this research and other scholarly work. First, there are inherent limitations in determining if the policy itself is the cause of change in the dependent variable. Previous studies on the effects of environmental policy indicate that data trends before the time of adoption can mask the true effect of policies. Ringquist and Kostadinova (2005) found that that participating countries in the Helsinki Protocol reduced pollution faster than nonparticipants; however, the reduction trend existed prior to adoption of the treaty and continued the a decrease in emissions without the program. Unfortunately, the Greenhouse Gas Reporting Program does not report GHG emissions before 2010 to conduct a trend analysis of pre-adoption pollution. Future versions of this research could solve this problem by narrowing the data to power plants and incorporating data from the Clean Air Market Program with the GHGRP data, which would identify carbon dioxide trends before the extant analysis.

There are also ways in which to improve the methodological approach to this study. Future studies need to develop a more nuanced dependent variable by dividing it by sector and including other GHG emissions provided in the GHGRP dataset. In this analysis, all emissions are aggregated by sector and only include carbon dioxide. However, the GHGRP data includes divisions across sector and includes other GHGs, such as methane. It could be important to evaluate reductions across pollutant and economic sector. Future analysis needs to incorporate more facility-level variables and modify the ambitiousness measure. Currently, the use of past year's emissions is a very crude and conservative test of all other variables. Much of the variation on the dependent variable is explained by past emissions. However, other measures such as owner and facility production data would clarify the facility level analysis by refining what influences the emission of pollution and what does not.

Conclusion

The current chapter initially asked the question of whether state GHG targets are effective in producing tangible changes to polluting behavior. Viewing these policies as evaluation policies, evidence presented here indicates the clear symbolic nature of more ambitious state GHG targets. Furthermore, this suggests that these policies have no direct impact on emissions activity, and perhaps these policies are useful in holding public officials accountable. Rather, states with more liberal citizens and smaller carbon dioxide emission problems are more likely to adopt these policies. While these GHG targets are for evaluation purposes, there is a disconnect between emissions activity and the emission goals of public officials, businesses, and other individuals involved overseeing carbon pollution. Perhaps it is better to evaluate GHG targets in a framework beyond a traditional outcome-based paradigm. While GHG targets may not provoke officials or industry to reach the intended goals, perhaps these policies are useful in holding public officials accountable for their lack of action. Future research should look at whether failure to meet certain goals and targets actually changes election results or impacts public support for candidates.

Ultimately, the evidence casts doubt upon the ability of states to address the mitigation of GHGs on their own. The underlying problem with how states address the mitigation of climate change is that, while they make ambitious targets and adopt outlines to develop climate mitigation programs, both the proposals are inadequate and/or the implementation of policies never occurs. Although there is evidence that state cap and trade programs result in larger emission reductions, only a limited number of states adopted these mandatory programs. And even though it is a political challenge, if states want to motivate businesses to reduce their pollution, then it is perhaps more expedient to adopt policy mechanisms that have some capacity to hold businesses accountable rather than adopting targets that are limited in effectiveness.

References

Aichele, R. and G. Felbermayr (2013). "The Effect of the Kyoto Protocol on Carbon Emissions." Journal of Policy Analysis and Management 32(4): 731-757.

Al Doyaili, S. and L. Wangler (2013). "International climate policy: does it matter? An empirical assessment." Journal of Environmental Economics and Policy 2(3): 288-302.

Aldy, J. E. (2006). "Per capita carbon dioxide emissions: convergence or divergence?" Environmental and Resource Economics 33(4): 533-555.

Aldy, J. E. (2007). "Divergence in state-level per capita carbon dioxide emissions." Land Economics 83(3): 353-369.

Aldy, J. E. (2007). "Energy and carbon dynamics at advanced stages of development: An analysis of the US states, 1960-1999." The Energy Journal: 91-111.

Barbour, E. and E. A. Deakin (2012). "Smart Growth Planning for Climate Protection: Evaluating California's Senate Bill 375." Journal of the American Planning Association 78(1): 70-86.

Bennear, L. S. (2007). "Are management-based regulations effective? Evidence from state pollution prevention programs." Journal of Policy Analysis and Management 26(2): 327-348.

Borck, J. C. and C. Coglianese (2009). "Voluntary environmental programs: assessing their effectiveness." Annual Review of Environment and Resources 34: 305-324.

Carley, S. and C. J. Miller (2012). "Regulatory stringency and policy drivers: A reassessment of renewable portfolio standards." Policy Studies Journal 40(4): 730-756.

Clémençon, R. (2008). "The Bali road map A first step on the difficult journey to a post-Kyoto protocol agreement." The Journal of Environment & Development 17(1): 70-94.

Daley, D. M. (2007). "Voluntary approaches to environmental problems: exploring the rise of nontraditional public policy." Policy Studies Journal 35(2): 165-180.

Drummond, W. J. (2010). "Statehouse Versus Greenhouse: Have State-Level Climate Action Planners and Policy Entrepreneurs Reduced Greenhouse Gas Emissions?" Journal of the American Planning Association 76(4): 413-433.

Fischlein, M. L. (2010). Renewable energy deployment in the electricity sector: Three essays on policy design, scope, and outcomes, UNIVERSITY OF MINNESOTA.

Gray, W. B. and J. P. Shimshack (2011). "The effectiveness of environmental monitoring and enforcement: A review of the empirical evidence." Review of Environmental Economics and Policy: req017.

Howard, G. J. (1999). "Garbage laws and symbolic policy: Governmental responses to the problem of waste in the United States." Criminal Justice Policy Review 10(2): 257-290.

Jiusto, S. (2006). "The differences that methods make: Cross-border power flows and accounting for carbon emissions from electricity use." Energy Policy 34(17): 2915-2928.

Koehler, D. A. (2007). "The Effectiveness of Voluntary Environmental Programs—A Policy at a Crossroads?" Policy Studies Journal 35(4): 689-722.

Lyon, T. P. and E.-H. Kim (2006). "Greenhouse Gas Reductions or Greenwash?: The DOE's 1605b Program." The Doe's 1605b Program (November 2006).

Lyon, T. P. and J. W. Maxwell (2007). "Environmental Public Voluntary Programs Reconsidered." Policy Studies Journal 35(4): 723-750.

Maggioni, E., et al. (2012). "Industry Influence in Stakeholder-Driven State Climate Change Planning Efforts." Policy Studies Journal 40(2): 234-255.

May, P. J. (2005). "Regulation and compliance motivations: Examining different approaches." Public Administration Review 65(1): 31-44.

Metcalf, G. E. (2008). "An empirical analysis of energy intensity and its determinants at the state level." The Energy Journal: 1-26.

Moon, S.-G. and S. Bae (2011). "State-Level Institutional Pressure, Firms' Organizational Attributes, and Corporate Voluntary Environmental Behavior." Society & Natural Resources 24(11): 1189-1204.

Pizer, W., et al. (2008). "Evaluating voluntary climate programs in the United States." Resources for the Future RFF DP: 08-13.

Pollak, M., et al. (2011). "Reducing greenhouse gas emissions: Lessons from state climate action plans." Energy Policy 39(9): 5429-5439.

Potoski, M. and A. Prakash (2005). "Covenants with weak swords: ISO 14001 and facilities' environmental performance." Journal of Policy Analysis and Management 24(4): 745-769.

Potoski, M. and A. Prakash (2013). "Do Voluntary Programs Reduce Pollution? Examining ISO 14001's Effectiveness across Countries." Policy Studies Journal 41(2): 273-294.

Potoski, M. and A. Prakash (2013). "Green clubs: Collective action and voluntary environmental programs." Annual Review of Political Science 16: 399-419.

Rabe, B. G. (2004). Statehouse and greenhouse : the emerging politics of American climate change policy. Washington, D.C., Brookings Institution Press.

RAMIREZ HARRINGTON, D. (2013). "Effectiveness of state pollution prevention programs and policies." Contemporary Economic Policy 31(2): 255-278.

Ringquist, E. J. and T. Kostadinova (2005). "Assessing the effectiveness of international environmental agreements: The case of the 1985 Helsinki protocol." American Journal of Political Science 49(1): 86-102.

Schmalensee, R. and R. N. Stavins (2012). "The so2 allowance trading system: The ironic history of a grand policy experiment."

Shanti Gamper-Rabindran, S. R. F. (2009). "Does industry self-regulation reduce pollution? Responsible Care in the chemical industry? ." Journal of Regulatory Economics 43(1): 1-30.

Vedung, E. (2008). Public policy and program evaluation, Transaction Publishers.

Welch, E. W., et al. (2000). "Voluntary behavior by electric utilities: Levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide." Journal of Policy Analysis and Management 19(3): 407-425.

Wheeler, S. M. (2008). "State and municipal climate change plans: the first generation." Journal of the American Planning Association 74(4): 481-496.

Young, O. R. (2001). "Inferences and indices: evaluating the effectiveness of international environmental regimes." Global Environmental Politics 1(1): 99-12.

Appendices

VARIABLES	(1) N	(2) Mean	(3) Standard Deviation	(4) Min	(5) Max
State Mean of C02 Emissions	200	467,790	235,995	20,317	1.243e+06
Number of Environmental Groups	200	370.7	361.5	49	2,254
Climate Action Plan Adoption	200	0.760	0.428	0	1
Citizen Ideology	200	47.43	15.35	18.07	86.18
Manufacturing from GSP	200	39,326	46,247	1,242	239,008
Gross State Product	200	313,471	377,925	26,570	2.203e+06
Population	200	6.242e+06	6.911e+06	564,222	3.833e+07
State C02 Emissions 2009 (EIA)	200	107.5	105.0	6.097	626.4
Ambitiousness of State GHG Targets	200	0.00748	0.0120	0	0.0484
State Cap and Trade Adoption	202	0.203	0.403	0	1

Variable	**Description**
State-level GHG Emissions (2010-2013)	Average state carbon dioxide emissions per year (aggregated from facility-level). Source: Greenhouse Reporting Program
Facility-level GHG emissions (2011-2013)	Facilities-level GHG carbon dioxide emissions. Source: Greenhouse Reporting Program.
Ambitiousness Measure of Target adoption	Source: C2es and Energy Information Administration
GSP (2010-2013)	Gross State Product per capita. Bureau of Economic Analysis.
Population (2010-2013)	Raw population numbers by state. U.S. Census.
Citizen Ideology (2010)	0-100 scale. 0= Very Conservative. 100= Very Liberal. Adapted from Berry et al. (2007). Constructed from the electorate's perceived ideal ideological fit with Congressional candidates' ideology.
GSP from Manufacturing (2010-2013)	Gross State Product from the Manufacturing sector. Bureau of Economic Analysis.
State mandatory Cap and Trade program	Whether state adopted a mandatory state level cap and trade program. Source: C2es.
State Climate Change Plan	Whether state adopted a climate action plan. Source C2es.
Environmental Groups in a state	Total number of C-20 Pollution and Abatement groups registered between 2012 and 2014. Source: National Center for Charitable Statistics
State C02 emissions (2009)	Total carbon dioxide emissions by state (Million metric tons). Source: EIA Source

Conclusion

Throughout this dissertation I sought to explore the role of state governments in the adoption and implementation of air quality regulations, along with the response of private actors to these regulations. I show that the optimism expressed by scholars in the state's role in air pollution may be overstated. Each of these cases suggests a more cautious approach when understanding the capabilities of state air quality regulation.

In chapter one, I explored the relationship between state political and economic conditions and the adoption of GHG tracking and reduction policies. Using Event History Analysis, I found several relationships between state adoption and internal state factors—the strongest being citizen liberal ideology and adoption. Ideology plays such a large role in adoption that certain policies, such as GHG targets, are adopted only by certain very liberal states. With a few exceptions, other external factors through ideological and geographical proximity play no role in the adoption of these policies.

Businesses also may respond by trying to avoid air quality regulations. I sought to investigate whether the RTTB hypothesis properly explained the influence of state air quality regulations on the siting of new coal power. By looking at information from the national coal project, which provides information on permitting behavior between 1999 and 2009, I used Negative Binomial and OLS to analyze firm behavior. Controlling for economic conditions and past coal siting behavior, I found that business modify the size and number of applications for air quality permits for coal power. They apply to more and for larger increase power capacity in states with more conservative citizens and less stringent CAA air quality regulations.

Finally, in chapter three, I found that firms may even ignore certain air quality regulations. I consider whether the state adoption of GHG targets reduces a state's carbon dioxide emissions under the auspices that this type of evaluation policy produces changes to individual firm behavior. Initially, I found a negative relationship between a state's adoption of more ambitious GHG targets and state-level emissions in the GHGRP data. However, further facility-level analysis shows no relationship between ambitious targets and the size of emission reductions. Instead, state "cap and trade" programs were associated more consistently with carbon dioxide emission reductions.

I found throughout this dissertation that while many states adopted more stringent air quality regulations, state political conditions dominated this policy process. Most important of all: not all states adopted climate change policies. Only more liberal states were likely to adopt voluntary GHG inventories, climate action plans, GHG reduction targets, and more stringent CAA regulations. Additionally, even moderately liberal states were reluctant to adopt more ambitious GHG targets. This suggests that even though some states adopted these policies, they responded unevenly to the problem of air pollution.

Problems associated with state adoption of climate change policies are compounded further when states who contribute the least to climate change are those most likely to adopt more ambitious GHG targets and "cap and trade" programs.[25] This suggests that even though states have the ability to develop legislation to mitigate factors contributing to climate change, these solutions may not be present in states who significantly contribute to the problem in the first place.

[25] Many adopters of "cap and trade" programs are small, lower emitter states in the Northeast.

Even if states adopt more climate mitigation policies this does not necessarily mean that they modify businesses' behavior. There is evidence that the adoption of GHG targets did not produce tangible decreases in carbon dioxide. Additionally, although large states like California and New York developed effective "cap and trade" programs, which seem to have made some tangible impact on carbon dioxide trends in their states, businesses still attempted to avoid more stringent regulations when possible. This is evident in the siting of coal-fired power plants over the last decade. Utilities site in states with the minimum standard of new sources of pollution and more conservative states where the regulatory environment is less stringent.

These cases indicate some instances of the inability of states to meet the demand of air pollution on their own. Although there is reason to be hesitant about the achievements of state governments in regulating their air quality, this dissertation should not be read as an outright indictment of their efforts to reduce air pollution. Federal and state cooperation led to massive reductions in the CAA criteria air pollutants. This study does not suggest that state governments play no role in the regulation of air pollution, only that regulators should be aware of the limits of these governments when allowing them to develop their own policy.

Perhaps the ideal relationship consists of state and federal governments working together on air quality. For example, while utilities want to site coal-fired power plants in states with less stringent regulations, the federal government prevents state governments from going below certain standards for the main criteria pollutants under the CAA. This suggests that while the states can assist the federal government in implementation of future air quality regulations, the EPA can work with the states to produce a regulatory environment that produces ideal policy outcomes into the future.