From Planning to Action: An Evaluation of State Level Climate Action Plans

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FROM PLANNING TO ACTION: AN EVALUATION OF STATE LEVEL CLIMATE ACTION PLANS

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DEDICATION

In dedication to my parents for making me who I am, and my husband for supporting me all the way!

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ABSTRACT

Climate change is one of the most daunting problems of our time requiring innovative responses to its causes and consequences. In the United States, the long absence of strong federal leadership along with growing public awareness of the problem created a fertile ground for state-level climate action planning. To date, 34 states have adopted Climate Action Plans (CAPs). The question that this study addresses is: Does state-level climate action have the potential to reduce carbon emissions significantly? This question was examined by assessing the relationships between CAPs, emissions reduction targets, plan implementation and emissions mitigation. My hypothesis was that CAPs result in emissions mitigation beyond the trend.

This study compares states with and without CAPs, before and after adoption and implementation of plans. The first phase of the research, a content analysis of state-level CAPs, involves four components: 1) CAP development procedures; 2) goal setting, policy coverage and regional coordination; 3) implementation provisions and conditions; and 4) implementation mechanisms and monitoring results. The analysis reveals six types of CAPs, categorized based on the rigor of their targets and implementation. The second phase of the research analyzes the relationships between CAP types and changes in emissions using panel emissions data from 1990 to 2013. The regression model controls for social, political and climatic context, industrial mix and change over time, urban form and energy prices.

The research shows that CAPs do result in reductions in emissions, although they are modest. Only a few CAPs set enforceable targets and provide strong evidence of implementation, monitoring and evaluation. Overall, progress towards goals is slow and near-term targets are low. The findings also suggest a role for planners in two key areas: transportation and land use. The analysis demonstrates that state-level CAPs call for low emissions reductions from transportation and land use changes, compared to these sectors' contribution to total emissions. The regression, though, shows that urban compactness leads to transportation emissions reductions even when controlling for changes in income, energy prices and unemployment. Thus, transportation planning represents a large opportunity for future emissions reductions—particularly through integration with smart growth policies.

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CHAPTER I

INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) has consistently detected human impact on the warming of the atmosphere and the ocean, on the global water cycle, on reductions in snow and ice, on global mean sea level rise, and on changes in some climate extremes (IPCC 1996, 2001, 2007, & 2013). In the most recent publication (IPCC, 2013), even stronger evidence in support of a finding of human influence on climate change has been documented: The anthropogenic impact is “the dominant cause” of the observed warming since the mid-20th century with a probability standard exceeding 95%. If unabated, the anthropogenic climate change can cause irreversible and lasting impacts on human settlements and ecosystems (IPCC, 2013). Whereas climate change impacts are complex scientific phenomena, defining and implementing a global response of an appropriate magnitude and distribution across various levels of human communities is rather complicated.

There are two major reasons why the issue of level of action (i.e. from local to global) is convoluted. First, the impacts of climate change will not balance out, some communities and ecosystems are expected to experience the worst hit independent of the significance of their contribution to the problem. This means that the patterns of harm as a result of climate change are likely to be highly inequitable affecting the most vulnerable of poor populations and future generations disproportionately. For example, low-lying coastal communities, areas that are prone to desertification and drought, those with economies highly dependent on natural resources, and those with the most constrained capacity to respond to climate change or its adverse impacts are especially vulnerable. To reduce the risk of climate change to natural and human systems, adaptation (i.e. measures to alleviate harm or exploit opportunities to benefit from impacts of climate change) and mitigation (i.e. reducing greenhouse gas emissions to limit climate change) must be combined. Adaption is unavoidable because even with the most stringent mitigation actions further climate change in the next few decades will continue to happen (IPCC, 2007). Yet, without mitigation, the magnitude of climate change may be intensified to a level that makes adaptation impossible for certain natural systems and very costly (both socially and economically) for most human communities (IPCC, 2007). Because those with the least resources have the least capacity to adapt to the adverse impacts of climate change, and future generations are likely to experience climate damages regardless of their own contribution, climate change is one of the most daunting ethical problems of our times.

Second, climate change is the "ultimate global-commons problem" (Aldy & Stavins, 2009): the locations of its impacts are completely independent of the locations of emissions sources; and the burden of mitigation costs are normally on the action taking jurisdiction, while the expected benefits are global. This has made negotiation processes at international levels complicated and agreements hard to reach, especially among historic and new or emerging super-emitters. Every attempt by the community of nations to curb greenhouse gas (GHG) emissions has provided further evidence that developing an agreed-upon international climate policy is not easy, and that climate change is a "wicked" (Churchman, 1967) problem. The first such substantial international attempt to tackle climate change was the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). While the United States originally signed the first agreement in Kyoto, the U.S. government, led by the Bush administration, later refused to ratify its participation. The observers of the protocol, regardless of their position on the suitability of the policy approach in Kyoto, took note of the United States' reluctance to reengage in the international climate policy.

In June 2013, President Obama laid out his administration's long anticipated climate action plan that most significantly calls for reductions of GHG emissions from power plants, which are responsible for roughly one-third of the nation's emissions. The plan also declares a commitment on part of the United States to cooperate with other great emitters, such as China. International analysts acknowledged the President's plan as a bold and important step forward, especially taking into account the long stalemate within the U.S. Congress (Bals et al., 2013). Yet, up until then, most observers outside the United States considered the country an "obstructionist" when it came to tackling global climate change (Moser, 2007). Perceptions of America's disinterest in an international climate regime, according to Byrne et al. (2002), were fueled by several key policy decisions at the national level: 1) rejecting mandatory GHG emissions reduction targets under the Kyoto Protocol; 2) prioritization of next generation fossil fuel and nuclear energy technologies over renewables in US energy policy; and 3) efforts by the misinformation campaigns to cast doubt on the "scientific consensus" on climate change and the need to take immediate action due to "uncertainties." One way or another, for years, the United States lacked a strong top-level climate leadership, and the federal efforts to address climate change did not go much beyond some support for research and voluntary programs (Christiansen, 2003).

The long absence of meaningful action and strong leadership at the federal government level along with growing public acceptance of the reality of the problem created a fertile ground for bottom-up climate policy (Byrne et al., 2007; Moser, 2007). Numerous sub-national governmental and non-governmental entities started to craft innovative and cooperative strategies particularly in the area of energy efficiency and renewable energy sources (Byrne et al., 2007). In this arena, US states played an integral role.

Empirically speaking, many of the state governments along with their local municipalities have been ready to lead America's climate action ever since the decentralization of environmental policy resources and regulatory authority from the federal government in recent decades. In fact, the vast majority of state governments have undergone fundamental changes ever since the first Earth Day in 1970, before which states were deemed "sufficiently lethargic" to require federal level supervision in many of the environmental policy areas (Rabe, 2013). By the 1980s, the "resurgence of the states literature," identified several states as rising environmental leaders (Bowman & Kearney, 1986; Kane, J., & Anzovin, S., 1989; Van Horn, 1989). Rabe (2013) documented at least three reasons supported by the literature why commitment to stronger environmental policy may be expanded and accelerated at the state and by extension the local levels: 1) broad public concern on environmental issues provides significant momentum for bottom-up policy intervention; 2) the proliferation of environmental professionals, representing industry, advocacy groups, foundations and ultimately state and local agencies provides a considerable base of talent and a fertile ground for policy entrepreneurship; and 3) environmental policy at the state level can be stimulated by direct democracy not possible at the federal level, including promoting initiatives, referendums, and the recall of elected officials.

The majority of state-based initiatives originated from state Climate Action Plans (CAPs) developed in mid-to-late 1990s (Byrne et al., 2007; Wheeler, 2008). During these years, The U.S. Environmental protection Agency made grants available to state governments to prepare an inventory of their GHG emissions and develop mitigation plans (Wheeler, 2008). By 2008, 29 US states had already prepared and adopted CAPs (Wheeler, 2008). Although the motivations behind taking action and the focus of CAP strategies varied from state to state, policies targeting alternative fuel fleets (i.e. vehicles utilizing alternative fuels, such as natural gas, methanol or electricity and/or energy efficiency technologies, such as hybrid technology), public transportation, climate-neutral land-use, energy efficiency and renewable energy, waste management and recycling were widespread (Byrne et al., 2007). The state level efforts were accompanied by municipal initiatives to mitigate GHG emissions primarily orchestrated by the International Council on Local Environmental Initiatives (ICLEI-Local Governments for Sustainability). Under its Cities for Climate Protection Campaign initiated in 1993, ICLEI shaped the most extensive city level network by providing technical assistance to over 1,000 local jurisdictions worldwide and communities in 42 U.S. States (ICLEI USA, 2016).[1]

Despite the conventional propensity within literatures of environmental politics to examine levels of decision-making "as if they were independent" (Adger et al., 2003, p. 1101), 'global,' 'national,' 'state,' 'regional,' and 'local' environmental policy is not crafted in isolation. There is little questioning of the notion of "nested and discrete scales of political authority over the environment" (Bulkeley & Bestill, 2005, p. 43). Yet, in the case of climate action planning in the United States, analysis of state level actions is achievable and appropriate for several reasons: 1) given the federal government's long delay to address climate change at the national level, state level actions provide most of the information about the successes and failures of various policy approaches within the nation; 2) states are the lowest geographical level for which carefully collected and fully comparable energy data is available from the US Energy Information Administration (EIA); 3) the range of potential legal policy options to mitigate GHG emissions is similar for all states; 4) individual states have selected to undertake various policy options at different levels or no action by any means (Drummond, 2010); and 5) several states have recently reached across borders to collaborate in efforts addressing climate change by creating multi-state initiatives (some with Canadian provinces), and these initiatives are expected to make efforts more effective and efficient by eliminating "duplicative processes" and providing "predictable rules" (Center for Climate and Energy Solutions, n.d.).).

Evaluation of state level CAPs is important and interesting as it: 1) highlights the potentials and constraints of sub-national level action as laboratories of democracy and incubators of innovation; and 2) provides an opportunity for the planning profession to realize its new role of making global impacts while acting innovatively at local and regional levels. Moreover, evaluation of state CAPs will identify areas of strength and weakness in sub-national climate action. This can help to design a more effective federal level policy. By focusing on CAP implementation, this evaluation can also provide lessons for sub-national entities about implementing such plans and policies.

An evaluation of state level CAPs, focusing on implementation and actual reductions in GHG emissions, has not been performed yet. Wheeler (2008) has systematically reviewed the first generation of state-level CAPs in terms of their goals, their basic strength and weaknesses, included or left out measures, and ultimately issues and problems likely to impact implementation. Yet, Wheeler's study did not assess the relationship between CAPs and actual GHG emissions reductions. Drummond (2010) has compared states with and without CAPs, asking the question of whether or not these plans have been successful in reducing GHG emissions significantly. While Drummond (2010) identified some of the elements within CAPs that are associated with the greatest reductions, the author did not assess the relationship between implementation and GHG mitigation leaving the mechanisms linking CAPs and GHG emissions mitigation in question. Drummond (2010) also focused on CO2 energy emissions generated for use in the residential, commercial, and transportation sectors, and excluded the industrial sector of the economy—which is among the most controversial. The scholarly literature does not provide an assessment of possible relationships between variations in climate action plans across the nation, implementation of state CAPs and their effectiveness in reducing GHG emissions, which is one of the goals of this dissertation.

This dissertation is a two-pronged evaluation of state CAPs with two major components:

1) An assessment of CAP implementation and GHG mitigation potential through a content analysis of plan documents and available information about planning processes. This component involves the following questions: a) what are the CAP reduction goals? (e.g. interim and ultimate targets; reduction goals for each of the key sectors such as energy supply; etc.); b) what are the specified implementation provisions or conditions (e.g. funding sources; responsibilities; progress reports; etc.); and c) what are the specific implementation mechanisms recommended and employed by the CAPs to fulfill each of those goals (e.g. technical and financial assistance; cap and trade; carbon tax; research and development; etc.)?
2) A panel regression model depicting and assessing the relationships between CAP types based on the stringency of targets, rigor of implementation, and reductions in energy related carbon dioxide emissions from all end-use sectors (i.e. transportation, residential, commercial, industrial, and electric power). The general hypothesis that this phase sets out to investigate is: CAPs result in GHG emissions mitigation beyond the trend.

In the pages that follow, I first describe the theoretical underpinnings of my study. Second, I provide details about research methodologies for the two phases of analysis. Then, I discuss findings followed by conclusions, implications for climate action planning and directions for future research. Lastly, I present portions of the content analysis data organized in tables in appendices.

CHAPTER II

LITERATURE REVIEW

The goal of this literature review is to identify possible gaps in the literature as it relates to evaluation of sub-national climate action, and develop a framework for state CAP evaluation. To meet the aforementioned goal, two sets of literature were reviewed: 1) the literature on sub-national climate action activities and their impacts including energy and GHG emissions mitigation policies as well as state and municipal climate action plans; and 2) the literature on plan evaluation. The first set (i.e. sub-national climate action activities and their impacts) offered an overview of the current state of research on the topic of sub-national climate action and its impacts, and helped in narrowing the inquiry to areas where the literature is particularly thin. The second set (i.e. plan evaluation literature) provided the basic tools and techniques of plan evaluation. After reviewing the plan evaluation literature, the need to develop a framework appropriate for the purpose of CAP evaluation became apparent. This is because climate action planning is a new field of planning, and evaluation techniques suitable for CAPs are not fully developed.

Sub-national Climate Action

Parallel with the proliferation of sub-national action to mitigate GHG emissions and to adapt to the adverse impacts of climate change, various studies have catalogued these actions and their actual or potential impacts. More specifically, these studies have examined whether sub-national actions: 1) have actually resulted in GHG emissions mitigation beyond business as usual operations or have the potential to do so in their current form; 2) contribute to the pressure on the federal government to develop a homogenous and strong national policy, or obviate the formation or implementation of a national climate plan. A third group of studies important for building the regression model in this study focuses on explaining the variations among jurisdictions in environmental policy generally and climate action specifically.

Sub-national Action and Emission Reductions

There is substantial work that focuses on state GHG emissions mitigation and energy policies. Randolph and Masters (2008) present the full palette of state energy and climate action policies (p.720-732). Keeler (2007) assesses the efficiency of state programs in mitigating GHG emissions. Specifically, the author analyzes the potential for and difficulties of designing and implementing state cap-and-trade, renewable portfolio standards, technology/efficiency standards, subsidies and tax incentives, and registry and offset programs. Keeler (2007) concludes that while the desire of state governments to take climate action is understandable, the implementation of such policies at the state level presents specific problems. The most serious of these problems, according to Keeler (2007), is leakage of the controlled activities to other states that do not impose such controls.

Lutsey and Sperling (2008) and Moser (2007), on the other hand, are more optimistic about the potential of sub-national climate actions to result in significant GHG emissions reduction. Lutsey and Sperling (2008) inventoried and analyzed local, regional and state policy actions in terms of their potential impact on the national GHG emissions. The authors found that realization of all sub-national initiatives, as of 2007, can stabilize national emissions at 2010 levels by 2020. According to the authors, this finding shows that America's climate policy is much more complex and rich than is generally thought, and that these decentralized "bottom-up" actions can add up to serious reductions in GHG emissions. In contrast to Lutsey and Sperling (2009), who measured the effects of sub-national climate actions quantitatively, Moser (2007) took a qualitative approach to examine past and present signs of civic, private, local and state climate actions to find out whether these actions can result in a social movement in climate protection. The author concludes that while "momentum is quietly building" regarding mandatory emission reductions, the movement lacks a strong link (or what the author calls "a bridging frame") to bring sub-movements together as a whole (p. 140).

Using U.S. Energy Information Administration (EIA) state-level energy databases, a number of studies have conducted analyses of energy use and carbon emissions. Most prominent is Aldy's (2006, 2007a, 2007b) work on the relationship between carbon emissions and income. The author's detailed investigation generally indicated that income convergence is insufficient for CO2 emissions convergence. More specifically, Aldy (2007) concluded that while per capita emissions may appear to decline at high incomes, the decline reflects electricity imports more than decarbonization. Metcalf (2008) also analyzed different economic factors that resulted in overall decline in U.S. energy intensity since the mid-1970s. His state-level analysis demonstrated that rising per capita income and higher energy prices play an integral role in improvements in energy intensity. The two variables lower energy intensity primarily through improvements in energy efficiency rather than changes in economic activity (Metcalf, 2008). Jiusto (2008) offered an inclusive framework for analyzing and comparing state CO2 emissions. He investigated in considerable detail state-level CO2 energy emissions from 1990 to 2001 as well as differences among states in carbon emissions performance using sectoral indicators of emissions, energy consumption and carbon intensity.

The literature is thinner when one focuses on the impacts and potentials of sub-national and specifically state level climate action plans. Wheeler (2008) analyzed the first generation of sub-national (i.e. state and local) CAPs by assessing their goals and mitigation measures, issues and problems regarding their implementation, as well as their basic straights and weaknesses. The author's comprehensive analysis of 29 state level plans, 18 large-city and 17 small-city municipal level plans as of 2008 brought him to the largely pessimistic conclusion that most plans "lack the strong actions and political and institutional commitment needed to mitigate emissions" (Wheeler, 2008, p. 488). More specifically, the author's five main findings were that "near-term goals are too low," "progress is slow," "proposed measures are inadequate," "public understanding and involvement is insufficient," and ultimately "implementation is a problem" (p. 486-488).

Building and expanding upon the work of Wheeler (2008), Boswell, Greve, and Seale (2010) looked more closely at the palette of choices, elements and assumptions embedded in municipal GHG inventories--which have crucial policy implications for developing and implementing CAPs. Consistent with Wheeler (2008), Boswell et al. (2010) found that targets set by GHG emissions inventories fall well short of international targets. The authors also found that most municipal level CAPs contain all of the GHG emissions elements recommended in common protocols; yet, they "generally do a poor job of linking mitigation actions to reduction targets" (Boswell et al., 2010, p. 451). Ultimately, exogenous change potentially impacting communities' future GHG emissions as well as uncertainty were found to be generally unaccounted for in emissions forecasts and reduction targets.

Sub-national plan evaluations conducted by Wheeler (2008) and Boswell et al. (2010) are examples of what Baer (1997) classifies as evaluation of plans "as package and document", and more specifically "comparative plans research and professional evaluation" (p. 332). Drummond (2010) extended Wheeler's work by conducting what Baer (1997) called "post-hoc evaluation of plan outcomes" (Baer, 1997, p. 33). The author evaluated actions of innovative state level policy entrepreneurs previously chronicled by Rabe (2004) and state CAPs systematically analyzed by Wheeler (2008) in terms of their success in mitigation GHG emissions in a measurable way. Using a dataset obtained from the U.S. Environmental Protection Agency's (EPA) State Clean Energy and Climate Program (2009), Drummond (2010) came to the finding that state level CAPs lead to GHG emissions mitigation by a measurable but modest amount: approximately one half metric ton per person per year. Yet, the author focused on CO2 emissions resulting from energy production ultimately used in three non-industrial end-sectors of residential, commercial and transportation, and excluded energy emissions to be used in the industrial sector. This leaves out the question of what effects if any the plans might have on the energy emissions to be used in the industrial sector, which in 2007 accounted for approximately 12% of total U.S. GHG emissions from all sectors (2.8 metric tons per person).

A review of literature on the GHG mitigation impacts and potentials of sub-national action generally suggests that while these actions are likely progressing in the right direction, they are insufficient and lack certain qualities to warrant successful implementation.

Bottom-up Pressure on the Federal Government to Act on Climate Change

Another dimension of sub-national climate action discussed by several scholars is the potential impact of lower-level government action on the development of federal U.S. climate policy and active engagement of the United States in international climate action. The majority of these articles view bottom-up climate action positively, regardless of the different explanations provided for why and how these actions can eventually set the stage for federal climate policy. However, the opposite viewpoint--that the sub-national climate action might negatively affect the development and implementation of future U.S. federal climate policy—is also presented.

One of the first and foremost works that considered the potential impacts of state initiatives on the development of federal U.S. climate policy is Rabe’s 2004 book. Rabe (2004) argued that the U.S. bottom-up climate action can promote the development of federal policy. Yet, in a more recent publication, Rabe (2013) discussed the various conflicts that arose in late 2009 and 2010 at the federal level as a result of uneven state involvement in climate action. One major challenge that the congress faced at that time, according to Rabe, was the different state positions on the issue. States with high involvement and massive investments in climate action, such as California, awaited rewards for their early actions; whereas several Southeastern states argued that--because of their lack of experience—they should be compensated for major disruptions likely to be brought about as a result of climate policy implementation. Meanwhile, states that are considered to be more vulnerable to adverse climate change impacts due to higher exposure to certain impacts, such as floods or drought; higher dependency on vulnerable economic sectors, such as agriculture in certain areas; and/or lack of sufficient resources to adapt to these impacts) argued that they deserved a considerable share of federal funds to adapt to climate change. Indeed, the conflict over issues related to climate vulnerability is valid. There is a wide variation in vulnerability of different communities, economies and environmental systems to the adverse impacts of climate change (Watson, Zinyowera, & Moss, 1998).) Rabe (2013) concluded that these divides and conflicts served as hurdles for federal institutions to develop national climate policy.

Some optimistic researchers believe not only that bottom-up climate action might build pressure on the federal government to ultimately craft and implement national climate policy, but also these actions will eventually result in “re-engagement” of the U.S. in international climate action. For example, Selin and VanDeveer (2007) predict that federal climate policy will evolve from the bottom up and is a result of growing policy momentum among public, private, and civil society sectors. The authors also argue that U.S. “re-engagement” in international climate policy will become possible only after the development of a more significant federal policy--which itself is likely to be an outcome of mounting pressures from the bottom on the federal lawmakers to take climate action (Selin and VanDeveer, 2007). Similarly, Purvis (2004) and Bang et al. (2007) argue that the United States is unlikely to ratify the Kyoto Protocol or rejoin any global climate regime that is based on, or extended from it. Instead, U.S. “re-engagement” will likely entail the emergence of a new climate policy that is built on the existing U.S. domestic regulation (Purvis, 2004; and Bang et al., 2007).

Despite these optimistic expectations, some more recent articles cast doubt on the ease of building federal climate policy on existing sub-national policy. The earlier articles acknowledged that policy prediction is extremely difficult and loaded with uncertainty. The combination of factors that influence climate change policy cannot be easily foreseen. For example, the recent economic downturn had a chilling effect on both federal and sub-national climate action. One factor that seems to be underscored in earlier academic literature is the challenges that a wide climate policy divide between the states pose to federal climate policy. The problems associated with this policy divide were revealed only after the 111th Congress failed to produce new climate legislation—primarily due to the conflicts over how the federal funds were to be distributed among the states and uncertainties over the future of existing state homegrown climate policy under new federal action (Rabe, 2013). Along the same lines, Knudsen (2010) argues that how future federal climate policy will relate to existing state level policies remains an open question. It is likely that the “first-mover” states will defend their homegrown climate policy formulated based on their own interests, whereas states with high levels of GHG emissions will persistently resist new federal climate regime (Knudsen, 2010).

Uneven State Level Action on Climate Change: Rankings, Reasons and Explanations

Along with the growing enthusiasm about sub-national level climate action and its potentials, there are concerns over how evenly those actions are taken across the entire nation. A major problem with sub-national climate action is that these governments and entities face inherent limitations in environmental policy. As Rabe (2013) observed, instead of a "consistent across-the-board pattern of dynamism" (p. 40), there is an uneven pattern of performance—certain states always strive for national leadership in environmental policy, while others "race to the bottom", or "the middle of the pack" by doing as little as possible and/or virtually taking no innovative steps. Uneven action and interstate and interregional equity problems exacerbate the challenges faced in case of transboundary environmental issues, such as climate change.

A number of scholars have attempted to analyze activities undertaken at the state level and to develop ranking schemes for determining the most and least active and innovative states. One of the most prominent is Hall and Kerr's (1991) "Green Index" book which provides an environmental condition assessment for each region and state. The authors then rank states in eight areas ranging from "toxic, hazardous, and solid waste" and "water pollution" to "congressional leadership" and "state policy initiatives." Another example of such work is data published by the Brookings Institution on state receptiveness on a range of policies that could mitigate GHG emissions while offering other environmental benefits in many cases. Table 1 shows the rankings of the 50 states and the District of Columbia based on the number of programs adopted from a total of twenty possible options identified by the Brookings Institution. For comparison, I marked the states without a CAP. While these ranking systems have inherent limitations, they suggest substantial variation among states in environmental policy receptiveness.

Table 1. Receptiveness of states to environmental policies

Rank	State	# of Prog.*	Rank	State	# of Prog.*	Rank	State	# of Prog.*
1	California	20	6	Wisconsin	15	12	Kentucky	8
2	Connecticut	19	7	Iowa	14	12	Oklahoma	8 (No CAP)
3	Oregon	18	7	Nevada	14	12	South Carolina	8
3	Rhode Island	18	8	Montana	13	13	Arkansas	7
4	Massachusetts	17	8	New Hampshire	13	13	District of Columbia	7
4	New Jersey	17	8	Texas	13 (No CAP)	13	Georgia	7 (NO CAP)
4	New York	17	8	Utah	13	13	Missouri	7
4	Vermont	17	9	Colorado	12	14	Louisiana	6 (No CAP)
4	Washington	17	9	Delaware	12 (No CAP)	14	North Dakota	6 (No CAP)
5	Illinois	16	10	Florida	11	14	Tennessee	6 (No CAP)
5	Maryland	16	10	North Carolina	11	14	West Virginia	6 (NO CAP)
5	New Mexico	16	11	Idaho	10 (No CAP)	14	Wyoming	6 (NO CAP)
6	Arizona	15	11	Michigan	10	15	Alabama	5 (No CAP)
6	Hawaii	15	11	Ohio	10	15	Alaska	5
6	Maine	15	11	Virginia	10	16	Nebraska	4 (No CAP)
6	Minnesota	15	12	Indiana	8 (No CAP)	16	South Dakota	4 (No CAP)
6	Pennsylvania	15	12	Kansas	8 (No CAP)	17	Mississippi	3 (No CAP)

*Prog. stands for programs

In response to variations in the state level environmental policies and by extension sub-national climate action, a body of literature has developed to explore which economic, political and environmental or climatic factors are most likely to affect the rigor of state policy or the magnitude of resources devoted to it. Scholars have found that jurisdictions with higher proportions of their registered voters in the Democratic Party, greater vulnerability to climate-related natural hazards (Zahran et al., 2006; 2008), greater energy or climate planning capacity, higher environmental awareness, higher levels of environmental activism (Pitt, 2009), and smaller proportion of the labor force employed in carbon-intensive industries (Zahran et al., 2008) are more likely to take action on climate change. Understanding the reasons or motivations behind taking or refusing to take climate action is important for constructing the panel regression model for this study because all these factors can potentially be related to both adopting a climate action plan and implementing it to mitigate GHG emissions.

Planning Evaluation

The Importance of Evaluation

Planning evaluation is a complex but crucially important exercise (Alexander, 2006; Alexander and Faludi, 1989; Baer, 1997; Brody and Highfield, 2005; Brody, Highfield, and Thronton, 2006; Talen, 1997; Laurian et al, 2004). To have credibility as a discipline or a profession, a valid judgment of planning effectiveness, through a systematic assessment, must be possible (Alexander and Faludi, 1989). The “good” and “bad” planning or plans must be distinguishable from one another (Alexander, 2006; Alexander and Faludi, 1989; Baer, 1997). In the planning literature, evaluation is based on a variety of methods and takes on a range of meanings and applications (Talen, 1996). In this section, the range of planning evaluation currently found in the literature are differentiated and categorized.

In recent years, a new focus has been put on evaluation of plan implementation. For a long time, plan evaluation literature had paid little attention to whether or not and the degree to which plan objectives and policies were actually achieved in practice (Laurian et al., 2004; Talen, 1996). Meanwhile, the fields of policy implementation analysis and program evaluation had long generated a prolific body of literature on implementation since their inception in the 1970s and mainly after Pressman and Wildavsky published their prominent book named “Implementation” in 1973. Because the analytical content of this body of literature applies only to certain types of planning exercises, the planning profession needs to develop its own brand of evaluation that pays specific attention to implementation. While it is certainly difficult to establish a direct linkage between planning activities and empirical realities or outcomes, the profession cannot afford to limit evaluation to the nature and quality of plans and planning activities and ignore implementation altogether. If planners were ever to doubt that there is a legitimate way to determine the likelihood of plan implementation, many communities would begin to challenge the very notion of the planning profession (Talen, 1996).

Evaluation Perspectives

Oliveira and Pinho (2010) analyzed the evolution of evaluation theory and methods in the past fifty years from three perspectives: a policy program perspective; a planning theory perspective; and a welfare economics perspective. The first two reflect the tensions between different planning approaches, and the third focuses more on evaluation methods and some classification schemes. From a policy program perspective, Guba and Lincoln (1989) differentiate between four generations of evaluation: 1) measurement of individual attributes; 2) description of programs and objectives; 3) judgment on the contextual values; and 4) negotiation of claims, concerns and issues. From a planning theory perspective, because planning and evaluation are linked concepts, changes in evaluation functions and its major characteristics must reflect shifts in planning theory or definition and aims of the planning profession (Alexander and Faludi, 1988; Khakee, 1998). From a welfare economics perspective, Söderbaum (1998) differentiates between three levels of aggregation in evaluation: 1) highly aggregated methods, such as Cost-Benefit-Analysis (CBA), sum all impacts into a single value; 2) intermediate methods, such as "Goals-Achievement-Matrix" or GAM introduced by Hill (1968), use a single quantitative indicator to indicate the overall utility of an alternative, but the indicator has a composite makeup reflecting various dimensions; and 3) highly disaggregated methods, such as Environmental Impact Assessment (EIA), are essentially multidimensional.

The Timing of Evaluation

Another way to differentiate between forms of evaluation is by determining what stage in plan-making evaluation is performed. Broadly speaking, there are three types of evaluation identified in the literature corresponding to different stages in the evaluation process (Oliveira and Pinho; 2010): (1) Ex ante evaluation takes place at the initial stages of the planning process and promotes assessment of possible alternatives and choosing the best solution(s) for further consideration; (2) ongoing evaluation happens in the implementation process, and its conclusions are utilized for improvements in the plan or the planning process; and (3) ex post evaluation occurs following the implementation process and concerns the impacts or outcomes of the plan.

Baer (1997) distinguished between five types of evaluation based on when (i.e. at what planning stage) the evaluation is undertaken, who the evaluator is, and finally what is being evaluated: 1) plan assessment; 2) plan testing and evaluation; 3) plan critique; 4) comparative research and professional evaluation; and 5) post-hoc evaluation of plan outcomes. Figure 1 shows various stages for evaluation in the planning process. As illustrated in Figure 1, the “what” of evaluation takes several forms, such as the substance of plan alternatives; the plan package—including the document that communicates goals and objectives, needs or problems, assumptions and reasoning, proposals, and perhaps implementation devices; and the outcome following plan implementation.

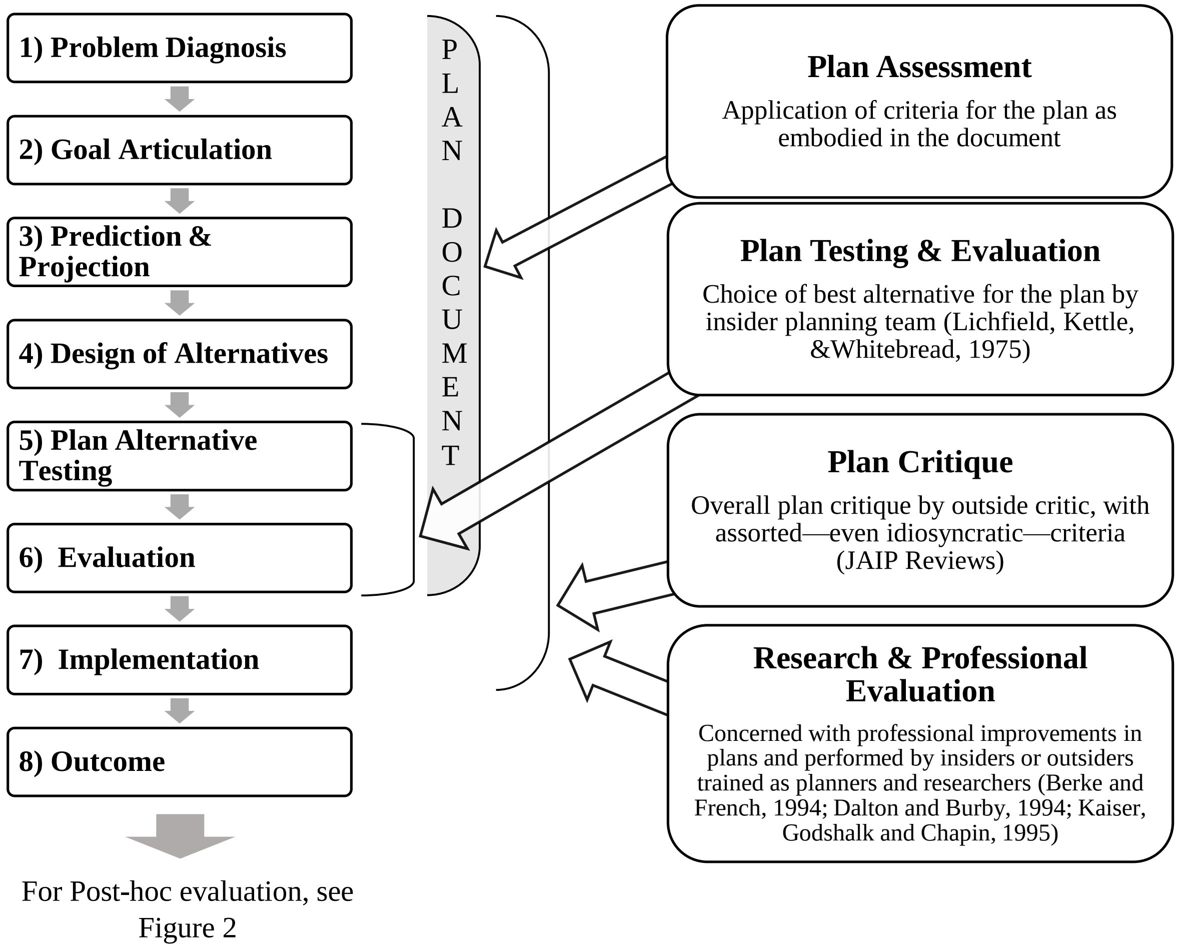

Figure 1. Various stages of evaluation in the planning process

Adapted from Baer, 1997

Defining Success

Because my goal here is not to develop alternatives, which is the focus of ex ante evaluation, I do not go into more details about judgments of optimality in this review. Moreover, it is only after or in the process of the implementation of the plan that judgments about plan success become meaningful. Thus, in the next paragraphs, I cover post hoc evaluation methods to formulate judgments about the success of plans.

Formulating judgments about planning success has generally followed two distinct purposes: discovering whether or not or the degree to which the plan was implemented; and/or determining the degree of plan effectiveness or assessing its performance. Both options deal with two fundamental questions: 1) when should the outcome be evaluated; and 2) against what should the actual outcome be compared to? Both questions are controversial and spark theoretical debate. The first question is complex mainly because although most plans specify implementation timeframes, the wait period for appearance of the full effects of the plan is difficult if not impossible to determine. Whereas a 20-year plan should not have its full outcomes evaluated, say, after five years, waiting too long for the full impacts may lead to missing the chance for making improvements in the plan or the planning process. Therefore, it is important to combine ongoing and ex post evaluation to spot problems in implementation, content or quality of the plan before it is too late to make improvements. This is essentially the goal of monitoring and evaluation which is often followed by revisions to the plan. The question of when to judge the success of plan is important, but it should not hold us back from evaluating plans as they are being implemented. The question of what terms should the performance of effectiveness of the plan be cast in involves comparison of outcomes to an alternative and making sense of the difference between the two. Figure 2 illustrates these two decisions in post hoc plan evaluation.

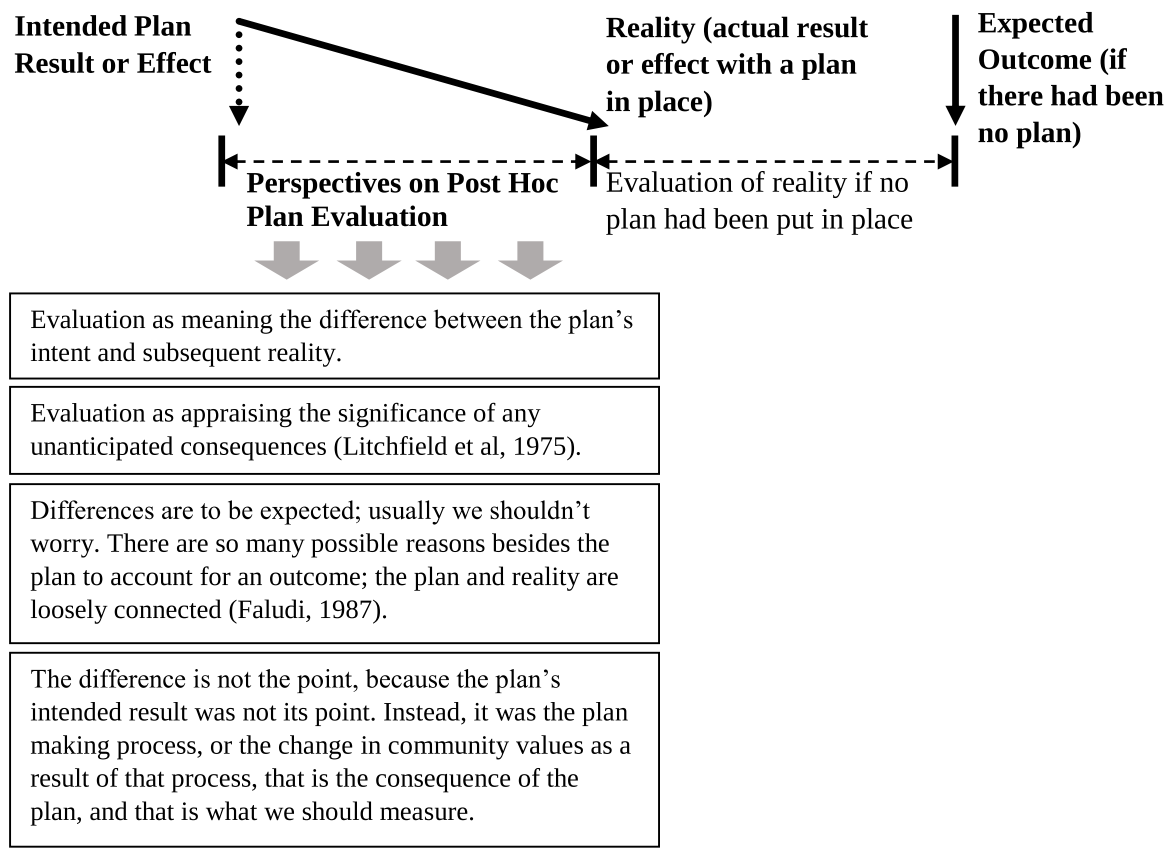

Figure 2. Post-hoc plan evaluation

Adapted with modifications from Baer, 1997

Aside from process-oriented evaluation that puts the focus on consensus building and generally execution of democratic processes, the literature offers two approaches to planning success judgment: conformance-based and performance-based approaches. Conformance-based evaluation entails comparison of the outcomes on the ground and the plan proposals, goals, objectives and specific implementation instruments (Alexander, 2006). This approach has been developed by several scholars, among others, Alterman and Hill (1978), Baer (1997), Brody and Highfield (2005), Brody et al. (2006), Burby (2003), Laurian et al. (2004), and Talen (1996; 1997). Typically, in conformance-based evaluation evaluators have assumed a "blueprint mindset" and have compared the plan's intended outcomes against what actually happened (Baer, 1997).

In performance-based evaluation, on the other hand, plans are defined as decision frameworks (Alexander, 2006). Therefore, evaluators taking this approach should understand whether or not and the degree to which, under what circumstances, and how the plan was consulted or referred to for subsequent decisions. The plan is deemed implemented when it is utilized in the decision-making process. The Dutch school of planning evaluation (Driessen, 1997; Lange, Mastop, and Spit, 1997; Faludi, 2000, 2006; Mastop, 1997; Mastop and Faludi, 1997; Mastop and Needham, 1997; Needham, Zwanikken, and Faludi, 1997; Damme et al. 1997) has developed this approach primarily based on the work of Fudge and Barrett (1981) highlighting the differences between conformance and performance. In short, conformance-based evaluation is outcome-oriented while performance-based evaluation is process-oriented. Because performance-based evaluation focuses on structural and long-term decisions that are often associated with high levels of uncertainty, and decisions tend to deviate from plans without compromising implementation proposals, conformance-based approaches have been considered more suitable for day-to-day planning practice and implementation evaluation (Laurian et al., 2004).

However, processes and outcomes may not always be separated easily. In a planning process that is based on "consensus building", processes and outcomes can be tied together (Innes and Booher, 1999). A consensus building process not only may have immediate direct effects easily identifiable at the end of the project, but also may yield impacts either during or after the project is completed, but outside the boundaries of the project or plan ("second order effects"), or impacts that appear some time later ("third order effects") (Innes and Booher, 1999, p. 419). In the case of climate action planning, impacts of CAP development processes may not be immediately observable after the consensus-building process through which stakeholders assess and select a set of measures. However, the process can yield outcomes (long) after the completion of the CAP development project within or outside the boundaries of the CAP. For example, stakeholders may form new partnerships or collaborations to work on specific energy efficiency programs outside of the boundaries of the CAP with emission reduction potentials. These indirect, yet potentially significant effects, make evaluation of CAPs very complicated. It is practically impossible to identify all of these indirect impacts or neatly isolate them from impacts of other programs or plans with similar aims in a study that analyzes a large number of CAPs. Yet, it is important to be conscious of potential indirect impacts, within or outside the boundaries of the CAP.

Evaluation Questions, Criteria, & Implementation Indicators

Thus far, I have described the importance of evaluation and analyzed the need for developing systematic methods for planning evaluation. A major part of evaluation methodology focuses on developing general guidelines for evaluation, such as questions, criteria, and indicators of implementation. Surely, in any given situation, evaluation questions, criteria and implications depend on the type of plan, its intentions and timing and purpose of evaluation. Yet, the literature provides a foundation for developing own evaluation protocol.

Planning scholars have developed sets of general criteria for evaluation. Among the most prominent is the work of Baer (1997) that proposes a vocabulary for plan evaluation and is intended to be used for differentiating between “good” and “bad” plans.

His framework, drawn from an analysis of the literature and published evaluation criteria, is organized around the following categories:

- Adequacy of content (political context, administrative authority, role of preparer, background information, client, purpose, source of funding, etc.)
- "Rational Model" considerations (assessment criteria, problem identification, goals and objectives, coordination with other agencies, alternatives considered, etc.)
- Procedural validity (groups involved in plan formation, transformation of technical matters to policy, use of advisory group, etc.)
- Adequacy of scope (consideration of relevant issues, efficiency and equity issues, cost-benefit distribution, financial or fiscal implications, legal implications, political feasibility, etc.)
- Guidance for implementation (appropriate provisions, priorities, costs, time span, scheduling and coordination, impact analysis, responsible agency, etc.)
- Approach, data, and methodology (technical bases, wide data spectrum, flexibility in adding data, data and methodology sources cited, etc.)
- Quality of communication (client and public identified, convincing presentation, rationales for decisions given, proposals consistent with objectives, etc.)
- Plan format (size and format conducive to use, authors listed, table of contents, graphics, etc.)

Other scholars have employed additional criteria for evaluation. Kaiser, Godschalk, and Chapin (1995) and Kaiser and Davies (1999) emphasize conceptual dimensions of plans themselves that define their quality, involving their goals, policies and fact bases. Hopkins (2001) recommends inclusion of external validity of plans that determines the degree to which the plan fits the needs of local situations. Berke and Godschalk (2009) proposed a list of plan quality characteristics. Table 2 illustrates the plan quality characteristics identified by the authors and examples of specific criteria grouped under each characteristic.

Table 2. Characteristics of plan quality proposed by Berke and Godschalk as evaluation criteria

Internal characteristics
Issue identification and vision: Description of community needs, assets, trends, and future vision
Assessment of major issues, trends, and impacts of forecasted change
A vision that identifies what the community wants to be
Goals: Reflections of public values that express desired future land use and development pattern
Statements of future desired conditions that reflect breadth of community values
Fact base: Analysis of current and future conditions and explanation of reasoning
Present and future population and economy
State of natural environment resources and constraints
Clear maps and tables that support reasoning, and enhance relevance and comprehensibility
Policies: Specification of principles to guide public and private land use decisions to achieve goals
Sufficiently specific (not vague) to be tied to definite actions
Spatial designs that specify future land use, infrastructure, transportation, and open space networks that are sized to accommodate future growth
Implementation: Commitments to carry out policy-driven actions
Timelines for actions
Organizations identified that are responsible for actions
Sources of funding are identified to supporting actions
Monitoring and evaluation: Provisions for tracking change in community conditions
Goals are based on measurable objectives
Indicators of objectives to assess progress
Organizations identified responsible for monitoring
Timetable for updating plan based on monitoring of changing conditions
Internal consistency: Issues, vision, goals, policies, and implementation are mutually reinforcing
Goals must be comprehensive to accommodate issues and vision
Policies must be clearly linked back to goals and forward to implementation actions
Monitoring should include indicators to gauge goal achievement and effectiveness of policies
External characteristics
Organization and presentation: Provisions to enhance understandability for a wide range of readers
Table of contents, glossary of terms, executive summary
Cross referencing of issues, vision, goals, and policies
Clear visuals, e.g., maps, charts, and pictures, and diagrams
Supporting documents, e.g., video, CD, Web page
Inter-organizational coordination: Integration with other plans or policies of public and private parties
Vertical coordination with plans or policies of federal, state, and regional parties
Horizontal coordination with plans or policies of other local parties within or outside local jurisdiction
Compliance: Consistent with the purpose of plan mandates
Required elements are included in plan and fit together

Evaluation of Climate Action Plans: Towards Developing a Framework

None of the mentioned evaluation criteria are specifically designed for climate action plans. There are three major problems associated with employing such criteria for this analysis. First, because these evaluation criteria are designed for traditional planning fields such as land-use planning, it is more likely that there are ("agreed-upon") best practice standards available for them. This is not the case for climate action planning which is an emerging field. Second, if these evaluation criteria are seen as broad guidelines, they won't be specific enough for ensuring validity. For example, multiple evaluators may interpret the criteria differently resulting in inconsistent judgments. The third problem is related to the issue of level: both the planning and evaluation level and the level at which plan impacts are meant to make a difference. Climate action planning at the state level differs from municipal level land-use plans both in terms of its planning level (municipal vs. state) and its intended impact level (local vs. global). Therefore, an evaluation framework developed for, say, municipal land-use plans cannot be directly applied to state level climate action plans. In this section, several studies have been discussed that influenced the evaluation criteria and methods to test and refine the CAP assessment protocol for this dissertation.

For assessing the quality of local level CAPs, Bassett and Shandas (2010) developed an evaluation matrix based on the work of other planning researchers such as Berke and Conroy (2000), Berke and Godschalk (2009), Brody (2003), and Norton (2008). This evaluation matrix was built in a two-part process. First, the authors identified "public policy interventions that could potentially affect urban GHG emissions and a separate list of strategies likely to be adopted only by the most committed municipalities" (p. 438). They used this first draft of the matrix to score four CAPs (not used in their final analysis) to test and refine the robustness of their evaluation matrix. Following this, they reorganized the matrix and consolidated some categories of actions and split others apart based on their findings from the reviewed plans. They divided the actions into "those that city governments could take to reduce GHGs they produced and those city residents could take to reduce emissions in the community" (p. 438). Table 3 shows the list of action strategies Bassett and Shandas looked for in the local CAPs.

It is important to note that Table 3 only included the "breadth" of actions (i.e. the array of climate-relevant policies identified for adoption), and not their "depth" (i.e. how fully developed, justified, and operationalized each of the plan's proposed policies or actions were). Other than the "breadth" of actions, the authors evaluated the CAPs based on their "depth" of strategies. To score "CAP depth", the authors evaluated a policy or strategy "according to whether it: 1) articulated a measurable target and specific indicator; 2) had an associated timeline; 3) clearly identified the actor responsible for implementation; 4) indicated a funding mechanism; and 5) was feasible, in that the local government had the power to implement it" (p. 443).

Climate change planning is a relatively new focus of planning, and thus its methods are not as developed as other conventional planning disciplines. This makes CAP evaluation more complicated. The two-stage approach that Bassett and Shandas took (i.e. assessing the breadth of actions first, followed by evaluating the depth of actions) reflects this complexity and is a good method to develop an appropriate framework for CAP evaluation. Therefore, one of the contributions of this dissertation is to develop an appropriate framework for CAPs.

Table 3. The list of action strategies to guide evaluation

1) Local Government Emissions
1a) Transportation
Employee commutes (carpooling, alternative mode incentives, telecommuting, etc.)
City fleet fuel efficiency (new vehicle fuel efficiency, hybrids, etc.)
City fleet low carbon fuel (biofuels, electric vehicles, etc.)
1b) Solid waste and recycling
Procurement and purchasing (e.g. purchasing products with minimal packaging)
1c) Energy efficiency
Existing buildings (weatherization, programmable thermostats, furnace retrofits, etc.)
New buildings (green building standards, etc.)
Streetlights and amenities (LED streetlights, traffic lights, etc.)
1d) Renewable energy
Renewable energy generation (wind turbines or solar panels on city hall, etc.)
Require municipality to buy power from green sources
2) Community emissions
2 a) Transportation
Reduce carbon content of fuels, including for transit (biofuel standards, electric vehicles, etc.)
Increase fuel efficiency (idling policies, taxi fleet improvement incentives, etc.)
Reduce vehicle miles of travel
Bicycle infrastructure (lanes, boulevards, etc.)
Pedestrian infrastructure (sidewalks, crosswalks, etc.)
Transit service (increased hours, extend number of lines)
Alternative transportation (discounted transit passes, free bike helmet programs)
Travel demand management policies (flex work hours, rideshare programs, etc.)
2 b) *Solid waste and recycling*
Increase recycling (residential, e-waste, etc.)
2 c) Energy efficiency
Existing residential buildings (weatherization, incentives, real-time utility bills, etc.)
New residential buildings (greening residential code, etc.)
Existing commercial and industrial buildings
New commercial and industrial buildings (green building practices)
2 d) Renewable energy
Encourage buying power from green sources
Encourage using renewable energy (programs supporting solar hot water heaters, etc.)
2 e) Forestry
Investments in reforestation and tree planting
2 f) Land use planning
Compact development (increase densities, remove lot size minimums, etc.)
Zoning ordinances to reduce auto use (e.g. transit-oriented development)
2 g) Education
General (climate change, carbon footprint, raising awareness, etc.)
Energy efficiency (weatherization, behavior change, etc.)
Waste reduction and recycling
3) Adaptation
The plan enumerates specific anticipated local impacts and identifies adaptive actions.

Adapted with modifications from Bassett and Shandas, (2010) Even if we assume that best practice standards for climate change planning were available and reliable, and those were utilized to prepare a climate action plan, some dimensions of the plan could have only been evaluated after they were fully implemented. It is virtually impossible to precisely predict how changing conditions will respond to proposed mitigation actions. The planning process, therefore, continues through the life of the plan--from the formation of initial concepts through full implementation—and beyond through plan updates and revisions during or after the official timeframe of the plan.

To deal with changing conditions and uncertainties involved in climate change planning, the literature suggests incorporating flexibility into the plans by taking an "adaptive approach" (Holling, 1978). Action-based planning, continuous monitoring, researching and adjusting are the major tools of "adaptive management" (Brody, 2003; Holling, 1978). In this method, policies are considered to be dynamic and not static. The appropriateness of a policy will be affirmed if it succeeds in meeting its objectives. However, if it fails, "an adaptive design still permits learning so that future decisions can proceed from a better base of understanding" (Brody, 2003, p. 192).

Although "adaptive management" better equips planners and their organizations to deal with uncertainty and changing conditions, it still involves unresolved issues (Brody, 2003). First, actions taken based on an "adaptive management" approach may be interpreted as reversible (i.e. the consequences of the actions can be reversed) (Brody, 2003). With the short time left to effectively reduce the amount of GHG emissions and avoid a catastrophic outcome, this might not be true in the case of climate action planning. Moreover, the success of this method depends on the players' willingness and commitment to learn through the process (Brody, 2003). With the player being a member of an organization within a larger and often heterogeneous community, such a responsive management structure might not exist (Brody, 2003).

The most successful climate action plans are those “that are initially written with a concern for realistic and well-timed implementation measures” (Tang et al., 2010, p. 81). The implementation section of the climate action plan must include a reasonable timeline, a description of financing mechanisms, and an assessment of responsibility to departments and staff (Tang et al., 2010). A prioritization matrix could be another essential component of the implementation section.

Organizations should place a high priority on developing effective GHG emissions reduction strategies, and an enumeration of the most urgent adaptation needs and major planning and investment decisions that are currently under consideration (Tang et al., 2010). Through monitoring, states can highlight their achievements, identify the sources of obstacles, assess key knowledge, provide directions for future response, and obtain feedback to improve measures over time (Tang at al., 2010). Although climate action plan implementation and monitoring is a crucial element in both “the theory of collaborative learning and the practice of adaptive management,” there is evidence in the literature that limited progress has been made in implementing policies and measures, and monitoring and verifying results in the climate action plans (Tang et al., 2010; Wheeler, 2008; Lyshall, 2011).

An overview of the current state of research on the actual or potential effects of sub-national level climate action coupled with an analysis of plan evaluation tools and techniques reveals a number of key findings. First, an evaluation of current state level

CAPs that simultaneously considers important CAP components, qualities, processes, as well as implementation and GHG reduction outcome has not been performed. This dissertation alleviates the gap in the literature by content analyzing state CAPs to understand variations in CAP components and characteristics across the nation, and comparing emissions of the states with and without a CAP and before and after climate action planning efforts. Second, to content analyze state level CAPs, an appropriate tool (i.e. CAP assessment protocol) should be developed. Since planning process and outcome may not be neatly separated, this tool should involve both process and outcome criteria. Third, evaluation of state level CAPs should be conducted with an understanding of potential indirect planning impacts: effects that appear outside the boundaries of the CAP, and/or the ones that appear outside the time boundaries of the study or the official timespan of a CAP. An analysis of these indirect impacts is not within the scope of this study. Yet, acknowledging the possibility of indirect impacts may help in explaining potential emissions reduction from CAPs without any evidence of implementation. For example, the development process of a state level CAP may energize local governments within the state to take action. These local level CAPs may be successful in reducing emissions even if the implementation of the state CAP is delayed, interrupted or stopped. These dynamics are complex and interesting and can serve as a basis for developing future research agenda.

CHAPTER III

RESEARCH METHODS

This dissertation involved two major phases each requiring distinct methods. This section provides detailed information about research methods used for each of the phases. While these phases have different methods and goals and are intended to yield standalone findings and contributions, they are not completely separate. The two phases overlap and influence each other.

Phase 1: Content Analysis of State-level Climate Action Plans

To date, 34 states have prepared some sort of a Climate Action Plan (CAP). This count is based on information published on the U.S. EPA's website in 2015 and a dataset of state CAPs available through Center for Climate and Energy Solutions (C2ES) that was updated in 2016. The policy scope and rigor of these CAPs range widely, and thus, it is important to understand major differences between them.

The goal of this phase was to systematically assess implementation and GHG emissions mitigation potential of state-level CAPs through a content analysis of plan documents and publically available information about planning and implementation processes on state websites. To collect these documents, I first downloaded final CAPs as well other reports through links provided by the EPA list. Once I obtained general information about the CAPs and responsible organizations or entities for developing, adopting or implementing the plans, I reviewed their websites for more information. I downloaded and considered all reports available through responsible state agency websites or CAP specific websites. I focused mostly on final CAPs and their updates, and used the rest of the information collected to answer questions that were not found in the plans. For example, to answer questions related to implementation, in most cases, I needed to review additional documents or information provided in relevant websites.

Broadly speaking, the content analysis involved four major themes: 1) General information about the CAP and its development and adoption processes; 2) CAP GHG emissions mitigation potential claimed to be achievable through its goals, array of policies, mitigation targets, and adherence to any regional initiative; 3) Implementation provisions or conditions that have been suggested by the literature to be linked to successful implementation, such as identification of funding sources and agencies responsible for implementation; and 4) Implementation mechanisms, such as voluntary programs, financial incentives, carbon tax or cap-and-trade, recommended and employed by the CAP to reach goals and/or targets.

The CAP evaluation framework used for this study was developed in three steps: 1) a preliminary evaluation framework was derived from the literature on plan evaluation and principles of sub-national climate action planning; 2) the preliminary framework was then validated through three in-depth interviews with climate action planning experts, including one university professor with an expertise in this area and two professionals from two key non-profit organizations involved in developing, adopting and implementing such CAPs; and 3) it was tested and refined through double coding four plans in two stages—double-coding two plans to test the reliability of the coding instrument and making necessary changes for the clarity of questions; immediately followed by double-coding two additional plans to assure consistency in coding throughout the coding process. The final CAP evaluation protocol is available in Appendix I.

The semi-structured expert interviews focused on CAP components, characteristics and qualities, as well as signs of implementation success, the usefulness of various implementation mechanisms such as cap-and-trade, carbon tax and voluntary agreements, and common challenges and opportunities involved in implementation. Questions were adjusted to fit each interviewee's position or experience. Two open-ended questions provided an opportunity for interviewees to describe their involvement in sub-national CAP processes and share other information about CAPs, their implementation and evaluation beyond the specific questions asked.[2]

After adjusting the CAP assessment protocol to reflect points raised by the experts during the interview, I trained another graduate student to work independently on the assessment of the CAPs using the protocol. Because content-analysis of each CAP approximately takes 10-30 hours (depending on the number and the length of CAP documents and the skills of the coder), we did not have the resources to double-code all

32 CAPs and report inter-coder report reliability scores. Thus, we double-coded a total of four CAPs in two steps in order to test and improve the CAP assessment tool. In their evaluation of 30 comprehensive plans, Berke and Conroy (2000) employed a similar method. To select the four CAPs to double-code, we first scanned through all 32 CAPs to detect potential patterns in CAP documents. From this initial analysis, we found that state level CAPs, although unique in certain aspects, typically follow commonly-used frameworks to set targets, as well as develop, analyze, select, and/or prioritize policy measures for each sector (e.g. transportation, agriculture, etc.). For example, all the states that used the Center for Climate Strategies (CCS)[3] services followed similar procedures for developing and selecting policy measures as well as organizing and reporting findings and recommendations in the CAP document. Because the protocol was initially developed based on the literature and principles of sub-national climate action planning provided in CCS' and other similar entities' websites, I expected that the CAP assessment protocol fit the typical CAP better. We quickly and independently tested (but not fully double-coded) the CAP assessment protocol using two typical CAPs, and found that my expectation was valid. Therefore, we decided to select the most unique CAPs to see whether the protocol would still be appropriate. Thus, we selected CAPs of the states of California, Colorado, Massachusetts, and Oregon for double-coding. The remainder of the CAPs were then coded by one of the researchers only. After double-coding CAPs of the two states of Oregon and California, we adjusted the questions for clarification, added explanations for the coders, deleted or modified the questions/sub-questions that could not be answered coherently using information provided in CAP documents, and provided more flexibility by adding answer choices or space for additional explanations--especially

when one of the coders could not easily choose among the provided options or there was a clear disagreement between the coders about the answers. Once we revised and improved the CAP assessment protocol, we double-coded two additional plans—those of the states of Massachusetts and Colorado-- to ensure consistency in the coding process. The level of agreement between the coders improved significantly after content-analyzing the first two CAPs both due to the improvements made to the protocol and agreements on certain coding procedures (e.g. choosing the answer based on the most current information in case of a disagreement between various CAP documents and explaining the discrepancy in the space provided). Once we independently completed the content analysis of the fourth CAP and compared our results, we found that we agreed on virtually all answers.

After finalizing the CAP assessment protocol with my assistant, I used it to assess the remaining 28 state level CAPs. I excluded Hawaii and Alaska because data were not available for some of the control variables, such as climatic variables and urban sprawl indices. .[4] The framework includes four major elements as discussed below and presented in Figure 3.

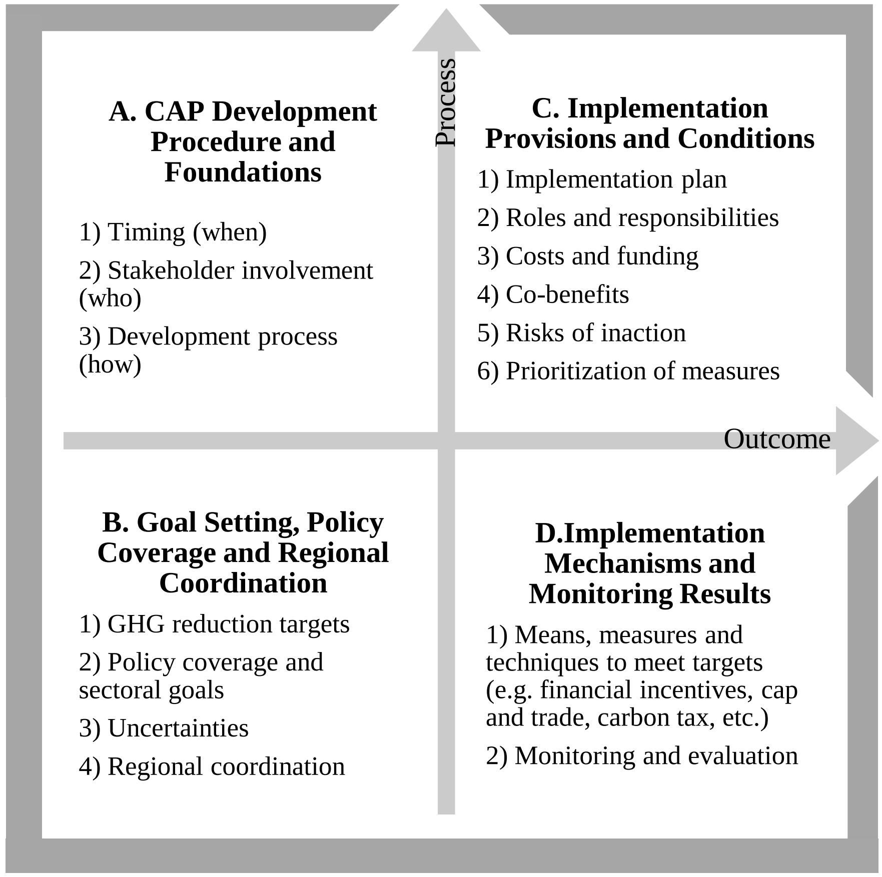

Figure 3. CAP evaluation framework

A. CAP Development Procedure and Foundations

The first element focuses on three main qualities of the planning process: 1) timing (when): when was the plan developed, adopted and updated; 2) stakeholder involvement (who): a) what agencies and organizations were engaged in the development of the CAP?, b) what entities provided leadership, facilitation, funding and technical support, and c) procedures through which input was received from entities representing government, industry, nongovernmental organizations, academia and the public; and 3) development process (how): what techniques were used to develop a plan and select specific policy recommendations.

Regardless of a particular state's environmental track record, CAP development is a new and different experience. For example, because most state's either adopted the Kyoto goal set for the United States (7% below 1990 emissions by 2008-2012) or its revised versions, one of the first steps of developing a plan was to estimate the 1990 level emissions (Wheeler, 2008). This is not a task that either the states or their local governments were familiar with. Similarly, many other CAP development procedures or requirements are highly technical and require support from external professionals and specialized tools to conduct analyses, such as estimating emission reductions from a particular intervention. Therefore, states typically engage entities with specialized staff and resources, such as the Center for Climate Strategies, to set the foundation for CAP development, such as a GHG inventory estimating historical emissions back to 1990 and projection of future business-as-usual (BAU) emissions.

B. Goal Setting, Policy Coverage and Regional Coordination

The second element deals with four key dimensions of CAPs: 1) targets: what are the nearest-term, intermediate and ultimate targets; 2) policy coverage and sectoral goals: what emission sectors have been considered, and what goals have been set for each sector; 3) uncertainties: whether uncertainties in Business as Usual (BAU) emissions and impacts of policies have been considered, and what measures or analyses have been used to take uncertainties into account; and 4) regional coordination: which of the multi-state climate initiatives (if any) has the state participated in. I obtained information about multi-state initiatives through C2ES' website as well as analysis of state-level CAPs that indicate membership in one or more of these multi-state initiatives or adherence to multi-state reduction targets.

C. Implementation Provisions and Conditions

The third element assesses conditions that are linked to implementation success, according to literature on plan evaluation. These provisions and conditions are: 1) implementation plan; 2) implementation roles and responsibilities; 3) funding and cost of policy measures; 4) specification and analysis of externalities or co-benefits of each action or the entire CAP; 5) identification and analysis of risks of inaction; and 6) selection and prioritization of policy measures. Figure 4 illustrates various components of implementation provisions and conditions.

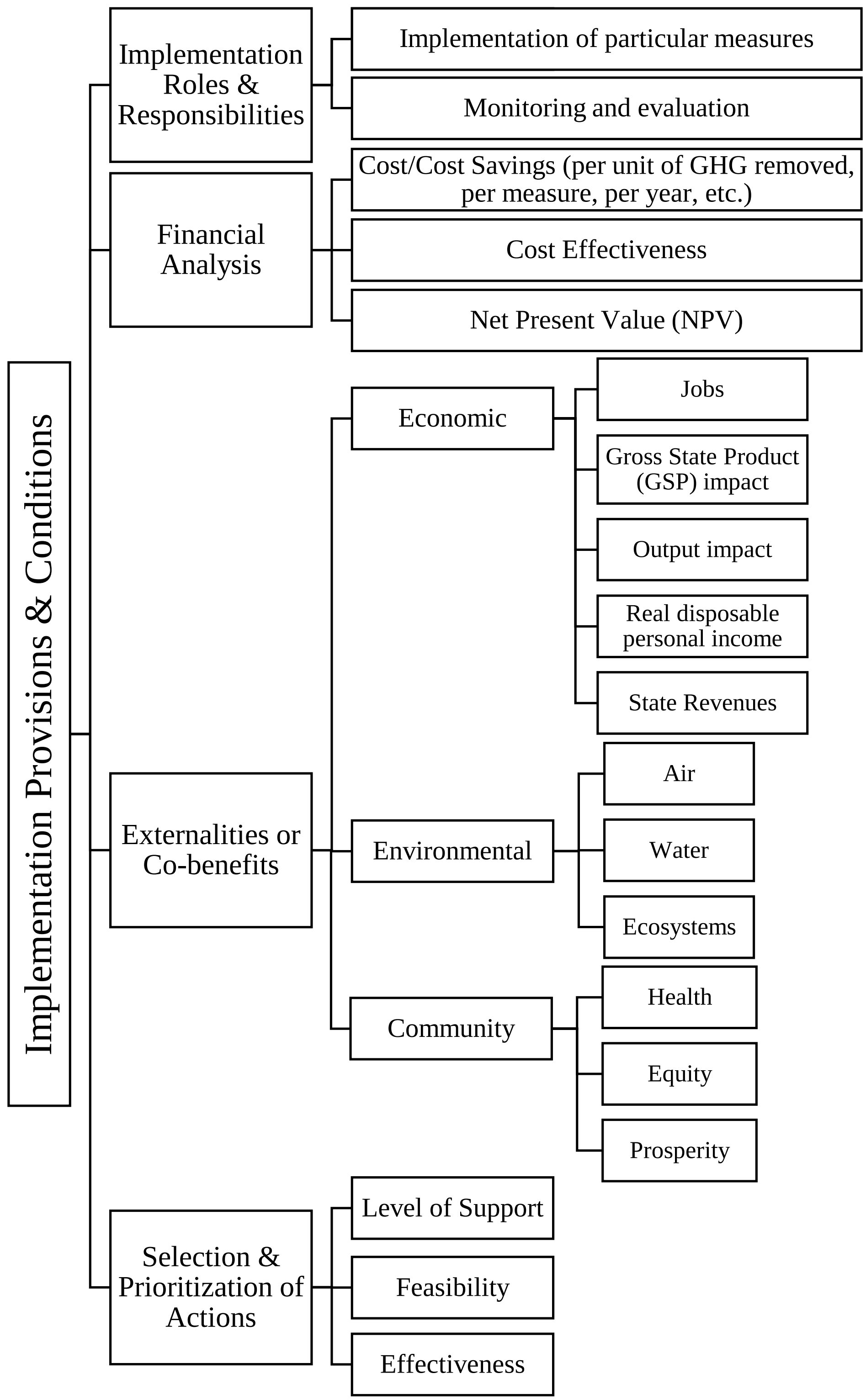

Figure 4. Implementation provisions and conditions

D. Implementation Mechanisms and Monitoring Results

The final element of the CAP evaluation framework is implementation mechanisms recommended or employed by the CAP to reach its goals and targets. In contrast to the previous element (i.e. implementation provisions and conditions) that solely relies on the content of the CAP to assess its implementation potential, this step also includes an analysis of other available evidence regarding the implementation of the plan. More specifically, evidence of CAP implementation or the lack thereof was found through searching the websites of governmental agencies or other organizations and entities that have either developed or published the CAP or are identified in the CAP as the responsible entity for implementation. I then cross-checked this information with state-specific data available through U.S. EPA, C2ES and the Center for Climate Strategies websites.

Implementation is defined as specific commitments made by the state to carry out policy actions recommended by the CAP, such as legislation to mitigate climate change. Implementation mechanisms are means, measures and techniques through which the state plans to reach CAP targets or goals. These include: voluntary and negotiated agreements; technical assistance, financial incentives; targeted spending (e.g., on public transportation); codes and standards; cap and trade; carbon tax; pilots and demos; information, education and outreach; research and development; emissions reporting and disclosure; and any hybrid combination of these mechanisms. In addition to implementation evidence, this step includes examining methods used to monitor and evaluate CAP implementation, such as progress reports, and plan and emissions inventory updates.

Once I completed the CAP evaluation form for each state, I then organized the collected data into four tables available in Appendices III through VI. The analysis of these tables revealed that while state CAPs vary in the details of their processes, components and characteristics, they can be classified into six major CAP types. These 6 types were not predefined; instead, they emerged from the analysis of collected qualitative data. The CAP types were used as an input to the regression model of the second phase. CAP categories are based on two important variables: targets and implementation. The findings section explains in detail what these categories are. There were several reasons to focus on these two variables. First, there is a gap in the literature about the relationship between targets, implementation and emissions mitigation. Second, the plan evaluation literature stresses the importance of goal-setting (i.e. targets) and implementation (see, for example, Baer, 1997; and Berke and Godschalk, 2009). Third, interviews with experts in the field indicate that targets are important as they serve as "the starting point," "the vision," "a motivational factor," "guide to achieving the objectives" and "[a] link between scientific [mitigation] requirements and planning." Implementation, on the other hand, is "extremely" important because "the plan is not the end goal, but a way to actually achieve the emissions reductions," and "[implementation is] the area that almost every place falls down on." Finally, comparing targets and implementation is realistically achievable, whereas details about the CAPs (e.g. the specific combination of policy packages) and planning processes (e.g. rigor of stakeholder engagement) cannot be practically reduced to simplified yet valid categories.

An analysis of collected qualitative data neatly separates the 6 CAP types based on targets and implementation. This is not the case for all criteria included in the CAP assessment protocol. There are a number of reasons why some of these qualities/characteristics either cannot be fully assessed through a content analysis only or reduced to quantitative terms or categories. One is the problem of making judgements on the quality of certain processes. For example, assessing the quality of stakeholder involvement without participation in these processes or collecting in-depth data from interviews with the stakeholders cannot yield a valid judgement. The number of stakeholders involved and/or the groups or entities they represent (i.e. industries, scholars, governmental and nonprofit organizations, community members, etc.) are mentioned in virtually all CAPs. However, the depth of information regarding the consensus-building processes varies extensively within CAPs. This brings us to the second problem: the lack of sufficient data on some of these qualities or characteristics within the CAPs and related publically accessible documents. Indeed, state CAPs do not provide the same level of information--some are much more detailed; others are not. This makes comparison of these detailed characteristics impossible based on a content analysis only.

Phase 2: State-level Climate Action Plans and Energy-Related Carbon Dioxide Emissions

The second phase builds upon the data and analysis of the first phase. After assigning each state a CAP category based on the rigor of targets and stringency of implementation, I used a panel regression model to isolate and assess the impact of state level CAPs on carbon emissions. The regression coefficients, if statistically significant, show a reduction in per capita energy-related CO_2 emissions, holding all other variables constant. The specific regression model that I have used is random-effects Generalized

Least Squares (GLS) regression model for panel (time-series) data. This model is appropriate when there is reason to believe that differences across entities have some influence on the dependent variable. Random-effects GLS model is suitable in this case because specific characteristics of states are most likely related to their energy-related CO_2 emissions. Another advantage of this model is that one can include time-invariant variables, such as geographic location (e.g. regions). The equation for random effects model is:

$$Y_{it}=\beta_1 X_{1,it} + \ldots + \beta_k X_{k,it} + \alpha + u_{it} + \varepsilon_{it}$$

Where:

- Y_{it} is the dependent variable (DV) where i = entity, and t = time,
- X_{it} represents one independent variable (IV),
- β1 is the coefficient for that IV,
- α is the unknown intercept,
- u_{it} is the between-entity error term, and
- ε_{it} is the within-entity error term

One major assumption of the random-effects model is that the entity's error term is not correlated with the predictors—this is the quality that allows time-invariant variables to play a role as explanatory variables. To ensure that my models do not violate this assumption, I ran the Hausman test (see, Greene, 2008). The Hausman test simply allows to see whether the unique errors (u_i) are correlated with the regressors; the null hypothesis is that unique errors are not correlated with the regressors. To run the test, I first ran a fixed-effects model (an alternative to random-effects) and saved the estimates, then performed the test in Stata (as recommended by Torres-Reyna, 2007). In all cases, the Prob>chi2 was larger than 0.05 which indicates that the null hypothesis cannot be rejected, and thus the random-effects model is appropriate.

My panel regression models includes 48 continental states and years 1990 to 2013, yielding a dataset of 1,104 observations. I excluded Alaska, Hawaii and Washington, DC due to lack of data for a number of independent variables and uniqueness of circumstances of these entities. Year 1990 was selected because it is the most common baseline year adopted by state level CAPs. This is because the Kyoto Protocol used 1990 as its base year, and because most states adopted the Kyoto goal or its revised versions, they also picked 1990 as their baseline year (Wheeler, 2008). The final year in my model, 2013, is the most recent year for which energy-related emissions data is available through U.S. Energy Information Administration. Table 4 lists the dependent and independent variables as well as variable explanations, expected sign of regression, data sources and date of download.

Table 4. Variables

Variable	**Explanation**	**Expected Sign of Regression Coefficient**	**Source & Date Downloaded**
Change in emissions per million persons (DV)	Energy CO_2 emissions for current year minus same for 1990	Not applicable	U.S. Energy Information Administration December 5, 2015
Climate action planning (CAP Types)	Categorical variable for state climate action planning efforts	Negative, since climate action planning is meant to reduce emissions through a wide array of policy options and increasing awareness	U.S. Environmental Protection Agency (EPA) list of states with CAPs; and Data collected through Phase 1 of this study

Variable	Explanation	Expected Sign of Regression Coefficient	Source & Date Downloaded
Change in unemployment rate	Unemployment rate (%) for current year minus same for previous year	Negative, due to decreased economic activity, and by extension, emissions	Bureau of Labor Statistics (BLS) December 6, 2015
Change in per capita income	Per capita income for current year minus same for previous year	Positive, since states with higher income tend to consume more energy	Bureau of Economic Analysis (BEA) December 6, 2015
Change in regional energy prices	Change in regional energy prices for current year minus same for previous year	Negative, since higher prices reduce consumption	Bureau of Labor Statistics. Consumer price indices program. December 6, 2015
Democratic presidential vote %	% of vote for Democratic presidential candidate in nearest election	Negative, since states with higher percentage of democratic vote tend to be more concerned about the environment	Presidential Elections Data extracted from UC Santa Barbara's The American Presidency Project December 6, 2015
Heating degree days (HDDs)	Annual heating degree days weighted by population as a measure of heating energy demand	Positive, since greater number of HDDs means greater demand for energy	National Climatic Data Center December 7, 2015
Cooling degree days (CDDs)	Annual heating degree days weighted by population as a measure of cooling energy demand	Positive, since greater number of CDDs means greater demand for energy	National Climatic Data Center December 7, 2015
Change in percent GDP from carbon-intensive manufacturing industries	GDP from carbon-intensive manufacturing divided by the size of the economy for current year minus same for previous year	Positive, since states with larger share of carbon-intensive industries relative to the size of their economy tend to consume more energy	Bureau of Economic Analysis (BEA) NAICS December 6, 2015

Variable	Explanation	Expected Sign of Regression Coefficient	Source & Date Downloaded
Change in percent GDP from carbon-intensive non-manufacturing industries	GDP from carbon-intensive manufacturing divided by the size of the economy for current year minus same for previous year	Positive, since states with larger share of carbon-intensive industries relative to the size of their economy tend to consume more energy	Bureau of Economic Analysis (BEA) NAICS December 6, 2015
Compactness index	State level average compactness calculated from county level composite sprawl score that considers density, land use mix, activity centering and street connectivity	Negative, since urban compactness reduces VMT and thus transportation emissions	Smart Growth America Measuring Sprawl 2014 December 7, 2015
Interstate energy trades	Controls for the effect of interstate electricity trades by creating a credit for electricity exporting states and debit for importing states	Positive, since energy exporting states emit carbon for producing electricity	U.S. EIA December 5, 2015
Regions	Regions as defined by BLS consumer energy price indices	--	Bureau of Labor Statistics (BLS)

The dependent variable measure is derived from EIA State Energy Data System (SEDS) that is annual time-series data extending back to 1960. Emission estimates are based on energy consumption data from EIA's State Energy Consumption, Price, and Expenditure Estimates (SEDS) released in summer 2015. The dataset includes energy-related emissions for five energy-use sectors (i.e. transportation, residential, commercial, industrial, and electric power) and emissions from all sectors combined. EIA defines energy consumption in these sectors “as a source of heat or power or as a raw material input to a manufacturing process” (SEDS, 2013).

I made several changes to the combined emissions to develop an appropriate dependent variable. First, I divided emissions by population to obtain per capita emissions. By doing so, I normalized emissions between small and large states and controlled for possible effect of population increase or decrease (e.g. in-migration vs. out-migration) on emissions. Second, I calculated change in emissions as a measure of progress towards emissions reductions. The change was calculated compared to most popular baseline year emissions (i.e. year 1990) because the baseline year is what plans compare their progress with. Furthermore, this controls for the effect of historic dependency on coal for producing electricity (coal-fired power plants). If I were to use emissions as opposed to change in emissions, I would have to control for differences in initial energy endowments (e.g. coal-fired power plants, hydroelectric power, and nuclear power).

My models involve a number of independent variables to explain part of changes in emissions. I am particularly interested in the potential impacts of climate action plans, their targets and implementation on emission changes. I treated state level CAPs--categorized into 6 groups--as a nominal variable. Thus, the model compares each category to a No-CAP alternative. I assigned the appropriate CAP category to each state the year the plan was adopted. Therefore, the model also compares each state before and after the adoption of the plan.

Another independent variable that attracts planners' interest is urban compactness as opposed to sprawled development. There is considerable evidence in the planning literature that sprawl is linked to higher levels of emissions when compared to a more compact development pattern (see for example, Ewing, Bartholomew, Winkelman, Walters, & Chen, 2008, pp. 107–111; Ewing & Rong, 2008; Glaeser & Kahn, 2008; and Randolph, 2008, among others). My compactness variable is derived from a multi-factor sprawl index published by the Metropolitan Research Center at the University of Utah in April 2014 and later in the year by Smart Growth America. This research is an update and refinement of a sprawl measure released in 2002. The dataset is based on an analysis of Metropolitan Statistical Areas (MSAs) as well as development in metropolitan counties. The score on the sprawl index is based on an analysis of development in metropolitan counties using four major factors: 1) development density; 2) land use mix; 3) activity centering; and 4) street accessibility. All four factors are combined in equal weight and controlled for population. Using the refined method of 2014, sprawl indices are calculated for years 2000 and 2010. The average compactness score is 100, and greater values indicate that an area is more compact. I used the county-level sprawl indices to compute average state-level compactness for years 2000 and 2010. I interpolated sprawl indices for the missing years. It is important to note that sprawl indices changed slightly between 2000 and 2010 with the same most compact, most sprawled or average areas in both years. Therefore, estimation of values for the missing years using the linear interpolation technique is an appropriate method.

It is also important to control for other variables that can potentially be correlated with the dependent variable, and thus, can provide a plausible alternative explanation for reductions in emissions. Change in energy prices, unemployment, income, and industrial mix are the most important of these variables. The logic behind including these variables comes from the potential relationship between the economy and changes in emissions. If I do not control for these variables in my models, I may mistakenly conclude that CAPs result in emissions reduction, when in reality the relationship between CAPs and emissions reductions is spurious. Explanation of these variables are provided in table 4, but two of them require further clarification. Following Drummond (2010) I used change in regional energy prices as opposed to state-level energy prices because change in energy prices is one of the major effects of CAP implementation. If I were to use change in state-level energy prices, this could have dramatically underestimated the impact of the CAPs. One limitation of this method, however, is the potential autocorrelation problem. I controlled this effect by adding the regions--where the states were assigned to in the regional consumer energy prices dataset--to the model. Regions are also considered geographic variables, and therefore also control for the potential relationship between location and emission changes.

Change in industrial mix is another variable that can potentially impact emission changes. For example, a shift in industrial output from energy- or carbon-intensive products (e.g. steel) to low-energy products (e.g. computer equipment) can result in emissions reductions. It is very difficult, if not impossible, to track industries within states to know whether a switch in industrial output is responsible for emissions changes. However, it is possible to measure the dependency of a state's economy on carbon-intensive industries and its changes over time. To control for potential effects of industrial mix changes, I calculated change in percent Gross Domestic Product (GDP) from carbon intensive industries. I included two variables related to change in industrial mix in my model: change in percent GDP from carbon-intensive manufacturing and non-manufacturing industries. Generally, carbon intensive industries emit large amounts of GHGs per unit of good produced, and their energy costs are a large portion of their total costs (Zabin, Buffa, & Scholl, 2009). According to the most recent U.S. EPA inventory of GHGs, which is based on an analysis of EIA energy consumption data, several industrial activities consume a lot of energy and emit large amounts of GHGs. Within manufacturing activities, the most carbon-intensive industries are: Petroleum refineries; primary metals (e.g. iron, steel, and aluminum); chemicals; pulp and Paper; nonmetallic mineral products (e.g. cement and glass); and food (EPA 430-R-15-004, 2015; Zabin, Buffa, & Scholl, 2009). Among non-manufacturing industries, construction, mining, and agriculture are considered energy and carbon-intensive (EPA 430-R-15-004, 2015).

In my models I also included two climatic variables: heating degree days and cooling degree days. These data come from National Climatic Data Center, and show heating or cooling fuel demand on a state-wide basis. These two datasets include state average degree day totals for each month—which is derived from the divisional values by weighting each division by its percentage of the total state population. The logic behind including these two variables is that greater number of heating or cooling degree days result in greater demand for energy consumption, and by extension larger amounts of emissions.

Lastly, I controlled for the effect of interstate electricity trade. In most states, electric power generation is the largest source of CO_2 emissions from fossil fuel combustion. Some states are net exporters of electricity, whereas others are net importers of electricity. One way to account for the effect of interstate electricity trades is by constructing interstate carbon credits and debits and calculating an indicator of the full carbon effects of a state's electricity consumption by adding or subtracting emissions with traded electricity. Jiusto (2005) has offered a complex method to deal with carbon emissions from cross-border power flows. This method has three major steps: 1) calculating carbon emissions associated with in-state power production; 2) determining whether or not and the extent to which a state is a net importer or exporter of electricity; and 3) calculating CO_2 attributable to a state's net electricity consumption by subtracting carbon reflecting inter-state power trade from carbon associated with power production. This logic can be summarized in the following equation:

$$C_{con} = C_{gen} - (C_{exp} \text{ or } C_{imp})$$

Where:

- C_{con} is carbon from in-state consumption of electricity;
- C_{gen} is carbon from in-state generation of electricity;
- C_{exp} carbon credit for net exporters of electricity; and
- C_{imp} carbon debit (a negative number) for net importers of electricity.

This method is superior to other methods that measure carbon contribution at either the site of electricity production or generation because it considers interstate electricity flows. Yet, it still has a major disadvantage: use of a single average carbon intensity of energy production for imported electricity. Using available data from U.S. Energy Information Administration, it is feasible to measure carbon intensity of electricity production. Thus, one can calculate an export credit (i.e. C_{exp}) that is based on each state's carbon intensity of power generation. However, data is incomplete when it comes to the volume and dynamics of electricity trades linking intra-state producers and consumers. Therefore, we still cannot calculate an import debit (i.e. C_{imp}) that reflects the actual carbon intensity of purchased electricity. As a result, Jiusto (2005) distributes total exported carbon across all importing states commensurate to the volume of their imports. This assumes that the CO_2 emissions associated with interstate electricity inflow of a state that imported electricity from an out of state coal-fired power plant is the same as a state that purchased electricity from a cleaner producer as long as the unit electricity purchased is the same. In other words, the calculated carbon credit is insensitive to variations in carbon intensity of electricity production across the nation.

This assumptions can be problematic because the carbon intensity of electric generation varies from producer to producer based on production methods and type of fuel used. For example, a fossil-fuel power station may burn coal, natural gas or petroleum to produce electricity. Natural gas power plants emit half as many GHG emissions of coal-fired power plants, according to a 2013 report by the Center for Climate and Energy Solutions. By the same token, combined heat and power systems emit smaller amounts of GHGs per unit electricity produced because these systems utilize heat energy otherwise wasted, and thus are much more efficient. Additionally, CAPs can require electricity to be purchased from cleaner producers as an emissions mitigation policy measure (e.g. California's CAP). If so, the model would underestimate the impact of CAP implementation by controlling for emissions associated with traded electricity. On the other hand, tracking where the states buy their electricity from, carbon-intensity of power these entities produce, and the changes in these dynamics over time is rather difficult. Therefore, I chose the simpler method of controlling for electricity trades without making assumptions about carbon-intensity of power they purchase and consume.

CHAPTER IV

FINDINGS

Phase 1 Findings

This section focuses on findings from the first phase of this dissertation: Content analysis of state level CAPs and their related documents. In the pages that follow, I first describe the six different types of CAPs based on targets and implementation. Table 5 provides a summary of CAP types. As mentioned earlier, these six CAP types provide a basis for the second phase analysis. Then, I discuss the general strengths and limitations of state level CAPs.

Table 5. A summary of CAP types

CAP Type	**Key Identifiers**		**States with a CAP**
	Target(s)	Implementation	*(Total Analyzed: 32)*
Type 1	No Target	No or limited evidence of implementation	*4 CAPs:* Missouri, Nevada, Ohio, Utah
Type 2	A short-term target only	No or limited evidence of implementation	*5 CAPs:* Arkansas, Illinois, Kentucky, North Carolina, South Carolina
Type 3	A long-term ambitious target	No or limited evidence of implementation	*5 CAPs:* Arizona, Iowa, Montana, New Mexico, Wisconsin
Type 4	A short-term target only	Evidence of some implementation	*3 CAPs:* Florida, Pennsylvania and Virginia
Type 5	A long-term ambitious target	Evidence of some implementation	*7 CAPs:* Maine, Michigan, New Jersey, New York, Rhode Island, Vermont, Washington
Type 6	A long-term ambitious target	Stronger evidence of rigorous implementation, monitoring and evaluation	*8 CAPs:* California, Colorado, Connecticut, Maryland, Massachusetts, Minnesota, New Hampshire, Oregon

CAP Types

Broadly speaking, there are two major types of CAPs based on targets: 1) CAPs that set a GHG emissions reduction target—often following an executive order from state governor that sets such targets or appoints a climate change sub-cabinet or advisory group to do so; and 2) CAPs that do not set any emissions reduction target. The vast majority of state level CAPs (30 out of 32 set at least one target for GHG emissions reduction within their jurisdiction; however, sometimes the targets are tied to multi-state climate change planning commitments. For example, the states that partnered in The Western Climate Initiative (WCI), Midwest Greenhouse Gas Reduction Accord (MGGRA) and Pacific Coast Collaborative (PCC), to name a few, agreed to collectively set a regional emissions target. This resolution is either based on targets originally established by participating states or otherwise are reflected in state level plans, with states proposing to either meet or exceed the regional target. Several states have also chosen to join such multi-state initiatives as observers. Observer states often set matching or comparable reduction targets, but normally do not commit to the implementation mechanism set by the regional initiative—such as a regional cap-and-trade program.

State CAPs have set targets that may be single-step, two-step or multiple-step. Figure 5 illustrates types of state level CAPs based on targets. Typically, CAPs with two- or multiple-step targets set a long-term goal to be reached by 2050 with a midterm target to be achieved by 2020 or 2025.[5] 2050 marks the middle of the century; it is a date often used—in addition to the end of century mark--in scientific scenario analyses to illustrate the impacts of climate change and/or define necessary reductions to possibly avoid the most catastrophic impacts. A number of states also set interim target(s)--to help them make progress towards the midterm target. For example, New Hampshire sets a midterm goal of reducing emissions 20% below 1990 levels by 2025 and specifies five interim targets to reach the 2025 goal. Following the Kyoto Protocol, the most common baseline year is 1990 for state level CAPs, with some states setting emissions of the year 2000, 2005 and 2006 as their baseline.[6] Thus, the first step commonly involves either going back to 1990 emissions levels or lower than that (5%, 10% or 20% lower).

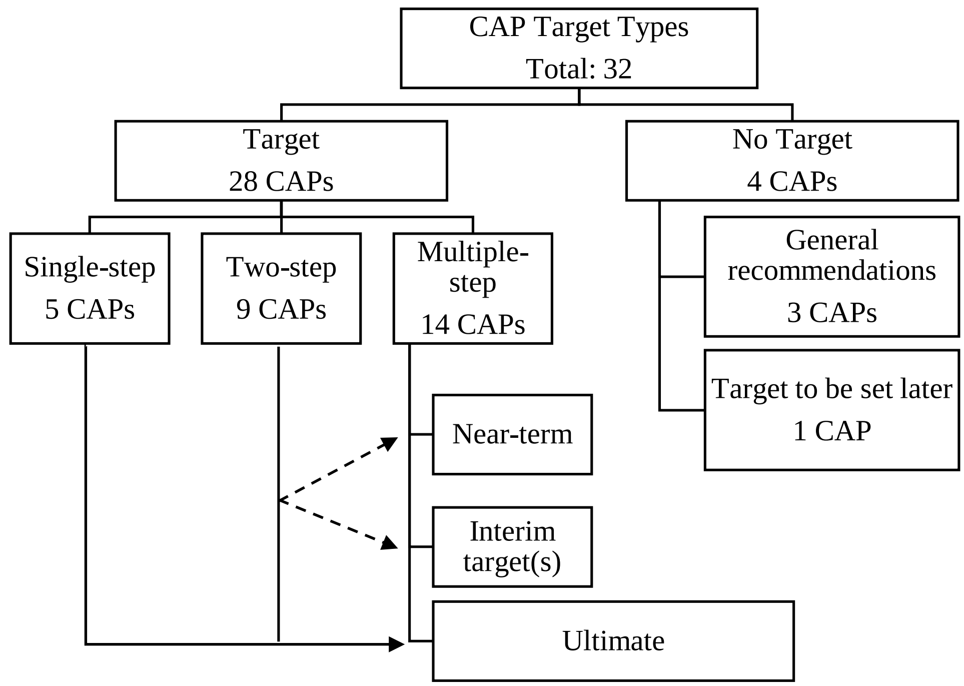

Figure 5. CAP types based on targets

I define *long-term ambitious target* as: aiming at or close to scientific requirements for emission reductions in the United States by mid-century as interpreted by the CAPs. It is important to note that scientific requirements vary based on different targets for stabilization of atmospheric GHG concentrations. In other words, emission allowances for all industrialized nations (including the U.S.) are different for various GHG concentration levels. Therefore, scientists have developed several scenarios for stabilization levels and mitigation requirements. Gupta et al.'s (2007) systematic analysis of the literature suggests that under low and medium stabilization levels, developed nations would need to cut their emissions substantially (i.e. 40% to 95% below 1990 levels)--even if developing nations achieve significant reductions. Nonetheless, virtually all states with an ambitious target have interpreted scientific requirements for emission reductions as approximately 75% to 85% below 1990 levels in the long run (around 2050). Types 3, 5, and 6 CAPs (20 CAPs total) have a long-term ambitious target.

A *short-term target*, on the other hand, does not meet the requirements of a long-term ambitious target. A short-term target does not preclude a state from adopting rigorous policy measures or developing an ambitious target in the future. Yet, in and of itself a short-term target is insufficient to guide the state emissions reduction efforts in the long run to meet the scientific requirements. In other words, a short-term target lacks a long-term vision. Additionally, since state level short-term targets tend to be low, having a short-term only can imply elimination of rigorous policy options from consideration. For instance, South Carolina sets a target to reduce emissions to 5% below 1990 levels by 2020; no long-term goal is set. Types 2 and 4 CAPs (8 CAPs total) have a short-term target only.

In addition to the targets, CAPs differ in terms of the stringency of their implementation. I classified a CAP in the *strong evidence of rigorous implementation* group if: there is stringent state level legislation governing the implementation of the CAP with lead or other responsible agencies identified and clear monitoring and evaluation mechanism, or otherwise, there is evidence of extensive programmatic interventions with progress toward goals clearly documented in some type of a progress report, implementation plan, updated inventory or online tool. Type 6 CAPs (8 CAPs total) provide strong evidence of rigorous implementation. I classified a CAP in the *some evidence of implementation* group if: there is some evidence of early actions or programmatic interventions; yet, there is evidence of stopped funding, discontinued or sporadic climate council or advisory group meetings or documents clearly showing that the state is not on track to reach its goals although some programs have been implemented. Types 4 and 5 CAPs (10 CAPs total) provide some evidence of implementation. I classified a CAP in the *no or limited implementation* group if: I found no evidence of implementation whatsoever, insufficient evidence of implementation, or evidence of lack of implementation—meaning that it is clearly stated on the relevant state agency website that the state has stopped the CAP process after its adoption. I considered evidence of implementation insufficient if: there were either very limited information provided and/or I found a few programs that seemed relevant but these were not tied to the CAP or its other documents whatsoever. Types 1, 2 and 3 CAPs (14 CAPs total) provide no or limited evidence of implementation. Considering the type of CAP targets and the rigor of their implementation, plans can be broadly categorized into 6 groups described in-detail below and illustrated in Table 5 and Figure 6.

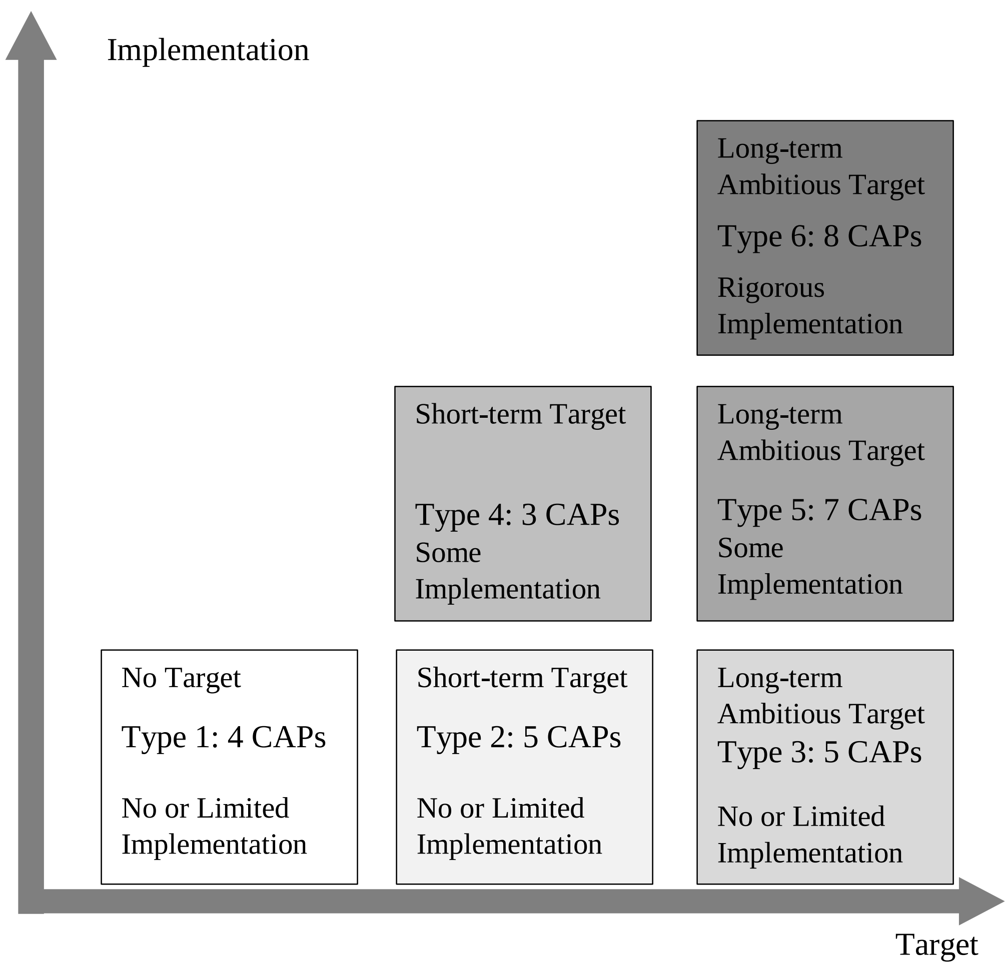

Figure 6. CAP types based on targets and implementation

1) CAPs without a target and no evidence of implementation (Type 1): These plans rely on general recommendations only and have not set a GHG emissions reduction target. Additionally, I found neither any sign of implementation (e.g. implementation plan, specific mitigation actions, etc.) nor any sign of monitoring or evaluation (e.g. progress reports, updated inventories showing progress towards goals, etc.). CAPs of four states (Missouri, Nevada, Ohio, Utah) belong to this group.

Utah joined the Western Climate Initiative (WCI) -- a collaboration between seven U.S. states and four Canadian provinces to reduce GHG emissions—in 2007 requiring the state to develop a target and a set of recommendations. However, Utah developed and adopted a CAP in 2008 that does not set a GHG reduction target. It can be implied from Utah's CAP that a target should have been set at a later time, but I found no further evidence.

Nevada's CAP, on the other hand, clearly states that a target with stringent implementation such as "cap and trade" or "cap and fine" is not the intention of the plan. Such targets, according to Nevada's CAP, "may severely limit the economic growth potential for the State, resulting in significantly higher utility rates for Nevadans" (Nevada Climate Change Advisory Committee Final Report, 2008, p. 24).

Ohio's plan developed in 2011 and entitled "Assuring Ohio's competitiveness in a carbon-constrained world" is the most recent of all state level CAPs. This plan takes an entirely different approach by stating that the plan "is meant to highlight important factors related to Ohio's ***exposure to climate policies*** [emphasis added] and the ways in which Ohio can capitalize on the opportunities created by such policies" (Executive

Summary, 2011, p. 2). This means that Ohio's CAP is more focused on responding to federal level mitigation policies and requirements rather than GHG emissions mitigation. Therefore, while the plan does analyze emissions sources and opportunities to mitigate emissions, setting a target, let alone enforcing it, is clearly not the intent of the plan.

Missouri Department of Natural resources released a set of action options for reducing GHG emissions in 2002. Similar to other CAPs in this group, Missouri's CAP includes general recommendations and does not include a statewide target.

2) CAPs with a short-term target and no or limited evidence of implementation (Type 2): These plans set a near-term target that is insufficient to guide the states' long-term GHG emissions reduction efforts. For instance, the state of Illinois sets the target of reducing emissions to 1990 levels by 2020. As explained earlier, having a short-term target to initiate CAP development and implementation does not intrinsically mean that the state cannot reduce emissions significantly. In my interview with a national climate planning expert, she explained:

> "I think you could achieve reductions without [a long-term ambitious target], but I think it is really valuable to give a guiding goal to work towards. I think some states do it out of ambitious reach goals. They set a goal that need[s] to be met and worry less about whether they are confident that they can get there. That is motivational for some states. Other states are much more conservative and don't sign up for something they are not confident they can accomplish. They don't set the goals without knowing that there are strategies to achieve the goal. Longer-term targets involve a greater level of uncertainty. From the perspective of states, I don't think there is anything wrong with any of those methods [to target-setting] because states can approach this with different intentions".

However, even if setting short-term achievable targets is the approach a state is taking, it is important to monitor the progress towards goals and set a an updated goal when the near-term target is approaching.

CAPs of the five states of Arkansas, Illinois, Kentucky, North Carolina, and South Carolina fall in this category. Arkansas chose to set three 5-year targets to reduce emissions about 5%, 10% and 15% below 1990 levels by 2015, 2020 and 2025 respectively. The only evidence of executive legislation that I came across for the state of Arkansas was Act 696 of the Arkansas 86th General Assembly (HB2460), which established the Governor's Commission on Global Warming (GCGW). Otherwise, I found no evidence of implementation, monitoring or evaluation. Kentucky chose a two-step target to reduce emissions 10% and 20% below 1990 levels by 2020 and 2030.

The other remaining three states of Illinois, North Carolina and South Carolina set a target to be reached by 2020 only. Illinois set the target of going back to 1990 levels by 2020. North Carolina's plans recommended to stay within 1% of 1990 levels in 2020, which is approximately 47% lower than the reference case projected. South Carolina, on the other hand, set a target of reducing emissions to 5% below 1990 levels by 2020.

I also found evidence of legislation for the states of Illinois, North Carolina and South Carolina that established or assigned a responsible entity to develop recommendations for mitigating emissions. Executive Order 2006-11 signed on October 5, 2006 created the Illinois Climate Change Advisory Group—which developed and released the CAP in 2007. This 2007 CAP includes appendices showing the implementation status of each policy measure. Yet, these are essentially actions taken prior to the CAP development. I found no further information about implementation of the CAP after its release in 2007. Documents from meetings and inventories are also not posted after the CAP development process in 2007.

In North Carolina, the Clean Smokestack Act (CSA) signed in 2002 tasked the Department of Environment and Natural Resources' (DENR) Division of Air Quality (DAQ) to study options for reducing carbon emissions from coal-burning power plants and other sources. North Carolina Climate Action Plan Advisory Group released the CAP in 2008. In North Carolina Department of Environment and Natural Resources' division of Air Quality website, where state implementation plans are posted, there is no sign of a CAP implementation, progress reports, monitoring or evaluation. With the exception of an adaptation plan (i.e. Climate ready North Carolina: Building a resilient future) published in 2012, no other climate planning related documents were publically available. The adaptation plan does not include information about emissions mitigation.

In South Carolina, Executive Order No. 2007-04 established the Governor's Climate, Energy, and Commerce Advisory Committee (CECAC) to develop a Climate, Energy, and Commerce Action Plan containing specific recommended actions for mitigating GHG emissions. With the exception of a report published by South Carolina Department of Natural Resources (DNR) in 2013 about climate change impacts on natural resources, I found no other climate planning related documents. This report addresses how climate change may affect wildlife, fisheries, water supply and other natural resources in South Carolina, and identifies some key adaptive steps for DNR to respond to these impacts. The report does not provide information about emissions mitigation.

3) CAPs with a long-term ambitious target and no or limited evidence of implementation (Type 3): CAPs in this category started strong by setting a long-term ambitious target to meet scientific requirements of GHG emissions reduction, but such efforts or enthusiasm faded away after the adoption of the CAP resulting in implementation problems. Five state CAPs fall in this category. These are Arizona, Iowa, Montana, New Mexico, and Wisconsin.

New Mexico's CAP was developed and adopted as a result of Executive Order 05-33 signed in 2005 that established the New Mexico Climate Change Advisory Group (CCAG). This CAP sets a target of reducing emissions 75% below 2000 levels by 2050 and even includes cap-and-trade provisions. In 2012, however, the Environmental Improvement Board (EIB)[7] approved the repeal of GHG reporting requirements and cap-and-trade provisions for New Mexico. By the same token, Iowa's CAP was developed and adopted as a result of Senate File 485 establishing the Iowa Climate Change Advisory Council (ICCAC). However, as a part of the 2010 State Government Reorganization (Senate File 2088), the Iowa Climate Change Advisory Council was disbanded on July 1, 2011. I did not find any evidence that implementation of Iowa's CAP was continued under a different institutional framework.

Montana also set a target of reaching 1990 emissions levels by 2020, and reducing emissions 80% below 1990 levels by 2050. Montana's CAP was released in 2007. Later, The Environmental Quality Council (EQC), which is an interim committee of the Montana Legislature, polled public support for the CAP recommendations. However, it is stated in EQC's website that "broad-based legislation addressing climate change has not emerged", and therefore, implementation of the CAP is not underway.

In Arizona, Executive Order 2005-02 directed the Climate Change Advisory Group (CCAG) to develop a CAP under the coordination of the Arizona Department of

Environmental Quality. The CAP was adopted in 2006 which set the two-step target of reaching 2000 emissions levels by 2020 and reducing emissions to 50% below 2000 levels by 2040. I did not find any evidence of implementation, monitoring or evaluation for Arizona's CAP.

In Wisconsin, Executive Order 191 created The Global Warming Task Force in 2007 to reduce GHG emissions. The CAP was released in 2008 setting a tri-step target: reducing GHG emissions to 2005 levels by 2014; reducing GHG emissions to 22% below 2005 levels by 2022; and reducing GHG emissions to 75% below 2005 levels by 2050. I did not find any evidence of implementation, monitoring or evaluation in relevant state websites.

4) CAPs with a short-term target and evidence of some implementation (Type 4): The CAPs of the three states of Florida, Pennsylvania and Virginia set a short-term target; yet, there is some evidence of implementation, monitoring and evaluation.

Florida set a two-step target, but instead of comparing emission reductions to a baseline year (e.g. 1990), the state proposed to reduce emissions compared to a projected reference case (i.e. BAU emissions). These targets are reducing emissions 30% and more than 64% below the reference case by 2017 and 2025 respectively. Two major pieces of executive legislation are Executive Order 07-127—which set emission reduction goals; and Executive Order 07-128—which created the Action Team to develop recommendations for mitigation and adaptation to achieve or surpass the statewide targets. Pursuant to Executive Order 07-128, the Action Team released a final CAP in 2008. In the same year, Florida's Governor signed into law House Bill 7135, enacting a number of energy and climate change policies. I did not find more recent evidence of implementation, monitoring or evaluation.

In 2007, Virginia's Governor signed Executive Order 59—which established the Governor's Commission on Climate Change. The Commission was tasked with creating a CAP and proposing actions (beyond those identified in the Energy Plan) to be taken to achieve a 30% reduction goal below the BAU projection of emissions by 2025. A 2014 update report entitled "Virginia Accomplishments Since the 2008 Climate Action Release" shows evidence that implementation is underway.

Similarly, Pennsylvania released an update to its 2009 CAP in 2013. The 2009 CAP was developed following Pennsylvania Climate Change Act 70—which was signed in 2008 and required the Department of Environmental Protection to develop an inventory and a plan. There is some evidence of implementing certain programs. Examples include Natural Gas Energy Development Program, which is a program funded by natural gas operator impact fees, that provides $20 million over three years for purchasing or retrofitting heavy-duty vehicles to operate on natural gas; and Pennsylvania Sunshine Program that provides rebates to residential and commercial entities for installation of Solar Photovoltaic and Solar Hot Water Systems. The 2013 CAP update shows some progress towards emission reduction goals. Yet, it can be inferred from the updated CAP that most of the progress is attributable to either federal level regulations or "broad-based changes to Pennsylvania's economy and energy portfolio" (p. 1)—that result in GHG emissions reduction--as opposed to rigorous CAP implementation.

5) CAPs with a long-term ambitious target and evidence of some implementation (Type 5): The states of Maine, Michigan, New Jersey, New York, Rhode Island, Vermont and Washington set an ambitious target but have struggled in the process of implementing, monitoring and evaluating their CAPs. The dynamics of implementation varies across these states. Yet, the distinguishing factor is that all of these states started strong, but there is evidence suggesting that these CAPs lost momentum (at least for a period of time). Evidence from available sources on CAP related websites suggests that a number of factors have played a role in impeding implementation. These include the economic downturn, lack of funding, other pressing issues (including adaptation to climate change) getting prioritized or changing administrative ethos or preferences. However, the interest in addressing climate change has not faded away in these states; more recent evidence reiterating enthusiasm for action is available in most cases.

Some of these states admit that they are unlikely to reach their targets due to some or all of the aforementioned challenges. Washington, for example, released a report entitled “Path to a low carbon economy” in 2010 showing that the state is not on track to meet its statuary reduction limit for 2020 and beyond. Others, have gone through a bumpy implementation process but have reiterated their interest and are hopeful to get back on track. For instance, Rhode Island continued its initial CAP process for six years (from 2001 to 2007) to stop the process in 2007 due to lack of funding. However, a 2013 review of the CAP showed that approximately 65% of the 52 program and policy options have been implemented. Despite the relatively high percentage of program implementation, many of these programs can be attributed to the Energy Efficiency Program Plan, as admitted by Rhode Island’s Department of Environmental Management

(DEM). DEM also names several other pieces of legislation that have also had a key role in GHG emissions mitigation. Examples include the 2004 RI Renewable Energy Standard (RES), 2013 Energy Efficiency and System Reliability Program Plan, RI Public Energy Partnerships (RIPEP), Renewable Energy Fund, 2012 amendment to the Least Cost Procurement Statute to encourage the installation and investment in combined heat & power (CHP). This means that despite the fact that the CAP process was stopped for a number of years, related efforts were taking place under a different legislative framework. Yet, a 2016 update to the CAP is underway signaling that the state is aiming to continue its climate initiative in a more comprehensive way.

In 2007, New Jersey's Governor signed Executive Order 54 to stabilize GHG emissions at 1990 levels by 2020; and to reduce emissions to 80% below 2006 levels by 2050. Later in the same year, the New Jersey Global Warming Response Act (P.L. 2007, c.112) established statewide limits on GHG emissions and required two recommendations reports, one for each limit. The Bureau of Energy and Coordination developed four scenarios for analyzing possible outcomes for 2050--ranging from BAU path to a path fully employing non-combustion energy technologies and large-scale energy efficiency programs in non-electric sectors. At minimum, the most stringent scenario is needed for achieving the 2050 goal. However, this scenario is "not defined by statute, regulation, agency policy, or administrative directive" (New Jersey Department of Environmental Protection, 2015). Similar to many other CAP targets, the near-term target set by New Jersey is very low compared to its 2050 target. As a result, New Jersey attained its 2020 reduction goal in 2012 (8 years ahead of schedule) but will need deep reductions to come closer to the 2050 target. In 2011, New Jersey withdrew from

Regional Greenhouse Gas Initiative, a multi-state cap-and-trade program to reduce emissions from the power sector. After the devastating damage caused by Hurricane Sandy, the focus has shifted away from climate change mitigation to adaptation. This shift in focus from mitigation to adaptation is also evident in other impacted states, such as New York and Maine. In New York, The Community Risk and Resiliency Act (CRRA), and The Climate Smart Communities program are both adaptation-focused. Maine's "The monitoring, mapping, modeling, mitigation and messaging" report, released in 2014, also focuses mainly on adaptation.

6) CAPs with a long-term ambitious target and stronger evidence of rigorous implementation, monitoring and evaluation (Type 6): The remainder of eight state level CAPs (California, Colorado, Connecticut, Maryland, Massachusetts, Minnesota, New Hampshire, and Oregon) set an ambitious target and have aimed at rigorously implementing, monitoring and evaluating it. This does not mean that there are no challenges involved in the implementation of these plans; neither does it suggest that these CAPs will likely reach their long-term targets. However, these CAPs are the most likely of all six groups to have resulted in regulatory statutes, mandated emissions reduction targets and/or more extensive programmatic actions to mitigate GHG emissions. Also, all of these states are participating in multi-state climate initiatives. Typically, CAPs in this category involve relatively stringent monitoring and evaluation mechanisms. Having a clear monitoring and evaluation scheme is an identifying factor for CAPs in this category. In most cases more recent evidence of implementation efforts, such as stakeholder meeting information are available. Furthermore, these CAPs are more likely to have some type of an implementation plan, and have clearly identified responsible entities for implementation. Lastly, I have not observed any major gaps in the CAP implementation process.

In Massachusetts, for example, the Global Warming Solutions Act (GWSA) signed in 2008 created a framework for reducing GHGs. Additionally, the Energy and Environmental Affairs website provides detailed information about GWSA, such as strategies to reduce GHG emissions by 2020, sectoral progress towards goals, and information about the Regional Greenhouse Gas Initiative Auction Process. Massachusetts has also established an Implementation Advisory Committee and Implementation Subcommittees, and 5-year progress reports are published regularly. The 2015 update of Massachusetts Clean Energy and Climate Plan for 2020 shows that the state is on track to reach or exceed the 2020 goal of reducing emissions to 25% below 1990, but major technological and policy innovations are required to reach the 2050 goal of reducing emissions to 80% below 1990 levels. GWSA requires setting 2030 and 2040 emission limits to design a path for reaching the 2050 goal.

In California, the California Global Warming Solutions Act of 2006 (AB 32) set a binding economy-wide target for GHG emissions, and the Sustainable Communities and Climate Protection Act of 2008 (SB 375) set regional land-use GHG emissions targets. AB 32 directs the California Air Resources Board (ARB) to be the lead agency to implement the law and develop a Scoping Plan laying out a strategy for meeting the goals. AB 32 is primarily funded through fees collected from major sources of GHGs, such as oil refineries, electricity power plants (including imported electricity), cement plants and other industrial entities. ARB updates a statewide GHG inventory annually and the Scoping Plan every five years. In 2014, ARB approved the first update of the

Climate Change Scoping Plan. Evidence from the Scoping Plan and other ARB documents show that California has implemented major GHG reduction measures (e.g., Low Carbon Fuel Standard, Advanced Clean Car standards, and Cap-and-Trade) over the last five years and is on target to meet its goal of getting back to 1990 levels by 2020. In 2015, Executive Order B-30-15 established a mid-term GHG reduction target of 40% below 1990 levels by 2030. To reach its 2050 goal of reducing emissions to 80% below 1990 levels, major technological and policy innovations are needed.

In the past decade Oregon has released two CAPs, one in 2004 and another in 2008. House Bill 3543 (Global Warming Actions) of 2007 codified GHG reduction goals, established a Global Warming Commission, and created the Oregon Climate Research Institute in the Oregon University System. Oregon's CAP initially set a three-step target: reaching 1990 levels by 2010; 10% below 1990 levels by 2020; and at least 75% below 1990 levels by 2050. In a 2015 progress report, an interim target of 2035 has been added "to help focus State and local efforts while being far enough in the future to allow the emissions-reducing impact of policy choices to materialize" (Oregon Global Warming Commission 2015 Biennial Report to the Legislature, 2015, p.6). Implementation is underway and the biennial progress reports have been published regularly since the adoption of the CAP. The 2015 biennial report shows that the 2010 goal is met. Yet, the report projects Oregon's 2020 emissions to be slightly above the target level, with the gap between emissions and goals widening each year to 2050 unless additional action is taken. This is another example of a low near-term target that necessitates deep reductions to reach longer-term goals.

Colorado’s CAP was adopted in 2007 with a stakeholder panel convened by the Rocky Mountain Climate Organization, a nonprofit charitable organization that partnered with the Center for Climate Strategies for technical support and facilitation of stakeholder meetings. In 2008, Executive Order D 004 08 declared the state’s GHG reduction goals, directing the Colorado Department of Public Health and Environment (“CDPHE”) to develop regulations to address climate change. Two Colorado Climate Scorecards, released in 2011 and 2013 show the implementation status of the Colorado CAP and Rocky Mountain Climate Organization’s Climate Action Panel Recommendations. Each policy measure includes the “consensus” status of the Climate Action Panel (e.g. super majority vote, majority vote, unanimous vote, etc.).

Connecticut developed a CAP in 2005. CT Global Warming Solutions Act (Public Act 08-98) reaffirmed Connecticut’s commitment to GHG targets for 2020 (10% below 2010 levels) and 2050 (75-85% below 2001 levels by 2050). A 2011 implementation update report published in 2014 shows progress towards goals. In the Department of Energy and Environmental Protection website, there is a “climate change” link that provides information on the state’s climate actions through time. Inventories showing progress are also posted regularly.

In Maryland, Executive Order 01.01.2007.07 established a Climate Change Commission and tasked the Commission to develop a CAP. The CAP was released in 2008, and Greenhouse Gas Emissions Reduction Act of 2009 established a mandatory goal of reducing the state’s GHG emissions 25% below 2006 levels by 2020. Additionally, the bill stated that it is in the state’s best interest to act aggressively on the interim targets of 10% reduction by 2012 and a 15% reduction by 2015 but did not make these targets mandatory goals. Sustainable Communities Act of 2010 implemented a GHG reduction initiative similar to that contained in California's Senate Bill 375. There is a progress link on the state's climate change webpage that directs the user to the Department of Information Technology Open Data Portal. Also, there is information about legislative actions, executive orders, and several related reports posted on the state's climate change website.

Minnesota developed its first CAP in 2003, which served as a framework for later efforts. The 2003 CAP includes an analysis of actions taken by other jurisdictions, especially other states. In 2006, Minnesota's governor announced the Next Generation Energy Initiative that involved developing a comprehensive CAP. The Next Generation Energy Act of 2007 included requirements to increase energy efficiency, expand community-based energy development, and establish a three-step target (at least 15% below 2005 levels by 2015, at least 30% below 2005 levels by 2025, and at least 80% below 2005 levels by 2050). As a result, an updated CAP was released in 2008 to develop recommendations for meeting these targets. The estimated emission reductions associated with the recommendations of this CAP along with recent actions would be sufficient to achieve Minnesota's GHG reduction goal for 2015 and be within 2.4 MMtCO2e of meeting Minnesota's goal for 2025 (i.e. approximately 2% of target emissions). There are a number of statutes related to the implementation of the plan. For example, 216H.07 Emissions-reduction Attainment; Policy Development Process intends to create a mandated process to develop and implement policies to attain emissions reduction goals and requires the commissioners of commerce and the Pollution Control Agency to jointly develop a biennial progress report. The most recent progress report was released in 2015 and shows that emissions have declined 7% between 2005 and 2012. The report does not comment on whether or not the state will be able to meet its 2015 target. Yet, it finds that major cause of emission reductions was reduced use of fossil fuels. Minnesota's economy has grown while emitting lower levels of GHGs per dollar amount of Gross State Product, according to the biennial progress report. In addition to biennial reports, there is evidence of more recent meetings related to the implementation of the CAP (i.e. 2014 MN Climate Solutions & Economic Opportunities (CSEO) Stakeholders Meeting).

In New Hampshire, Executive Order 2007-3 established the Climate Change Policy Task Force to develop GHG reduction goals and recommend specific actions. The New Hampshire CAP was adopted in 2009, and set a mid-term goal of reducing emissions 20% below 1990 levels by 2025 (including 5 interim targets to meet the 2025 target), and a long-term reduction in emissions of 80% below 1990 levels by 2050. The website of NH Department of Environmental Services provides information about several programs and legislative action related to the CAP. There is also a Greenhouse Gas Emissions Reduction Fund (GHGERF) established to support energy efficiency and renewable energy projects and initiatives in New Hampshire.

Table 6 shows information about CAP targets, implementation, monitoring and evaluation across the United States.

Table 6. CAP targets, implementation, monitoring and evaluation

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
Arizona	2006	Reach 2000 levels by 2020	50% below 2000 by 2040	No or limited evidence of implementation	No evidence of monitoring/evaluation	3
Arkansas	2008	15% below 1990 by 2025	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	2
California	2006 2010	Reach 1990 levels by 2020	80% below 1990 by 2050	Stronger evidence of rigorous implementation AB 32, the California Global Warming Solutions Act of 2006 set a binding economy-wide target for GHG emissions. SB 375 set regional land-use GHG emissions targets.	ARB annually updates a statewide GHG inventory. AB 32 requires ARB to develop a Scoping Plan which lays out California's strategy for meeting the goals.	6
Colorado	2007	20% below 2005 by 2020	80% below 2005 by 2050	Stronger evidence of rigorous implementation There is evidence of some progress in the implementation of several measures reported on the Colorado Climate Scorecard.	Two Colorado Climate Scorecards (2011; & 2013) show the implementation status of the CAP and Rocky Mountain Climate Organization's Climate Action Panel Recommendations.	6
Connecticut	2005	10% below 2010 by 2020	80% below 2001 by 2050	Stronger evidence of rigorous implementation CT Global Warming Solutions Act (PA 08-98) reaffirms CT's commitment to GHG targets for 2020 and 2050. A 2011 implementation update report published in 2014 shows progress towards goals.	In the Department of Energy and Environmental Protection website, there is a "climate change" link that provides information on the state's climate actions through time. Inventories showing progress are posted regularly.	6
Florida	2008	64% below reference case by 2025	No long-term target	Evidence of some implementation House Bill 7135 of 2008, enacted a number of energy and climate change policies.	No evidence of monitoring/evaluation	4

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
Iowa	2008	Scenario 1: 11%; & 2: 22% below 2005 by 2020	Scenario 1: 50%; & 2: 90% below 2005 by 2050	No or limited evidence of implementation Iowa Climate Change Advisory Council was disbanded on July 1, 2011 (Senate File 2088)	No evidence of monitoring/evaluation	3
Illinois	2007	Reach 1990 levels by 2020	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	2
Kentucky	2011	20% below 1990 levels by 2030	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	2
Maine	2004	10% below 1990 in 2020	Up to 75% below 1990 in the long run	Evidence of some implementation The website of Maine Department of Environmental Protection has a climate change link with some evidence of programs and monitoring.	Some evidence of monitoring provided in the climate change webpage of the DEP. The Monitoring, Mapping, Modeling, Mitigation and Messaging Report (2014) is adaptation-focused.	5
Maryland	2008 2013	25% lower than 2006 by 2020	Up to 90% from 2006 by 2050	Stronger evidence of rigorous implementation GHG Emissions Reduction Act of 2009 (SB 278/ HB 315) established a mandatory GHG reduction goal; Sustainable Communities Act of 2010 is the regional/local tool for reducing GHGs; EmPower Maryland Energy Efficiency Act of 2008 includes a number of State- and utility-managed energy efficiency programs.	There is a progress link on the state's climate change webpage that directs the user to the Department of Information Technology Open Data Portal.	6

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
Massachusetts	2004 2010	25% below 1990 by 2020	80% below 1990 by 2050	Stronger evidence of rigorous implementation The Global Warming Solutions Act (GWSA) signed in 2008 created a framework for reducing GHGs. The Green Communities Act (GCA) of 2008 reformed MA's energy marketplace by promoting energy efficiency and renewable energy. The 2015 update shows that MA is on track to meet or exceed the 2020 goal.	5-year progress reports are published regularly. The Energy and Environmental Affairs website provides information about progress towards the 2020 goal.	6
Michigan	2009	20% below 2005 by 2020	80% below 2005 by 2050	Evidence of some implementation e.g. Climate Action P2 Projects 2010 provided grants for local governments to develop CAPs	No evidence of monitoring/evaluation.	5
Minnesota	2003 2008	30% below 2005 by 2025	80% below 2005 by 2050	Stronger evidence of rigorous implementation There are several statutes related to the implementation of the plan (e.g. 216H07 Emissions Reduction Attainment; Policy Development Process)	There is evidence of more recent meetings related to the implementation of the CAP (i.e. 2014 MN Climate Solutions & Economic Opportunities (CSEO) Stakeholders Meeting)	6
Missouri	2002	No short-term target	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	1
Montana	2007	Reach 1990 levels by 2020	80% below 1990 by 2050	No or limited evidence of implementation	No evidence of monitoring/evaluation	3
North Carolina	2008	Within 1% of 1990 levels by 2020	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation With the exception of an adaptation plan (i.e. Climate Ready North Carolina: Building a Resilient Future) published in 2012, there are no other progress reports published.	2

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
New Hampshire	2009	20% below 1990 by 2025	80% below 1990 by 2050	Stronger evidence of rigorous implementation NH Department of Environmental Services provides information about several programs and legislative action related to the CAP. There is also a Greenhouse Gas Emissions Reduction Fund (GHGERF) established to support energy efficiency and renewable energy projects and initiatives in New Hampshire.	NH Department of Environmental Services provides information about CAP implementation in its website. CAP implementation webpage was last updated in 2014.	6
New Jersey	2009	1990 levels by 2020	80% below 2006 by 2050	Evidence of some implementation The New Jersey Global Warming Response Act (GWRA) enacted in 2007 established statewide limits on GHG emissions.	NJ's Department of Environmental Protection provides a link to the plan, inventories and other related publications. In GWRA's webpage progress towards targets is illustrated in graphs.	5
New Mexico	2002 2006	10% below 2000 by 2020	75% below 2000 by 2050	No or limited evidence of implementation In 2012, the Environmental Improvement Board (EIB) approved the repeal of 20.2.300 NMAC-Reporting of GHGs, 20.2.301 NMAC-GHG Reporting - Verification Requirements, and 20.2.350 NMAC-GHG Cap-and-Trade Provisions.	The latest inventory is 2000-2007 published in 2010.	3
Nevada	2008	No short-term target	No long-term target	No or limited evidence of implementation No evidence of Nevada developing a final CAP as recommended by the 2008 Advisory Committee Report.	No evidence of monitoring/evaluation.	1

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
New York	2010	40% below 1990 by 2030	80% below 1990 by 2050	Evidence of some implementation Except for information about Regional Greenhouse Gas Initiative (RGGI), The Community Risk and Resiliency Act (CRRA), and The Climate Smart Communities program (the latter two are more adaptation-focused) there is no evidence of implementation.	No evidence of monitoring/evaluation	5
Ohio	2011	No short-term target	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	1
Oregon	2004 2008	10% below 1990 by 2020	75% below 1990 by 2050	Stronger evidence of rigorous implementation House Bill 3543: Global Warming Actions of 2007 codified GHG reduction goals, establishes a Global Warming Commission, and created the Oregon Climate Research Institute in the Oregon University System. The 2015 Biennial Report shows that the 2010 goal is met.	Four biennial reports have been published (2009; 2011; 2013; & 2015) showing CAP implementation progress.	6
Pennsylvania	2009 2013	30% below 2000 by 2020	No long-term target	Evidence of some implementation There is some evidence of implementing certain programs, such as Natural Gas Energy Development Program and Pennsylvania Sunshine Program. Yet, it can be inferred from the webpage that most of the progress is attributable to either federal level regulations or "broad-based changes to Pennsylvania's economy and energy portfolio"—that result in GHG emissions reduction--as opposed to CAP implementation.	Pennsylvania Climate Change Action Plan Update was published in 2013.	4

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
Rhode Island	2002 2013	20% below 1990 by 2024 (based on 2013 CAP)	80% below 1990 by 2054 (based on 2013 CAP)	Evidence of some implementation The initial CAP process lasted six years: from 2001 to 2007. In 2007 the process stopped due to lack of funding. A 2013 review of the CAP shows reiterated interest.	The 2013 review evaluates the outcome of the CAP. A 2016 update to the CAP is underway.	5
South Carolina	2008	5% below 1990 by 2020	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation except for a report published by South Carolina Department of Natural Resources in 2013 entitled Climate Change Impacts to Natural Resources in South Carolina (adaptation-focused).	2
Utah	2007	No short-term target	No long-term target	No or limited evidence of implementation	No evidence of monitoring/evaluation	1
Virginia	2008	30% below BAU by 2025	No long-term target	Evidence of some implementation In 2014, Virginia's Governor signed Executive Order convening Climate Change and Resiliency Update Commission (the Commission). The 2014 report shows some progress.	Virginia Accomplishments Since the 2008 Climate Action Release was published in 2014. The Commission is charged with evaluating the 2008 CAP, updating its recommendations, and identifying funding sources.	4
Vermont	2007	50% from 1990 by 2028	75% from 1990 by 2050	Evidence of some implementation Agency of Natural Resources provides information about initiatives related to the CAP. Examples include the VTrans Climate Change Action Plan (2008) and Clean Energy Development Fund (2005). It is stated in the 2015 inventory that Vermont did not achieve its 2012 goal of reducing GHG emissions to 25% below 1990 levels.	The most recent inventory was published in 2015.	5

State	Date	ST Target	LT Target	Implementation	Monitoring & Evaluation	Type
Washington	2008	Reach 1990 levels by 2020	50% below 1990 by 2050	Evidence of some implementation Path to a Low Carbon Economy report published in 2010 shows that the state is not on track to meet its statuary reduction limit for 2020 and beyond.	With the exception of the two progress reports released in December 2012 and June 2015 related to state government emissions only and the interim report of 2010, there are no progress reports published on the implementation of the CAP.	5
Wisconsin	2008	22% below 2005 by 2022	75% below 2005 by 2050	No or limited evidence of implementation	No evidence of monitoring/evaluation	3

Strengths and Contributions

Despite the ranges and types of climate action plans across the nation, state level CAPs have strengths that are common among most plans. This section highlights major CAP strengths and their broad contributions to the field of climate action planning and beyond.

Participatory Process and Evidence-based Analysis: Virtually all CAPs have been developed through some type of a “fact-finding” and “consensus-building” process involving numerous stakeholders. Because the field of climate action planning is highly technical and involves numerous actors and entities, governmental agencies alone are unlikely to have the range of skills and capacity to develop and implement a plan. Thus, it is crucial to not only get related governmental agencies engaged but also seek help from experts in the field. Almost all CAPs have benefited from technical support and/or facilitation of processes provided by external organizations and experts. Center for Climate Strategies, a non-profit catalyst for state level climate action planning, has provided technical support--ranging from preparing a GHG emissions inventory and forecast to financial analyses and developing recommendations—and facilitation of processes including developing and implementing a stakeholder consensus-building process for most CAPs. Through analyzing all state CAPs, I found that approximately two-third of states have relied on various services provided by Center for Climate Strategies for their CAP processes.

Almost all States have also greatly benefitted from academic resources by engaging university professors and research centers in the planning process. The scope and level of involvement of these universities vary significantly from state to state.

Ohio's CAP, for example, is entirely prepared by Ohio University and the Ohio State University in consultation with the Ohio Environmental Protection Agency and The Public Utilities Commission. However, Ohio's CAP is an exception. Other CAPs have at least involved academia as one group of stakeholders alongside other partners, such as representatives from businesses; state, local and tribal government; environmental groups and other community organizations. University faculty and/or researchers have also provided scientific research, technical analyses and/or policy recommendations either individually or collaboratively. A number of states--including California, Illinois, Massachusetts, and Rhode Island—have also utilized consulting firm services.

With the exception of Ohio and Missouri, other state level CAPs have been developed in response to an executive order, house or senate bill or any other legislative act requiring or promoting the development of strategies to mitigate climate change, and in some cases setting an emissions reduction target. Details of these mechanisms are presented in table 6. An advisory committee, a climate change commission or council, a governmental agency (e.g. Department of Public Health and Environment) or a combination of both is normally assigned (for example, through the executive order) with the task of leading the development of the CAP. The advisory committee or the council normally involves representatives from public interest groups, environmental organizations, utilities, key industries, universities, and state, local, and tribal government. The responsible entity (the advisory committee or the governmental agency) then creates Technical Working Groups (TWGs) to focus on sectoral emissions and recommendations to reduce them. Most CAPs have five or six TWGs. The most common TWGs are: Energy Supply (ES); Residential, Commercial and Industrial (RCI);

Transportation and Land Use (TLU); Agriculture, Forestry and Waste (AFW); Cross-cutting Issues; and/or Lead by Example (i.e. state government).

TWGs of close to three-quarter of all CAPs, conducted or had access to detailed financial analyses of each specific recommendation and other alternatives. Net Present Value (NPV) and cost-effectiveness (i.e. cost of savings per ton of GHG emissions reduction) analyses are the two most common types of financial analyses conducted. About one-quarter of all CAPs have reported both NPV and cost-effectiveness calculations of each recommended measure. These two methods of financial analysis (i.e. NPV and cost-effectiveness) are appropriately selected for the purpose of CAP measures. Compared to a simple payback period, calculation of NPV is more complex. Yet, NPV is a superior model because it shows the long term profitability of the project. A simple payback period analysis dose not account for the time value of money. If simple payback period is used as the main decision making tool, many CAP measures would probably lose their desirability due to longer payback periods. For most CAP measures NPV is positive, indicating the financial desirability of a measure. As opposed to cost-benefit analysis, cost-effectiveness is much more suitable for the purpose of CAP measures. Cost-effectiveness ratio is calculated by dividing total costs of a policy or program by “units of effectiveness” –defined as “a measure of any quantifiable outcome central to the program’s [or the policy measure’s] objectives” (Cellini and Kee, 2010, p. 494). This means that the outcomes of a CAP measure can be reported in terms of units of emissions reduced or avoided using a cost-effectiveness analysis, whereas cost-benefit expresses benefits (or outcomes) in monetary figures (e.g. dollar value of emissions reduced or avoided). Cost-effectiveness is a suitable technique because it is difficult to place dollar value on environmental outcomes, such as emissions reduction.

In addition to financial analyses, at least one quarter of all CAPs also included level of support for each action among stakeholders. As shown in table 6, with the exception of Ohio and Missouri, all other CAPs have involved some type of a stakeholder process involving representatives from industries, academia, governmental agencies, nonprofit organizations (e.g. environmental groups), and so forth. Analyzing various emissions mitigation options as a part of the planning process, these stakeholders have voted on each alternative measure using criteria such as, cost-effectiveness, NPV, feasibility, co-benefits, potential implementation barriers and so forth. The results are then reported in a set of policy recommendation tables in these CAPs. There is evidence that the remainder of the CAPs (with the exception of a few) have also selected measures through some type of voting procedures but have not necessarily included the level of support data in the CAP. For example, Colorado's CAP has listed whether the recommendation was supported unanimously, approved by a super majority (defined as fewer than five votes against a measure) or a simple majority vote.

Close to three-quarters of all CAPs have discussed costs of inaction and/or potential impacts of climate change on the state. Yet, detailed analysis or quantification of these costs are uncommon. This is likely due to complexity of such analyses and high level of uncertainty about local impacts. In Virginia's CAP, for instance, it is stated that "While [the costs of inaction] are difficult to calculate with any level of certainty, it is certain that Virginia residents, governments, and businesses will face increased costs to adapt to the effects of climate change" (p. 27).

There is significant evidence that CAP-related stakeholder meetings and TWG discussions have been open to members of the public, and more often than not materials and proceedings of the planning processes have been provided on a public project website. For the states that have used services provided by The Center for Climate Strategies (CCS), there is evidence that CCS has been involved in facilitation of these meetings and consensus-building processes. Yet, the scope and level of public involvement as well as the number of stakeholders involved from different interest groups vary from state to state. Overall, state level CAPs are a good example of practice of planning that relies on evidence-based analyses and participatory process involving a fairly diverse group of stakeholders. Table 7 shows Technical Working Groups (TWGs) and stakeholders involved in state level CAP processes as well as legislation, executive order or other legal mechanisms through which CAPs have been developed.

Table 7. Information about CAP development processes

State	Major Legislation/ Executive Order Requiring a CAP & Setting Targets	Technical Working Groups (TWGs) Involved	Other Entities/Stakeholders Involved
Arizona	Executive Order 2005-02 directed the Climate Change Advisory Group (CCAG), under the coordination of the Arizona Department of Environmental Quality to develop a CAP.	Energy Supply (ES); Residential, Commercial, Industrial and Waste Management (RCI); Transportation and Land Use (TLU); Agriculture and Forestry (AF); and Cross- Cutting Issues (CC)	Technical support: Center for Climate Strategies (CCS) Representatives from various governmental and nongovernmental entities, experts from the University of Arizona, and members of the public
Arkansas	Act 696 of the Arkansas 86th General Assembly (HB2460), established the Governor's Commission on Global Warming (GCGW) to develop a CAP.	Agriculture, Forestry, and Waste Management TWG; Energy Supply TWG; Residential, Commercial, an Industrial TWG; Transportation and Land Use TWG; Cross-Cutting Issues TWG	Technical support: Center for Climate Strategies (CCS) Representatives from universities, governmental and non-governmental entities, donor organizations that supported CAP development process, and members of the public
California	Executive order S-03-05 signed in 2005 established emissions reduction goals for California and directed the Secretary of Cal/EPA to coordinate efforts with meeting the targets with the heads of other state agencies.	Two sub-groups: Scenario Planning Subgroup and Market-based Options Subgroup Ten Working Groups: Agriculture; Biodiversity; Coastal and Ocean Climate Adaptation Team; Interagency Forestry Working Group; Intergovernmental Working Group; Land Use and Infrastructure Working Group; Public Health Workgroup; Research Working Group; State Government; and Water Energy Working Group.	Governmental agencies (CalEPA, Integrated Waste Management Board, Caltrans, California Energy Commission, Cal ARB, Department of Food and Agriculture, CPUC, Governor's Office, and Business Transportation and Housing Agency), individuals from Union of Concerned Scientists, representatives from consulting firms and experts (e.g. university scholars, ICF, Tellus Institute), and members of the public through participation in meetings, workshops, public hearings, etc.
Colorado	Executive Order D 004 08 issued in 2008 declared the state's GHG reduction goals, directing the Colorado Department of Public	Transportation and Land Use; Energy Supply; Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste Management (AFW)	Technical support: Center for Climate Strategies (CCS) The Rocky Mountain Climate Organization, business and community

	Health and Environment (CDPHE) to develop regulations to address climate change.		leaders, conservationists, scientists and concerned citizens
Connecticut	Public Act 04252 (AAC Climate Change) of 2005 appointed the Governor's Steering Committee on Climate Change (GSC) to develop a CAP.	Transportation and Land Use (TLU); Energy Supply; Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste Management (AFW); State Government; Education	Representatives from government, industry, nongovernmental organizations, foundations, academia and the public
Florida	Executive Order 07-127 set emission reduction goals. Executive Order 07-128 created the Action Team to develop recommendations for mitigation and adaptation to achieve or surpass the statewide targets.	Energy Supply and Demand TWG; Transportation and Land Use TWG; Agriculture, Forestry and Waste Management TWG; The Cap and Trade TWG; The Government Policy and Coordination TWG; The Adaptation TWG	Technical support: Center for Climate Strategies (CCS) Representatives from governmental agencies, academia, business leaders, foundations and members of the public
Iowa	Senate File 485 established the Iowa Climate Change Advisory Council (ICCAC).	Energy Efficiency and Conservation (EEC); Clean and Renewable Energy (CRE); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste Management (AFW); and Cross-Cutting Issues (CC)	Technical support: Center for Climate Strategies (CCS) Representatives from industries, universities and governmental agencies and members of the public
Illinois	Executive Order 2006-11 on October 5, 2006 created the Illinois Climate Change Advisory Group.	Five independent subgroups: power and energy; transportation; commercial, industrial, and agriculture (CIA); cap and trade; and modeling	Technical support: The World Resources Institute (WRI), and ICF International (ICFI)--a global energy and environmental consulting firm Representatives from local government, labor unions, public transit, academia, scientists, consumers, faith-based groups, and several industries
Kentucky	The Governor created the Kentucky Energy and Environment Cabinet (KEEC) in 2009. KEEC appointed a group of stakeholders to develop the Kentucky Climate Action Plan Council (KCAPC).	Energy Supply (ES); Residential, Commercial, and Industrial (RCI); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste (AFW); and Cross-Cutting Issues (CCI)	Technical support: Center for Climate Strategies (CCS) Stakeholders from the business, academic, government, nonprofit, and environmental sectors, as well as individual citizens

Maine	A 2003 Maine law (PL 237) required the Department of Environmental Protection (DEP) to develop and submit a CAP.	Transportation and Land Use; Buildings, Facilities, and Manufacturing; Energy and Solid Waste; Agriculture and Forestry; Education and Public Outreach	Technical support: the Muskie School of Public Service at the University of Southern Maine Stakeholders from government, industries, NGOs, and members of the public through public listening sessions
Maryland	Executive Order 01.01.2007.07 established a Climate Change Commission and tasked the Commission to develop a CAP. Greenhouse Gas Emissions Reduction Act of 2009 (SB 278/ HB 315) established a mandatory goal of reducing the state's GHG emissions.	Adaptation and Response Working Group; Education, Communications and Outreach Working Group; Mitigation Working Group; The Scientific and Technical Working Group; and Steering Committee tasked with combining and refining working group work plans	Technical support: Center for Climate Strategies (CCS); University of Maryland Center for Environmental Science and Center for Integrative Environmental Research Representatives from
Massachusetts	The Global Warming Solutions Act (GWSA) signed in 2008 required the Executive Office of Energy and Environmental Affairs (EOEEA), in consultation with other state agencies and the public, to set economy-wide GHG targets and develop a regulatory program to address Climate Change.	The Climate Protection and Green Economic Advisory Committee (consisting of representatives from various sectors such as commercial and transportation) convened a technical working group consisting of staff from EEA, the Department of Environmental Protection, DOER, the Department of Transportation and the Executive Office of Housing and Economic Development	Technical support: Northeast States for Coordinated Air Use Management (NESCAUM); the Center for Clean Air Policy; analytical work undertaken by a group by consultants led by Eastern Research Group Representatives from governmental agencies, cities and towns, businesses, industries and institutions, and of hundreds of citizens
Michigan	Executive Order 2007-42 signed in 2007 created the Michigan Climate Action Council (MCAC) to prepare a CAP with recommended GHG reduction goals and potential actions to mitigate climate Change.	Energy Supply (ES); Market Based Policies (MBP); Residential, Commercial and Industrial (RCI); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste Management (AFW); and Cross-Cutting Issues (CCI)	Technical support: Center for Climate Strategies (CCS) Representatives from public interest groups, environmental organizations, utilities, the manufacturing sector and other key industries, universities, and state, local, and tribal government.
Minnesota	Next Generation Energy Initiative signed by the Governor in 2006	Energy Supply TWG; Residential, Commercial, and Industrial TWG;	Technical support: Center for Climate Strategies (CCS); University of

	required development of a comprehensive plan to reduce Minnesota's GHGs.	Agriculture, Forestry, and Waste Management TWG; Cap-and-Trade TWG; Cross-Cutting Issues TWG; Transportation and Land Use TWG	Minnesota; Hamline University, Center for Global Environmental Education; Northern Minnesota State University 100 Minnesotans were members of Minnesota Climate Change Advisory Group and the TWGs
Missouri	--	--	Plan prepared by: John Noller, Energy Specialist Information, data and research results were provided by a number of Missouri state agencies, and faculty and professional staff of the University of Missouri-Columbia
Montana	The Governor issued a letter issued in 2005, directing the Montana Department of Environmental Quality (MDEQ) to establish a Climate Change Advisory Committee (CCAC) to evaluate state-level GHG reduction opportunities.	Agriculture, Forestry, and Waste Management TWG; Energy Supply TWG; Residential, Commercial, Institutional, and Industrial TWG; Transportation and Land Use TWG; Cross-Cutting Issues TWG	Technical support: Center for Climate Strategies (CCS); and Scientific Advisory Panel drawn from agencies and Montana universities assisted the group. Coordination and oversight: Montana Department of Environmental Quality Representatives from public and private sectors
North Carolina	The Clean Smokestack Act (CSA) signed in 2002 tasked the Department of Environment and Natural Resources' (DENR) Division of Air Quality (DAQ) to study options for reducing carbon emissions from coal-burning power plants and other sources.	Energy Supply (ES); Residential, Commercial, Industrial (RCI); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste Management (AFW); and Cross-Cutting Issues (CC)	Technical support: Center for Climate Strategies (CCS); The Appalachian State University (ASU) Energy Center 40 volunteers from business, industry, environmental groups, academia, government and the general public.
New Hampshire	Executive Order 2007-3 established the Climate Change Policy Task Force to develop GHG reduction goals and recommend specific actions.	Residential, Commercial and Industrial (RCI); Electric Generation (EGU); Transportation and Land Use (TLU); Agriculture, Forestry and Waste (AFW); Government, Leadership and Action (GLA); Adaptation (ADP)	Technical support: the University of New Hampshire through Carbon Solutions New England (CSNE) Members of the public, including the University of New Hampshire students, foundations, and individuals

			representing a wide range of interests and expertise from public and private entities
New Jersey	Executive Order 54 signed in 2007 set a reduction target in NJ. The New Jersey Global Warming Response Act (P.L. 2007, c.112) enacted on July 6, 2007 established statewide limits on GHG emissions.	No evidence found.	Technical support: Center for Climate Strategies (CCS); and Rutgers University Center for Energy, Economic & Environmental Policy (CEEEP) New Jersey Department of Environmental Protection and a number of other governmental agencies A number of public hearings held for specific rules
New Mexico	Executive Order 05-33 signed in 2005, establishes the New Mexico Climate Change Advisory Group (CCAG) to prepare a CAP.	Energy Supply (ES); Residential, Commercial, Industrial and Waste Management (RCI); Transportation and Land Use (TLU); Agriculture and Forestry (AF); and Cross-Cutting Issues (CC)	Technical support: Center for Climate Strategies (CCS); the Waste Management Education and Research Consortium (WERC)-- a consortium of New Mexico universities Stakeholders, representing a broad range of interests and expertise
Nevada	Executive order signed in 2007 created the Nevada Climate Change Advisory Committee (NCCAC) to propose recommendations for GHG emissions mitigation.	Electricity Production and Use Subcommittee, Transportation Subcommittee, and Waste/Agriculture/Other Subcommittee	Technical support: Center for Climate Strategies (CCS); University of Nevada evaluated the geologic carbon sequestration opportunities A diverse group of public agency personnel, private industry representatives, interest groups, and the public at large
New York	Executive Order 24 signed in 2009 established a goal of reducing GHG emissions and named the Climate Action Council to determine how to meet this goal.	Residential, Commercial/Institutional, and Industrial (RCI); Transportation and Land Use (TLU); Power Supply and Delivery (PSD); Agriculture, Forestry, and Waste Management (AFW); Adaptation	Technical support: Center for Climate Strategies (CCS); and a number of universities State agency heads, representatives from the Governor’s Office, three external advisory panels consisting of experts, additional public, private, and non-profit sector stakeholders

Ohio	--	--	Report prepared by: Ohio University and The Ohio State University Requested by: the Ohio Department of Development, and conducted in consultation with the Ohio Environmental Protection Agency and the Public Utilities Commission of Ohio The project team also convened an independent Advisory Committee to provide input to the process, representing sectors such as agriculture, automotive, consumers, the environmental community, labor, local government, manufacturing and utilities.
Oregon	House Bill 3543: Global Warming Actions codified GHG reduction goals, and established a Global Warming Commission to publish a CAP.	Energy Technical Committee; Transportation and Land Use Technical Committee; Industrial Technical Committee; Agriculture Technical Committee; Forestry Technical Committee; Materials Management Technical Committee	Oregon Global Warming Commission (Roadmap, 2010); The Governor's Climate Change Integration Group (2008); and Governor's Advisory Group on Global Warming (2004) Technical committees drawn from business, academia, non-governmental organizations, local government and state agency staff Broad public review of all recommendations through a public process
Pennsylvania	The Pennsylvania Climate Change Act 70 signed in 2008 requires the Department of Environmental Protection to develop an inventory and a CAP.	The five Subcommittees considered information and potential mitigation actions for the following sectors: Energy Generation, Transmission, and Distribution (EGTD); Residential and Commercial (RC); Industry and Waste (IW); Land Use and Transportation (LUT); and Agriculture and Forestry (AF)	Technical support: Center for Climate Strategies (CCS); a team of researchers within the Environment and Natural Resources Institute of the Pennsylvania State University. Pennsylvania Department of Environmental Protection (DEP), Climate Change Advisory Committee

			(CCAC) consisting of a diverse group of members. DEP encouraged Public participation
Rhode Island	Rhode Island Energy Independence and Climate Solutions Act signed in 2013 sets GHG limits and provides a framework for developing strategies to reach targets.	Buildings and Facilities; Transportation and Land; and Energy Supply and Solid Waste	Technical support: Tellus Institute Project Manager/Facilitator: Raab Associates, Ltd. The Rhode Island Greenhouse Gas Stakeholder Process involving stakeholders from business, industry, citizen groups, environmental organizations, and government agencies
South Carolina	Executive Order No. 2007-04 established the Governor's Climate, Energy, and Commerce Advisory Committee (CECAC) to develop a Climate, Energy, and Commerce Action Plan containing specific recommended actions for mitigating GHG emissions.	Energy Supply; Residential, Commercial, and Industrial; Transportation and Land Use; Agriculture, Forestry, and Waste Management; Cross-Cutting Issues	Technical support: Center for Climate Strategies (CCS) South Carolina Climate, Energy, and Commerce Committee involving governmental agencies, university professors and members of the public
Utah	The Blue Ribbon Advisory Council on Climate Change (BRAC) organized by The Governor in 2006, to provide a forum for governmental and nongovernmental stakeholders to identify proactive measures to mitigate impacts of GHGs.	Five Stakeholder Working Groups (SWG): Agriculture/Forestry; Cross-Cutting Issues; Energy Supply; Residential/Commercial/Industrial; Transportation/Land Use	Technical support: Center for Climate Strategies (CCS); Utah scientists with expertise in climate science The Blue Ribbon Advisory Council on Climate Change representing a broad range of stakeholders from state agencies, the Legislature, local government, industry, utilities, foundations and interest groups. Participation in SWG meetings was open to members of the public.
Virginia	Executive Order 59 signed in 2007 established the Governor's Commission on Climate Change. E.O.59 to create a CAP that	Adaptation and Sequestration; Built Environment; Electric Generation and Other Stationary Sources; Transportation and Land Use	Governor's Commission on Climate Change comprised of citizens of the Commonwealth, including scientists, economists, environmental advocates,

	Identifies the actions (beyond those identified in the Energy Plan) to be taken to achieve the 30% reduction goal. In 2014, Governor McAuliffe signed Executive Order convening Climate Change and Resiliency Update Commission.		and representatives from the energy, transportation, building, and manufacturing sectors, local government representatives and state lawmakers. The Commission's work was supported by professionals from governmental agencies.
Vermont	Executive Order 07-05 signed in 2005 established the Governor's Commission on Climate Change (GCCC) and specified a target of reducing Vermont's GHG emissions.	Energy Supply and Demand (ESD); Transportation and Land Use (TLU); Agriculture, Forestry and Waste (AFW); and Cross-Cutting Issues (CC)	Technical support: Center for Climate Strategies (CCS) The Governor's Commission on Climate Change and a Plenary Group (PG) representing a broad range of interests, backgrounds and capabilities to provide their diverse expertise and perspectives. The Vermont Agency of Natural Resources provided contract, logistical, and staff support to the Plenary Group.
Washington	Executive Order 07-02 Washington Climate Change Challenge signed in 2007 established goals for reducing GHG emissions. Executive Order 09-05 Washington's Leadership on Climate Change signed in 2009 requires the state to develop strategies and collaborations with other West Coast States to meet the targets and prepare for climate impacts. RCW 70.235.020 sets state GHG emissions reductions limits.	Transportation Implementation Working Group (IWG); Energy Efficiency and Green Building IWG; The State Environmental Policy Act IWG; and Beyond Waste IWG	Technical support: Center for Climate Strategies (CCS) The Climate Action Team (CAT) consisting of a broad-based group of Washington business, academic, tribal, state and local government, labor, religious, and environmental leaders.
Wisconsin	Executive Order 191 created The Global Warming Task Force in	Six Work Groups: Energy Conservation and Efficiency; Electric Generation and Supply; Transportation; Industry;	Technical support: the World Resource Institute; Winrock International;

	2007 to develop a CAP to reduce GHG emissions.	Agriculture/Forestry; Carbon Tax and Cap and Trade Five ad hoc Work Groups: Sustainable communities and behavioral change marketing; Low-income concerns; Co-generation; Waste materials recovery and disposal; Water conservation	Technical Advisory Group (TAG) to work with staff from the Department of Natural Resources (DNR), the Public Service Commission of Wisconsin (PSC) and other state agencies, as well as the consultants retained by the Task Force. A Task Force consisting of a diverse members representing a cross-section of Wisconsin's economy and its communities. Members of the public commented on the Task Force's work.

Cross-state Learning & Collaboration: There is substantial evidence of states learning from other CAPs and their specific policy measures and strategies. First and foremost, in setting their GHG emissions targets, states take into consideration targets set by other jurisdictions. For example, Virginia's CAP includes a table that compares and contrasts the reduction goal set by Virginia Governor Executive Order 59 (2007)--that sets a target of reducing emissions by 30% below business-as-usual projection of emissions by 2025—to targets set by other states, regional initiatives, national EPA testimony, and IPCC requirements.

Several states have also joined together to form a regional or multi-state climate action initiative (some involving Canadian provinces), and have agreed to commit to a regional emissions target and/or a set of rules to mitigate GHG emissions and boost investment in clean energy, energy efficiency, and sustainable infrastructure (Center for Climate and Energy Solutions). The most notable of such efforts are:

- *Regional Greenhouse Gas Initiative (RGGI):* Created in 2005 and currently composed of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont, RGGI is the first U.S. cap-and-trade program to mitigate GHGs from power plants across the region. The initiative is administered by RGGI, Inc., but enforcement authority is with the states. New Jersey was also among the states that had initially agreed to implement this first mandatory cap-and-trade program, but the state officially exited the program in 2012. The 2013 RGGI monitoring report shows that in 2011-2013, the annual average carbon dioxide emissions from electric generation sources within the RGGI states had dropped 32.5 percent, relative to the base period of 2006-2008. A 2015 study demonstrates that the initiative has led to net economic benefits of $1.3 billion to its participant jurisdictions throughout the second compliance period (i.e. 2012-2014).[8]

- *Western Climate Initiative (WCI):* Originally formed as a collaborative between several jurisdictions exploring sub-national climate action options and implementation mechanisms, WCI, Inc. is currently a non-profit organization providing administrative and technical assistance to state and provincial GHG emissions trading programs. Its current participants are: California, and the Canadian Provinces of British Columbia, Ontario, and Quebec. WCI was established in 2007 through a joint agreement between the governors of the States of Arizona, California, New Mexico, Oregon, and Washington. Utah, Montana and the Canadian Provinces of British Columbia, Manitoba, Ontario, and Quebec joined later, and were followed by 14 observer jurisdictions, including U.S. States of Alaska, Colorado, Idaho, Kansas, Nevada, and Wyoming. The initiative was built upon the individual efforts of participant jurisdictions, along with two regional initiatives: the Southwest Climate Change Initiative of 2006, involving Arizona and New Mexico, as well as the West Coast Governors' Global Warming Initiative, involving California, Oregon, and Washington. WCI partners agreed to collectively set a regional emissions target and establish a market-based implementation mechanism (e.g. cap-and-trade) to achieve this target. This is reflected in the CAPs of participating states.
- *Midwest Greenhouse Gas Reduction Accord (MGGRA):* A commitment launched in 2007 by the governors of six Midwestern States of Illinois, Iowa, Kansas, Michigan, Minnesota, and Wisconsin, and the premier of Canadian Manitoba Province, MGGRA's goal was to reduce GHG emissions through a regional cap-and-trade program coupled with other complementary measures. MGGRA participants agreed to set a regional target

consistent with state targets. Later, Ohio, South Dakota and Ontario also joined as observers. After the release of the Final Model Rule in 2010--which included a detailed cap-and-trade program to achieve the two targets of 20 percent below 2005 levels by 2020, and 80 percent below 2005 levels by 2050—MGGRA members stopped pursuing their GHG emissions reduction goals through the accord. Yet, the baseline of 2005 (as opposed to the common baseline of 1990) is reflected in participating state CAPs.

- *Pacific Coast Collaborative (PCC):* PCC is a cooperative agreement established in 2008 between the leaders of Alaska, British Columbia, California, Oregon, and Washington fostering clean energy innovation and low-carbon development to confront the economic risks of climate change on the region. The most notable efforts through the collaborative include the creation of West Coast Infrastructure Exchange in 2012 to support sustainable infrastructure investments; and the Pacific Coast Action Plan on Climate and Energy, which is an effort to align climate policies and market-based implementation measures of member jurisdictions.

- *Transportation and Climate Initiative (TCI):* Launched in 2010, TCI is a collaboration between eleven Mid-Atlantic and Northeast states and the District of Columbia to reduce transportation emissions and develop a clean energy economy. TCI has involved similar planning procedures to state level CAPs: it is directed by the Transportation, Energy, and Environment Staff Working Group, and the Georgetown Climate Center [9] (a nonpartisan Center based at Georgetown Law) has provided facilitation and technical support. Two most distinguished efforts happened through TCI are: an agreement reached at 2011 to cooperatively support sustainable infrastructure and combine smart growth land use planning with sustainable development concepts; and the creation of Northeast Electric Vehicle Network to bring together companies, organizations, and jurisdictions within the region to foster deployment of electric vehicles.

Cross-state learning and collaboration, however, is not limited to target setting or multi-state regional initiatives only. There is evidence in state level CAPs that leading states have provided a pallet of policy options and specific strategies for others to consider, follow or learn from. California's Low Emissions Vehicle Program--which contains three main components of vehicle emissions standards, fleet-wide emissions requirements and Zero Emissions Vehicle (ZEV) sales requirement--is a good example of cross-state learning with a number of states either adopting or considering adoption of the same or similar standards. California was the first state in the nation to adopt regulation to reduce GHG emissions from cars in 2004. The U.S. EPA granted California a Clean Air Act waiver allowing the state to set its own (stricter) emissions standards for motor vehicles. There is evidence that at least twelve other states (Connecticut, Maine, Maryland, Massachusetts, New Jersey, New York, Oregon, Pennsylvania, Rhode Island, Vermont, Arizona, and Washington) followed California's example by requesting a waiver from the U.S. EPA to adopt stricter vehicle GHG emissions standards. Other state CAPs, such as Nevada and New Mexico, recommended that state agencies closely monitor California's vehicle GHG emissions regulations implementation (including any litigation) and consider adopting same or similar standards. Other examples also exist and they range widely from appliance standards and building codes to a variety of pilot programs. For example, it is stated in New Mexico's CAP that State Appliance Standards “policy option involves the replication of standards first adopted in nearby states for appliances not covered by federal standards” (p. 4-9).

Co-benefits: As a part of justifying state level action on climate change, virtually all states have identified several co-benefits or positive externalities of developing and implementing a CAP. Some have conducted a detailed analysis of these externalities including quantification of benefits. The discussion of co-benefits in state CAPs has taken four major forms, although these are not mutually exclusive. First, co-benefits have been included as criteria for the selection or prioritization of alternative measures in the planning procedures and during the stakeholder voting process. Second, co-benefits have been included as a part of policy description for each selected measure (see Kentucky’s CAP, for example). Third, co-benefits have been included in state CAPs to provide some context and more importantly link climate change to tangible issues and impacts within the state (e.g. local economy, public health, etc.). Fourth, discussion of co-benefits has appeared in monitoring and evaluation documents.

Creating or supporting jobs and especially green jobs is the most common co-benefit discussed by almost all of the state level CAPs. Massachusetts’s Clean Energy and Climate Plan for 2020 (2010), for example, estimates that as a result of implementation of the recommended policies, a total of 42,000 to 48,000 jobs will be created within the state (p. ES-2). By the same token, Pennsylvania expects the recommendations of the CAP to result in “the net creation of 65,000 new full-time jobs and add more than $6 billion to the Commonwealth’s gross state product in 2020” (Pennsylvania Final Climate Change Action Plan, 2008, p. ExS-2). In California, implementation of emissions mitigation strategies by 2020 is expected to increase jobs and income by additional 83,000 and $4 billion respectively above and beyond the substantial growth that will occur.[10] However, evidence provided by monitoring documents of CAPs suggest that such co-benefits can be expected from implementation. For example, data provided by Massachusetts Clean Industry Report 2013 shows that the Commonwealth's clean energy industry has added more than 15,500 jobs (i.e. a 24% growth) between 2011 and 2013, in spite of the tough economic environment. The information about clean energy jobs created—that are likely attributable to the implementation of the CAP--is provided on the monitoring webpage of Massachusetts' Global Warming Solutions Act.

Other co-benefits commonly identified by the CAPs are: energy savings, energy independence/security and portfolio diversification; public health; other environmental benefits such as improved wildlife habitat, healthier forests, cleaner air and water; facilitation of other state plans and programs (e.g. energy plans; bay restoration plans, etc.); and avoiding or reducing the significant costs of responding to a changing climate to the infrastructure, economy, and the health of citizens. Again, some CAPs have quantified these benefits. For instance, Florida's Energy and Climate Change Action Plan (2008) expects "a total fuel savings of 53.5 billion gallons of petroleum, 200.2 million short tons of coal, and 6.394 billion cubic feet of natural gas during the period of 2009 through 2025" that leads to energy security (p. 2).

Additionally, contributing to social justice has also been identified as a CAP implementation co-benefit, although it is not as commonly discussed as economic or environmental co-benefits. There are a number of ways climate change, and by extension CAP implementation, are related to social justice. For example, investing in alternative transportation infrastructure, such as bicycle lanes and light rail transit, is a common CAP measure that contributes to equitable access to jobs, services and amenities for individuals who do not drive. Brownfield redevelopment (often recommended as a part of smart growth strategies) is another common CAP measure that can alleviate disproportionate environmental pollution burden faced by economically or socially distressed communities. Another way that CAP co-benefits are linked to social justice is related to the increased vulnerability of marginalized populations to climate change impacts—due to greater exposure to these impacts and/or lack of adaptive resources to cope with them. For instance, New Jersey's CAP emphasizes that some urban populations are more vulnerable to heat wave stress. Through CAP implementation, states can contribute to mitigation of a major cause of these impacts (i.e. climate change) and build the adaptive capacity of local communities across the state.

Using an advanced modeling tool developed under the direction of the U.S. Environmental Protection Agency, Connecticut was able to identify benefits previously not quantified, such as reduced health costs and public health benefits. For instance, the state's energy efficiency program, overseen by the Energy Conservation Management Board, was found to achieve a $3 to $1 direct return on investment based on electricity savings. By utilizing the new EPA tool, an additional $4 to $1 payback in terms of reduced healthcare costs and public health benefits was identified due to reductions in air pollutants.

Limitations and Opportunities for Improving CAPs

Near-term targets are low and CAPs rely on major technological innovations to achieve long-term targets: Regardless of the differences in CAP targets across the nation, near-term targets are low compared to long-term targets, and especially the most rigorous CAPs rely on major technological innovations to reach their long-term targets. It is very typical of CAPs to set a rather achievable target to be reached by say, 2020. This is not intrinsically problematic, provided that we understand that simply continuing the trend of emissions reductions will not get us close to meeting the long-term targets. In other words, after meeting the near-term target, we need measures that sharply reduce emissions. By setting a near-term target, many CAPs have analyzed feasibility of their policy options. Yet, when it comes to the ultimate target, tools, techniques and mechanisms to reduce emissions dramatically to meet the long-term targets are unknown. To some degree, this is inevitable. Due to their long time span (i.e. more than forty years from the development of the plan), CAPs deal with numerous uncertainties. However, major lifestyle changes and technological innovations are needed to reach long-term targets that meet the scientific requirements.

Designing a path that links CAP measures and long-term ambitious targets is a crucial aspect of climate planning. The states that carefully monitor and evaluate their progress towards their targets have recently started to plan for emissions reduction beyond 2020. One approach that is common among these states is setting an interim target (e.g. 2030) that guides emissions reduction actions towards the 2050 goal. Massachusetts Clean Energy and Climate Plan for 2020 (updated in 2015), for example, begins to look more closely to longer term targets, includes scenario analyses for 2030 and 2050 emissions, and examines viable paths to deep reductions needed to meet the state's ambitious long-term target.

However, while setting an interim target can be helpful, it will not, in and of itself, solve the question of how we can achieve deep reductions that are sufficient for meeting the long-term targets set by state level CAPs. This question has interested a number of scholars. In 2004, Pacala and Socolow proposed “the stabilization triangle” concept—the area between the flat trajectory of emissions and business-as-usual (BAU) ramp--and a method involving global scale “wedges” of equivalent emissions reductions with current technologies. The authors concluded that with their proposed method and the use of current technologies, one-third of BAU emissions can be cut in 50 years. Subsequent studies provided more detailed analyses (Martinot et al., 2007; Olabisi et al., 2009). Yet, Williams et al.’s (2012) analysis was the first attempt that I know of to develop a realistic technology and policy roadmap to meet the ambitious long-term goal set by several U.S. States (i.e. reducing emissions to 80% below 1990 levels by 2050). The authors used the case of California, and developed detailed models of infrastructure stocks, resource constraints, and electricity system operability to illustrate the case. Williams et al. (2012) found that technically feasible energy efficiency measures coupled with decarbonized energy supply are not sufficient to meet California’s long-term goal. Meeting these ambitious long-term targets, according to Williams et al. (2012), will demand cutting-edge technologies not yet commercialized, along with coordination of investment, innovative technology improvements, and transformative infrastructure deployment that would enable widespread electrification of transportation.

Therefore, state level CAPs should only be one piece of a larger transformation mechanism that fosters innovative technologies and policy entrepreneurship. In this regard, my analysis of state CAPs shows that the importance of R&D (to encourage development of such technologies) as well as development of innovative policy measures are stressed in CAP documents. In fact, R&D is one of the common implementation mechanisms of most CAPs. Nevertheless, whether or not sufficient funding would be allocated for these R&D activities or the implementation of a transformative infrastructure is part of a larger federal and state funding allocation scheme.

Implementation Provisions

CAPs typically lack dedicated or sufficient funding sources for implementation: As mentioned earlier, most CAPs include a relatively detailed cost analysis using techniques such as NPV and cost-effectiveness calculations. Whereas many selected policy options are claimed to be cost-effective and a worthwhile investment, initial costs may still hinder implementation. This is more than serious in economic downturns, when CAP implementation competes with other pressing issues. Therefore, identification of funding sources and analysis of potential funding problems early on in the CAP development process is rather important.

Evidence from this study suggests that although funding options have been discussed one way or another in most CAPs, many lack dedicated or sufficient funding sources. Some CAPs mention identification of funding sources for implementation a challenge, whereas others leave this step (i.e. funding identification) to be dealt with at a later time. For example, one of the policy measures in Utah's CAP is to "explore funding options for the suite of transportation and land use options" (TL 14; p. VIII – 1). This means that for a whole set of transportation and land use measures (e.g. develop and implement aggressive mass transit strategy) current funding sources are not identified. In the description of this policy measure (i.e. TL 14), no further details are provided other than "resolving funding issues [related to transportation and land use measures] will require a sustained and concerted effort by political leaders and stakeholders" (p. VIII – 14).

Exceptions do exist. California's AB 32 (i.e. the California Global Warming Solutions Act of 2006), for example, is funded through a number of mechanisms that are discussed in detail in the Scoping Plan (updated every five years). A fee is collected from large sources of GHGs in the state annually that is used for covering annual expenses for State agencies to implement AB 32. Aside from regulatory and market-based programs aimed at reducing GHG emissions, investments from various sources provide incentives for industries to reduce emissions. The Greenhouse Gas Reduction Fund (GGRF)—which comes from auction proceeds as a part of ARB's cap-and-trade program—is set to be used for a wide range of projects that can result in long-term reductions in GHG emissions. ARB's Investment Plan evaluates GHG reduction alternatives and prioritizes promising investments that bring about co-benefits in addition to emission reductions.

Dealing with uncertainties is a challenge and scenario analysis is rare: Findings from this study show that CAPs, in general, have not accounted for uncertainties through sophisticated methods, such as scenario development. Scenario development comes from systems science. It is a method facilitating recognition and exploration of uncertainty and complexity in the decision-making process, as opposed to limiting or simplifying the context into a single forecast (Van Der Sluijs, 2005; and Vervoort et al., 2014). In the context of the United States, with public confusion about the reality of climate change coupled with lack of steady and sufficient federal level support, decision-makers involved in CAP processes have often chosen to simplify rather than further complicate the situation. This is understandable, especially because most of the current generation of CAPs have been developed years ago and/or with limited resources. Future CAPs or CAP updates, however, would benefit greatly from improved decision pathways that take uncertainties into account.

Most CAPs have either ignored uncertainties altogether or have identified it as a challenge. More research and better data are required to develop sophisticated scenario analyses to enhance decision-making. Evidence from the content analysis of state level CAPs shows that accounting for uncertainty in business-as-usual (BAU) emissions, policy designs and/or impacts of individual policies is rare. Although, exceptions exist. For instance, Massachusetts' plan has considered three levels of BAU emissions (i.e. high; middle; low) and three levels of policy impacts. When it comes to uncertainties as they relate to climate change impacts, scenario development is again uncommon. For us to calculate a more accurate cost-benefit analysis of CAP implementation, we need to draw a better picture of climate change impacts and risks. States have struggled to link implementation benefits to climate change risks in their CAPs. An example of a statement about the challenge of dealing with uncertainties in long-time climate planning is provided in New York's Climate Action Council Interim Report (2010):

> "Development of a Climate Action Plan for New York is a unique challenge in policy planning. Forty year planning, necessary to meet the 80 by 50 goal, is an unusually long time horizon, and the uncertainty associated with key variables—e.g. future prices of conventional and alternative fuels and technologies—complicates the analysis of policy options to a greater extent than is typical. This complication extends to the analysis of the cost of these policies and the cost of not taking action on climate change. Both are very difficult to estimate." (p. 1-5).

Cost-benefit analyses conducted for state level CAPs did not typically take into account costs avoided due to alleviated climate change risks. Stakeholders involved in state CAP processes have often considered co-benefits of specific measures, but these co-benefits are not quantified in most cases as discussed earlier. One example of an effort to integrate the avoided costs is Connecticut's CAP that estimate avoided health costs due to reductions in criteria air pollutants benefits. However, the cost of adapting to climate change impacts (assuming that adaptation is possible) is much higher than health costs alone in monetary terms only and notwithstanding potential devastating community and intergenerational costs. Current research is aiming at drawing a more complete picture of potential climate change costs. Ackerman and Stanton (2007), for example, analyzed hurricane damage, real estate losses, energy costs, and water costs among other potential climate change impacts and concluded that (under business-as-usual climate forecasts) these four types of impacts alone can cost 1.8% of U.S. GDP, or nearly $1.9 trillion per annum (in 2006 dollars) by 2100.

Projection of local impacts may involve a greater degree of uncertainty. Nevertheless, states that have developed an adaptation plan, as a part of their climate action planning efforts, have started to look more closely into these impacts. For example, New York's The Community Risk and Resiliency Act (CRRA) proposed sea level rise projections that are based on detailed analyses conducted by Horton et al. (2014). This report, also known as the ClimAID report, is prepared for the New York State Energy Research and Development Authority, and its projections are based on the outputs of over 20 global climate models, downscaled to New York. Integrating the costs associated with these projected impacts into CAP financial analyses can provide justification for actions that are not otherwise advisable. In other words, access to sophisticated analyses of climate change risks can impact decision making.

Implementation mechanisms are weak: Most CAPs lack regulatory teeth, and by extension, a direct way to enforce implementation. Even the CAPs in the rigorous implementation group, do not necessarily have a comprehensive program to reduce GHG emissions from all sources throughout the state. Additionally, carbon pricing mechanisms (i.e. carbon tax and/or cap and trade) are relatively uncommon. Carbon pricing is deemed as a necessary and effective policy step to address climate change in the United States (Metcalf, 2008; and Nordhaus, 2007). However, many CAPs rely merely on programmatic incentives or voluntary mechanisms to achieve their goals. These programmatic smaller scale interventions are likely insufficient to meet the deep reduction targets set for 2050. Achieving ambitious 2050 targets is inherently complicated, involving many factors, such as personal lifestyle choices and preferences. While it is unlikely that an individual "silver bullet" implementation mechanism exists to meet these ambitious long-term goals, an approach that combines a wide and diversified range of strategies is more likely to yield success (Yang et al., 2009). Yet, many states have opted out of carbon pricing options, choosing a shorter list of implementation mechanisms instead.

Several states are closely observing the progress of California's AB 32, its economic impact and legal consequences before considering a more stringent implementation strategy. Others are observing strategies employed by their neighboring jurisdictions. For example, Maine Climate Action Plan (2004) indicates that stakeholders strongly support the idea "to 'wait and see' how [California GHG tailpipe standards for passenger vehicle] standards are defined and the outcome of the likely lawsuit in CA" or an alternative of "a 'trigger' mechanism where Maine would adopt the standards after a certain number of other states in the northeast region did" (p. 40). However, the "wait and see" approach ignores the cost of not taking action. Human and economic costs of adaptation could become very large, if mitigation is further delayed (Stern, 2006).

Emission reductions from the Transportation and Land Use (TLU) sector are low compared to the sector's contribution to total emissions: Close to thirty percent of total GHG emissions in the United States come from the transportation sector (Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2013, EPA). In some states, transportation accounts for a larger chunk of total emissions. In Connecticut, for example, transportation is about 40% of total emissions, and in Florida it involves 36% of total emissions. This means that transportation emissions are about one third of the problem. However, expected emissions reductions from Transportation and Land Use (TLU) measures are low compared to the sector's contribution to total emissions. This means that emissions reductions expected from TLU measures are not about one third of total emissions reductions expected from implementation of all CAP measures.

Transportation and Land Use (TLU) measures can range widely from State Clean Car Programs (also known as the "Pavley" standards or California GHG Emission Standards) to land use planning measures that are related to Vehicle Miles Traveled (VMT), such as infill-brownfield redevelopment, transit-oriented development and other smart growth planning tools and techniques. Typically, greatest reductions are expected from the Energy Supply (ES) sector. In some cases greatest GHG emission reductions are expected from the Energy Demand (ED) sector, commonly known as Residential, Commercial and Industrial (RCI) buildings measures. Electricity generation and consumption are indeed the biggest source of emissions in the United States and have received commensurate attention in state level CAPs. Yet, the same is not true about transportation emissions. CAPs have relied on strategies focusing on other sectors, including energy and agriculture and forestry, to make up for low emissions reduction from TLU. On the one hand, this is because transportation emissions are difficult to reduce without major technological innovations and lifestyle changes. On the other hand, this limitation means that transportation policy represents a large opportunity for future emissions reductions—particularly through its integration with local smart growth policies that limit sprawl while providing social, environmental and economic benefits. This is a topic that has interested urban scholars (see, for example, Brown & Southworth, 2008; Hamin & Gurran, 2009; Ruth, 2006, among others) and practitioners, but future research can focus on developing innovative approaches to score higher emissions reductions from TLU measures.

Phase 2 Findings

This section focuses on findings from the second phase of my dissertation: Analyzing the relationship between state level CAPs and change in energy-related carbon dioxide emissions from all sectors (i.e. dependent variable). Sectors that contribute to energy-related carbon dioxide emissions include commercial, industrial, residential, transportation and electric power. Based on findings from the first phase, I examined the relationship between six types of CAPs and change in energy-related carbon dioxide emissions controlling for other economic, climatic, geographic and political variables.[11].

Table 8 provides descriptive statistics for the independent variables. Appendix VII includes plots illustrating change in per capita CO_2 energy emissions from 1990 to

2013 marking the year the CAP was first adopted. In addition to the CAPs, I was also interested in the potential relationship between urban compactness (as opposed to urban sprawl) and change in energy-related carbon dioxide emissions from the transportation sector for the reasons discussed below.

Table 8. Descriptive statistics for independent variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Cooling degree days (CDDs)	1071.74	804.68	42.00	3827.00
Heating degree days (HDDs)	5243.83	2085.25	430.00	10810.00
Change in % GDP from carbon-intensive manufacturing	0.00	0.01	-0.05	0.07
Change in % GDP from carbon-intensive non-manufacturing	0.00	0.01	-0.08	0.05
Change in regional energy prices	6.23	15.43	-45.84	34.31
Democratic presidential vote %	0.46	0.09	0.25	0.68
Compactness	95.07	11.24	64.29	129.03
Change in per capita personal income	1081.94	953.06	-5781.00	7527.00
Change in average unemployment	0.05	0.99	-2.54	5.51
Change in interstate energy trade	1008.41	3928213.00	-25200000.00	26600000.00

In my first model, I controlled for the effect of urban compactness. One limitation of controlling for urban compactness is that it can actually be an impact of the CAP. As discussed earlier, in their set of Transportation and Land Use (TLU) measures CAPs commonly include measures encouraging urban compactness, for example, through transit-oriented development, brownfield or infill development, and measures to encourage housing location-efficiency (i.e. housing that is closer to jobs, services and amenities). Findings of the first phase showed that emissions reductions expected from

TLU were modest compared to the contribution of the sector to total emissions. Therefore, it is interesting to also analyze the relationship between urban compactness and change in emissions. Additionally, the relationship between urban form and emissions has attracted a lot of scholarly interest (see for example, Ewing, Bartholomew, Winkelman, Walters, & Chen, 2008, pp. 107–111; Ewing & Rong, 2008; Glaeser & Kahn, 2008; and Randolph, 2008, among others). In the following pages, I first discuss findings of the first model (CAPs and emissions change) and then focus on a second model that analyzes the relationship between urban compactness and emissions change.

Climate Action Plans and Change in Energy-related Carbon Dioxide Emissions

My goal with this model was to explain variations in emissions with CAP types as well as a set of control variables. Before I discuss the findings, I would like to revisit my conceptual model to help explain the relationships between the independent variables and change in CO_2 emissions. As illustrated in figure 7 and explained in the methods section, CAPs along with a number of other variables can play a role in CO_2 emissions reduction. Presumably, social, political and climatic context variables can also impact development and implementation of the CAP, in addition to their potential impact on carbon emissions. These dynamics, while interesting, are not a part of the research questions investigated in this study.

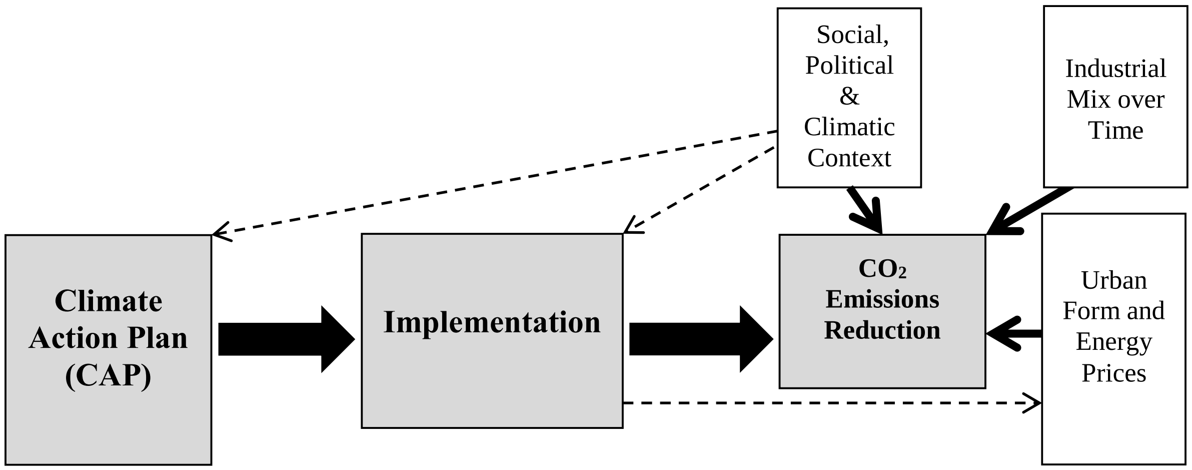

Figure 7. Conceptual model

The *direct* way that CAPs can result in carbon emissions reduction is through implementation of CAP policies and measures. I collected information about implementation of state level CAPs in the first phase. CAP types include information about implementation. For example, I found evidence of rigorous implementation (explained in phase 1) for type 6 CAPs. However, implementation is only one way that CAPs can impact carbon emissions. There are a number of *indirect* ways that CAPs can lead to reductions in carbon emissions. Perhaps the most important of these indirect mechanisms is the planning process. Altschuler argued that "planning is more important than any plan" (quoted in Baer, 1997, p. 336; and in Drummond, 2010, p. 416). The planning process, especially when various interest groups and the public are actively involved, can yield outcomes. Innes and Booher (1999) argued that a good consensus building process can have outcomes beyond the immediate and/or identifiable results at the end of the project. These outcomes, according to Innes and Booher (1999), can appear after the completion of the plan development process or outside its boundaries in the form of new collaborations, new discourses, learning that extends into the community, and so forth. In the case of state level CAPs, this means that the planning process can indirectly yield outcomes outside the boundaries of the plan in the form of other relevant policies or programs that reduce carbon emissions. Indeed, analyzing these indirect mechanisms is beyond the scope of this study. Yet, acknowledging the possibility of these indirect effects can help us understand why a CAP may result in carbon emissions reductions even the implementation has quickly faded away after the plan development process, or there is no evidence of direct implementation whatsoever.

Table 9 shows the results of the first regression model. Total number of observations are 1,104, and the number of groups, which is the number states included in the model, is 48. The overall R^2 is a reasonable .25, meaning that the model explains a quarter of the variations in state level energy related carbon emissions. For information about model residuals and output from Stata, refer to Appendices VIII-IX.

Table 9. Regression model predicting effects of state climate action plans on per capita CO_2 energy emissions

Variables	**Coefficient**
Climate Action Plans	
Type 1. No target; No or limited implementation	-2.738705**
Type 2. Short-term target; No or limited implementation	-1.160499**
Type 3. Ambitious target; No or limited implementation	-0.8332563*
Type 4. Short-term target; Some implementation	-2.36251**
Type 5. Ambitious target; Some implementation	-1.546992**
Type 6. Ambitious target; Rigorous implementation	-1.096547**
Cooling degree days (CDDs)	-0.0004712
Heating degree days (HDDs)	0.0001331
Change in % GDP from carbon-intensive manufacturing	-4.979222
Change in % GDP from carbon-intensive non-manufacturing	12.54649*
Change in regional energy prices	0.010386
Democratic presidential vote %	1.108312
Compactness	-0.0602424**
Change in per capita personal income	0.0002443*
Change in average unemployment	0.1368203^{ø}
Change in interstate energy trade	0.000000043**
Region	
West	-2.791596**
South	-0.8061115
Northeast	-0.6447329
Midwest	0
Constant	5.765357

Number of observations=1,104 Overall R^2=0.25
**P<0.01 *P<0.05 ^{ø}P<0.10

All CAP types are statistically significant at the 0.01 level (p<.01) except for Type 3 CAPs (long-term ambitious target, and no or limited evidence of implementation), which is significant at the 0.05 (p<.05) level. Coefficients are negative for all CAP types indicating that, in the years since 1990, all state level CAPs reduced emissions compared to the states without CAPs, holding all other variables constant. CAP coefficients for all groups range from -0.83 to -2.74. This means that, in the years since 1990, on average states with a CAP reduced per capita emissions by about 1.79 metric tons, when compared to the states without CAPs and controlling for other economic, climatic, geographic and political variables.

Ironically, what this model shows is that CAPs, regardless of their targets and implementation, result in carbon emissions reduction. Nevertheless, the model does not reveal mechanisms through which these CAPs work. In other words, the model does not show how exactly CAPs with no or limited evidence of implementation lead to carbon reductions. Although causal mechanisms between types 1, 2 and 3 CAPs (with no or limited evidence of implementation) and emissions reductions are uncertain and unknown, there are a number of possible explanations. One explanation for the statistical significance of the relationship between all types of CAPs, including the ones with no sign of implementation (i.e. types 1, 2 and 3), is the possibility of indirect effects of the planning process on carbon emissions reduction. State level climate action planning is typically a complex process involving numerous stakeholders. It is likely that these CAPs have resulted in other environmental policy measures or programs with similar carbon reduction benefits. Considering that most state CAPs have benefitted from fairly extensive consensus-building processes, as discussed in the first phase, the possibility of indirect effects should not be disregarded.

One surprise is that type 6 and 5 CAPs, which have an ambitious long-term target and stronger evidence of implementation, have a slightly smaller coefficient than the type 1 CAPs with no specified emissions target and no or limited evidence of implementation. One possible explanation is that the states with a types 6 or 5 CAP had already achieved lower carbon emissions through other environmental policy measures with emissions reduction benefits, making it difficult to reduce emissions after the adoption of the CAP.

Another possible explanation is related to a general critique of state level CAPs: low short-term targets. Because of these low 2015 or 2020 targets, it is possible that implementation of the CAPs have not yet resulted in reductions significant enough to reveal potential strengths of types 6 and 5 CAPs. The effects may appear later, if these states continue to rigorously implement the ambitious long-term goals set by the CAPs. Ultimately, the reason behind these findings may simply be a lag between implementation of measures and appearance of results. Since the latest year included in this study is 2013, it is possible that the major effects of the implementation of these CAPs have not yet appeared.

Interestingly, type 4 CAPs, with a short-term target and some evidence of implementation, have the second largest coefficient (after type 1 CAPs). This suggests that CAPs with a short-term target may also be successful in reducing emissions—at least in the short run. Again, the possible advantage of having an ambitious long-term target may not be apparent yet—especially because CAPs with a stringent long-term target still have a weak near-term target.

Among other variables of interest, compactness is also statistically significant at the 0.01 level ($p<.01$). Its negative coefficient is indicative of an inverse relationship between compactness and emissions, or a positive relationship between sprawl and emissions. As explained in the methods section, the sprawl measure used in this model is a composite measure involving many variables combined into four major factors: 1) development density; 2) land use mix; 3) activity centering; and 4) street acceability (Ewing & Hamidi, 2014).[12] This means that the development decisions of communities can have measurable impacts on emissions. The most relevant type of emissions related to urban compactness (or sprawl) is transportation sector emissions. This is because sprawled areas are associated with higher levels of vehicle ownership and vehicle miles traveled (VMTs) per capita and traffic delay per capita (Ewing, Pendall, & Chen, 2003). Therefore, the second model focuses on the relationship between per capita transportation emissions and compactness.

From the set of economic variables, year-to-year changes in per capita personal income and energy interstate trade are statistically significant at the 0.01 level ($p<0.01$). The positive coefficient of these two variables indicates that increases in per capita personal income and energy interstate trade are associated with greater energy related emissions. Because per capita personal income is a measure of personal wealth, this means that, when all other variables are held constant, increase in personal wealth results in greater contribution to emissions through increased consumption of energy. Energy interstate trade is a measure of interstate electricity exports and imports. For net exporters of electricity, this variable is positive; and for net importers, it is negative. In the process of electric power generation, producers of electricity emit carbon dioxide. Not controlling for electricity interstate trades in this model would be unfair to states that export large amounts of their generated electricity.

Two other economic variables, percent GDP from carbon-intensive manufacturing and non-manufacturing, are measures of dependency of a state's economy on industries that emit large quantities of GHGs per unit of goods or services produced. The first of the two, percent GDP from carbon-intensive manufacturing is not statistically significant in explaining variation in per capita carbon emissions. However, the second variable--percent GDP from carbon-intensive manufacturing--is statistically significant at the 0.05 level ($p<0.05$), and its coefficient is 12.55. Thus, a 1% increase in GDP from carbon-intensive manufacturing leads to an increase of 12.55 metric tons of carbon emissions per capita. This means that the higher the dependence of a state's economy on the three carbon-intensive nonmanufacturing industries--construction, mining, and agriculture—the greater their energy-related carbon emissions would be, when all other variables are controlled for. From a policy perspective, this could also represent an opportunity for significant emissions reduction, for example, through encouraging the use of efficiency measures in these industries.

The remainder of economic variables--namely changes in average regional energy prices, and average unemployment--are not significant at the 0.05 level. The two climatic variables--heating degree days and cooling degree days--as measures of need for energy consumption to air condition buildings are not statistically significant either. Among regions, being geographically located in the West Region is negatively correlated with changes in per capita carbon emissions ($p<0.01$). Lastly, percent democratic vote in the nearest presidential elections is not statistically significant in the model.

Compactness and Change in Transportation Carbon Dioxide Emissions

My goal with this second model was to explain variations in transportation emissions with compactness as well as a set of control variables. Transportation is currently the second largest source of greenhouse gas emissions in the United States after the electric power sector. The transportation sector emissions result from the combustion of petroleum-based products, such as gasoline, in order to move people and goods by cars, trucks, trains, ships, airplanes, and other vehicles. According to U.S. EPA, the majority (i.e. 96%) of greenhouse gas emissions from the transportation sector are CO_2 emissions.[13] More than 60% of transportation sector emissions come from passenger cars and light-duty trucks, such as pickup trucks, sport utility vehicles, and minivans (U.S. EPA Website, updated on June 8th, 2016). A typical passenger vehicle in U.S., with a fuel economy of approximately 21.6 miles per gallon driving about 11,400 miles annually, emits about 4.7 metric tons of carbon dioxide per year, according to EPA. Changes in income, unemployment and energy prices as well as the two climatic variables also used in the first model (CDDS and HDDs) may have an impact on transportation emissions because they may influence Vehicle Miles Traveled (VMTs). Therefore, I have controlled for these variables in my model. I have added a “Region” nominal variable for the reason explained in the methods section.

Table 10 shows the results of the second regression model.[14] The overall R^2 is 0.36, indicating that the model explains more than one third of the variations in state level transportation carbon emissions. For information about model residuals and output from Stata, refer to Appendix X.

Table 10: Regression model predicting effects of compactness on per capita transportation CO2 emissions

Variables	**Coefficient**
Compactness	-0.0176663**
Change in per capita personal income	0.0000639**
Change in average unemployment	-0.1502725**
Change in regional energy prices	-0.0004639
Cooling degree days (CDDs)	-0.0001226
Heating degree days (HDDs)	0.0000712ø
Region	
West	-0.4099271ø
South	0.0878208
Northeast	-0.0657239
Midwest	0
Constant	1.435372

Number of observations=1,104   Overall R^2=0.36

**P<0.01   *P<0.05   øP<0.10

Compactness is statistically significant at the 0.01 level (p<0.01). Its negative coefficient shows an inverse relationship between compactness and change in per capita state level transportation carbon dioxide emissions. This reinforces the findings from the first model that compactness can result in emissions reductions after controlling for changes in other key variables, such as energy prices, per capita income and average unemployment.

Change in per capita income and average unemployment are also statistically significant at the 0.01 level (p<0.01). As expected, an increase in per capita income is associated with an increase in per capita transportation emissions; whereas an in increase in average unemployment is linked to a decrease in per capita transportation emissions. Because change in average unemployment was not significant in the first model, these findings suggest that unemployment is related to reduced VMTs, and by extension transportation emissions, but does not necessarily reduce non-transportation energy consumption.

From the set of climatic variables, heating degree days is statistically significant at the 0.10 level ($p<0.10$), but cooling degree days is not significant. These two measures are derived from measurements of outside air temperature. The main justification for including these variables is that temperatures lower or higher than human comfort levels may influence transportation mode choice. A recent study by Saneinejad, Roorda, and Kennedy (2012) explored the relationship between weather and home-based work trips within the City of Toronto, focusing on active modes of transportation (i.e. cycling and walking). The results of this study showed that weather has a significant impact on the choice of active modes of transportation: cold weather is negatively related to walking and cycling (Saneinejad, Roorda, and Kennedy, 2012). The positive relationship between heating degree days and per capita transportation emissions supports findings from Saneinejad, Roorda, and Kennedy's (2012) study. Greater heating degree days is indicative of lower temperatures—which are likely influencing travel mode choices in favor of driving.

Lastly, similar to the first model, being located in the West Region is negatively related to change in per capita transportation emissions. This is likely due to unique dynamics of the states in this region that are influencing transportation emissions, such as policy measures encouraging alternative modes of transportation.

CHAPTER V

CONCLUSIONS AND IMPLICATIONS FOR CLIMATE ACTION PLANNING

Through the two phases of this study, the practice of climate action planning at the state level has been analyzed in detail. More specifically, I explored the various approaches taken by U.S. states to mitigate greenhouse gas emissions within their boundaries and beyond, and analyzed the potential strengths and weaknesses of state level CAPs. I found that all types of CAPs, regardless of the targets and status of their implementation, result in measurable yet modest reductions in carbon emissions, when a set of economic, climatic, political, and geographic variables are controlled for. This can be explained by the fact that climate action planning is a complex process, and can yield outcomes beyond implementation of policy measures specified in the CAP. Mechanisms such as learning that extends into the lower levels of government and the community as a result of the involvement of the public and various interest groups in the planning process, or the development of other related plans, policies or frameworks (with the potential to reduce emissions) that can emerge from a CAP process. Analysis of these mechanisms including the dynamics between CAP processes and indirect outcomes is beyond the scope of this study, but the findings suggest that this can be an interesting topic for future research. One limitation of CAP content analysis is that data about stakeholder processes are limited to what is provided in the plan, and there is a wide variation in the breadth and depth of information included in different CAPs. In-depth interviews with stakeholders involved in CAP processes would enhance our understanding of CAP dynamics beyond what is publically available through documents.

Another limitation of the model presented in this dissertation is that it does not include a local climate action variable. Municipal and community level CAPs may or may not be an extension of the state level CAP. In California, for example, many cities adopted a CAP due to a state level mandate. In Ohio, on the other hand, Cleveland and Akron adopted a CAP in 2009, two years before the state of Ohio released its first CAP. Unlike Ohio's CAP, Cleveland's plan set two goals for GHG emissions reduction, and provides evidence of progress.[15] Regardless of their relationship with the state level CAP, these local plans can be successful in reducing emissions. Future research can assess the potentials, effectiveness, strengths and weaknesses of these local CAPs. Collecting comparable monthly or annual emissions data at the city and metropolitan levels can provide an opportunity for evaluation of these CAPs.

Currently, state CAPs with an ambitious target and evidence of implementation have not proven greater emissions reductions than those with a short-term target and limited evidence of implementation. As explained earlier, this can be due to weak short-term targets, a lag between implementation and results becoming visible, the possible effect of indirect CAP processes, and/or the difficulty of emissions reductions beyond what has already been achieved through other actions by the states with a type 5 or 6 CAP. This finding is another evidence that CAPs are very complex involving many factors, and their success in significantly reducing emissions can be influenced by various dynamics. It is important to note that the regression model presented in this study is exploratory. Better understanding of possible mechanisms that link CAPs to emissions reductions are needed to develop an improved model.

The most valuable contribution of this study comes from the content analysis of the current generation of state CAPs. Broadly, findings from this study show that sub-national level climate action planning, in its current form, demonstrates considerable strengths and benefits but faces major obstacles and limitations. First and foremost, climate action is a heterogeneous phenomenon within various jurisdictions across the nation—ranging from no action at all to rigorous implementation of stringent climate regulations. This heterogeneity, in and of itself, irrespective of potentials and constraints of individual action taking jurisdictions, can be problematic and highlights the importance of federal level action. This is not only because of carbon leakage potential, but also due to sending mixed messages about our stance on climate action as a nation—which can hinder global efforts to mitigate emissions. Additionally, the "wait and see" (what other jurisdictions will achieve and go through) approach, taken by several states and documented in CAPs is an issue. Procrastination means ignoring the magnitude of the threat climate change can cause and the potential risks of irreversible impacts on the environment and human communities. Lack of strong federal leadership on climate planning has created an opportunity for innovative bottom-up climate action; however, this has also resulted in a patchwork of climate action across the nation. A robust federal leadership on climate protection can level the playing field for all jurisdictions, diminish possible carbon leakage to the states with minimal regulations, support the implementation of lower-level CAPs, and finally enhance chances of global cooperation against the threat of climate change.

Meanwhile, the unique strengths of current state CAPs illustrate important potentials of subnational climate action. Through CAP development and implementation, U.S. states have acted as laboratories of democracy and incubators of innovation and collaboration. The detailed analysis of co-benefits of climate action conducted through CAP development of many states shows a more holistic view of planning practice and policy implementation. Robust financial analyses, such as cost-effectiveness analysis and NPV, indicate that through climate action, states can undertake worthwhile investments benefitting the economy, the environment, and the community.

Setting a long-term target intensifies the need to deal with uncertainties. Without a long-term target that adheres to scientific requirements of GHG emissions reductions, we cannot design a path to get there. However, long-term climate action planning involves many uncertainties, ranging from uncertainty about policy matters to potential impacts of climate change. This can lead to confusion and discourage action or can result in "paralysis by analysis" rather than decisiveness (Peterson, Cumming, & Carpenter, 2003). Yet, viewed from a different perspective, uncertainty can be considered an opportunity (Ney & Thompson, 2000). Uncertainty can encourage tolerance between stakeholders due to the realization that the plans and beliefs of others can be more effective or correct, and uncertainty can inspire action because it indicates that the future is not already determined (Peterson, Cumming, & Carpenter, 2003). Thus, the key to deal with uncertainties is framing it in a way that the action becomes inspiring or empowering as opposed to confusing or demoralizing. Further research and better data about the range of potential outcomes can help alleviate the challenge of dealing with uncertainties. Two approaches taken by several states offer options for better implementation success at the face of uncertainties: 1) scenario planning (for both policy options and climate change impacts); and 2) scoping plans.

Scenario development was first introduced by Herbert Kahn to be used in situations where accurate forecasts cannot be developed (Kahn & Wiener 1967), and later was further elaborated and is currently being used widely in business management (Schoemaker, 1995) and conservation biology (Peterson, Cumming, & Carpenter, 2003). Scenario planning helps us grasp the range of potential processes and outcomes--that are based on a different set of assumptions--and plan accordingly. Although, scenario planning is not the only method to deal with uncertainties, it is an appropriate method when uncertainties are high and the system cannot be controlled easily or feasibly—for example, through "adaptive management" (Walters, 1986) which assumes that experimental manipulation of the system is possible. In climate action planning, it is important to differentiate between potential global warming impacts that can be impossible or infeasible to adapt to and develop scenarios to organize alternative courses of action.

The second long-term plan implementation tool is developing scoping plans, which help us break the distant target into manageable timelines and reduction goals, and identify policy and programs that can connect us to the ultimate target gradually and steadily. This also facilitates monitoring and evaluation of climate action plans. State level CAPs, in most cases, do include a projection of GHG reductions for specific policy measures or a set of policy measures. However, for distant targets, the likelihood of accurate projections diminishes. Scoping plans, as opposed to CAPs, focus on the short-term target. Therefore, it is possible to conduct a much more detailed analysis and develop projections with higher level of accuracy. However, this does not lessen the importance of ambitious long-term targets. Short-term targets with a concrete set of recommendations fully illustrated in a scoping plan can be practical and administratively desirable; ambitious long-term targets coupled with a more flexible set of possible policy options described in a CAP can be visionary and inspiring. A method that can be useful in linking longer-term and shorter-term plans when uncertainties and complexities are high is “backcasting” (Robinson, 1990). Backcasting was first developed as a novel planning methodology for future energy options as opposed to the traditional energy forecasting and planning approach (Robinson, 1990), and later was further elaborated and used for identifying, exploring and analyzing various sustainability solutions (see, for example, Gleeson et al., 2012; Quist & Vergragt, 2006; Phdungsilp, 2011; Vergragt & Quist, 2011, among others). There are a number of backcasting methods detailed in the literature, but the main idea is to start with a defined vision to set up targets (CAP with ambitious long-term targets), followed by developing scenarios (often including the forecast or BAU scenario for comparison) and detailed measures and timelines to get there (scoping plan). More recent applications of the backcasting approach have involved broad stakeholder engagement, multiple future visions or normative scenarios, and innovation (Phdungsilp, 2011).

Lastly, we should move beyond energy efficiency measures to be able to reduce emissions sharply. Findings from this analysis show that CAPs are reducing energy-related carbon emissions in a measurable but modest amount. Continuing the current trend of emissions reductions is insufficient to reduce emissions dramatically to meet the long-term targets. Achieving greater reductions involves major technological and policy innovations as well as lifestyle changes. The evidence that Transportation and Land Use (TLU) targets are low compared to the sector's contribution to total emissions suggests that we have not yet developed the tools and measures to reduce emissions from TLU significantly and efficiently. This is a great opportunity for planners, policymakers and urban scholars to develop creative solutions for smarter urban living. It is impossible to illustrate what future innovations will exactly entail or what can be achieved through major technological advancements. However, some of the described planning tools and techniques, such as backcasting that involves wide stakeholder participation and scenario planning that challenges current thinking, can be used as a framework to create an ecosystem amenable for innovation. Through these techniques, various decision making alternatives--ranging from urban development decisions to lifestyle choices—are converted into dynamic stories that involve "credible series of external forces and actors' responses" (Peterson, Cumming, & Carpenter, 2003, p. 361). Additionally, these techniques can provide a forum for not only policy creation but policy implementation and evaluation. Stakeholders involved in the visioning process are likely to find that some outcomes or processes represent a future or a situation that is more desirable than others. And then the question is: how do we get from the present to the desired situation. The excitement about climate action planning simply begins there.

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APPENDICES

A. State Level Climate Action Plan Assessment Protocol

Note: To answer the following questions use all CAP-related documents available through EPA or state websites. Provide explanation if there is a conflict between different CAP-documents or as needed.

I. General Information

- State: ______________________________

- Year Adopted: _______________ Year Updated *(If applicable)*: ____________________

- Who was involved in CAP preparation and adoption? (*Mark all that apply*. *Explain.*)

  ☐ Publishing organization ____

  ☐ Governmental agencies *(In addition to publishing organization)* _______________

  ☐ Technical Work Groups *(TWGs)* ____

  ☐ External organizations providing facilitation, technical support, etc.

  - ☐ Center for Climate Strategies
  - ☐ Center for Climate and Energy Solutions
  - ☐ Universities ____
  - ☐ Other ____

  ☐ Other stakeholders____

II. Timing; Policy Coverage; Goals; and Regional Coordination

- Specify the baseline year: ___________ or (*Mark*) Not included in the CAP ☐

☐

- Does the CAP specify a statewide GHG emissions target? Yes ☐ No
  (Explain. Year and reduction requirement %)
  - What is the *near-term* target?

    ____
  - What is (are) the *intermediate-term* or *interim* target(s)?

    ____
  - What is the *long-term* or *ultimate* target?

    ____
- Are uncertainties in Business as Usual (BAU) emissions and impacts of policies taken into account? *(Mark)* Yes ☐ No ☐
  - If yes, what are the most stringent scenario targets?

    ____
  - If yes, what are the least stringent scenario targets?

    ____
- Can a reduction goal be quantified for each of the key sectors? Note, look for headings as is in plan. Do not interpret here. (*Mark all that apply. If yes, specify.*)

  ☐ Transportation and Land Use Yes ☐ No ☐
  (Explain here if the goal is set seperately for transportation and landuse.)

  ____

  ☐ Energy Yes ☐ No ☐

  ____

  ☐ Residential Yes ☐ No ☐

  ____

  ☐ Commercial Yes ☐ No ☐

  ____

  ☐ Industrial Yes ☐ ☐

  No

  ____

☐ Agriculture Yes ☐ No ☐

____

☐ Forestry Yes ☐ No ☐

____

☐ Waste Yes ☐ No ☐

____

☐ State government Yes ☐ No ☐

- Explain reduction goals in comparison to the sector's contribution to emissions.

- Has the state participated in any of the following multi-state climate initiatives?
  Yes ☐ No ☐
  (Mark all that apply.)
  If yes, explain whether or not the state currently participates in the initiative.

  ☐ North America 2050 (*Note: No longer active as of 2014.)*

  ☐ Western Climate Initiative

  ☐ Regional Greenhouse Gas Initiative

  ☐ Pacific Coast Collaborative

  ☐ Midwest Greenhouse Gas Reduction Accord

☐ Transportation and Climate Initiative

☐ Under 2 MOU

III. Implementation Provisions and Conditions

1. Check what type of implementation plan the CAP includes. *(Mark all that apply.)*

   ☐ The CAP has a separate implementation plan

   ☐ The CAP has a separate implementation section

   ☐ Implementation plan is blended in policy options

2. Are implementation roles and responsibilities spelled out?

   ☐ Yes, all implementation roles and responsibilities are discussed.

   ☐ Some, but not all, implementation roles and responsibilities are discussed.

   ☐ No, there are no implementation roles and responsibilities discussed.

3. Are funding sources discussed at all? (*Explain*)

   ☐ Yes (*Explain*)

   ☐ No (*Explain*)

4. Are the costs of each action quantified? Yes ☐ No ☐

5. Are the externalities (co-benefits) of actions specified ? Yes ☐ No ☐
   (Mark all that apply; explain if externalities are quantified)

   ☐ Jobs

   ____

   ☐ Energy security

   ____

☐ Public health

___

☐ Other

___

6. Does the plan specifiy the risks of inaction? Yes ☐ No ☐
   (Explain what the risks are; explain whether the risks are quantified)

7. Are there scenarios developed for risks? Yes ☐ No ☐
   (Explain here.)

8. Are the policy options prioritized? Yes ☐ ☐
   No

9. What is the prioritization method? *(e.g. cost-effectiveness)*
   (Explain here.)

IV. Implementation Mechanisms

1. Is there any *(Mark all that apply. Explain)*
   - ☐ State level legislation? Yes ☐ No ☐
   - ☐ Executuve order? Yes ☐ No ☐

2. What are the implementation mechanisms recommended by the CAP?
   (Mark all that apply.)
   - ☐ Voluntary and negotiated agreements
   - ☐ Technical assistance
   - ☐ Financial incentives
   - ☐ Targeted spending
   - ☐ Codes, rules, and standards
   - ☐ Cap and trade
   - ☐ Carbon tax
   - ☐ Pilots and demos

☐ Information and education

☐ Research and development

☐ Reporting and disclosure

☐ Other *(Explain here.)*

☐ Not specified or unclear in the CAP and any other related document

3. What are the GHG emission reductions quantifications based upon? *(Mark. Explain.)*

   ☐ Specific measures, policy packages, or strategies

   ☐ Implementation mechanisms

   ☐ Both of the above

4. Is there any sign of implementation in the state's website where the CAP is posted?
   (Mark. Explain. Look for specific statements regarding implementation.)

   Yes ☐ No ☐

5. Is there any sign of monitoring and/or evaluation in the state's website?
   Yes ☐ No ☐
   (Explain.)

6. Has the plan been updated since adoption or is the plan in the process of a more recent update?
   (Explain.)

7. Are CAP progress reports posted regularly? Yes ☐ No ☐

   Other Notes:

B. Interview Questions

IRB Approval Date: May 13, 2015

- Please tell me briefly about your/your organization's involvement in state and multi-state climate initiatives.

1. What are the most important characteristics or components of a quality climate action plan (CAP)?

2. How important (if at all) is it to have a statewide emissions target?
    a. On what basis should the target be defined?
    b. What are the important considerations about setting a target or several targets?

3. How important (if at all) is it to develop multiple emissions reduction scenarios?
    a. What are some important considerations in developing such scenarios?

4. How do you think reduction goals for different sectors, such as transportation or energy supply, should be formulated?

5. How important (if at all) is it to have an implementation and monitoring plan?
    a. What are the most important components/qualities of such plans?
    b. What should the prioritization of specific measures be based on?

6. If you were to evaluate implementation of state level CAPs, what signs would you have looked for implementation success?

7. What are the challenges and opportunities of implementing state level CAPs?

8. What implementation mechanisms (e.g. voluntary and negotiated agreements, technical or financial assistance, cap and trade, carbon tax, education, R&D, targeted spending, codes and standards, pilots and demos, etc.) do you think are the most suitable for US states? Why?

9. How does (if at all) participation of a state in multi-state initiatives impact its state level CAP development and implementation?

10. Is there anything else that you would like to add or that you think I should know about state CAPs, their implementation or evaluation?

C. Emissions Sectors

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Arizona	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial, Industrial and Waste Management (RCIW); Agriculture and Forestry; State Government; Cross-cutting (NQ)	1) Transportation (39% of emissions) 2) Electricity (38% of emissions).	Emission reductions expected from Transportation are low compared to the sector's contribution to total emissions (91.0 MMtCO2e between 2007 and 2020 in TLU compared to 120 and 222 MMtCO2e in ES and RCIW respectively).
Arkansas	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial; Agriculture, Forestry and Waste Management (AFW); Lead by Example (NQ); Cross-cutting (NQ)	1) Electricity consumption (32%) 2) Transportation (26%) 3) Agriculture (14%) 4) Industrial (13%)	The greatest emissions reductions are expected from ES (179.5 MMtCO2e) followed by AFW (162.2 MMtCO2e). Reductions in transportation (TLU) emissions are small relative to the sector's contribution to the state's GHG emissions (30.2 MMtCO2e).
California	Energy; Transportation; Agriculture; Water (e.g. water-related energy conservation); Waste; Natural and Working Lands; Short-Lived Climate Pollutants; Green Buildings	1) Transportation (41.2%) 2) Industrial (22.8%) 3) Electric Power (19.6%) 4) Agriculture and Forestry (8.0%) 5) Other (8.4%)	The greatest emissions reductions are expected from energy efficiency measures followed by transportation measures. Expected sectoral reductions by 2020 are commensurate to the contribution of the specific sector to emissions.
Colorado	Transportation and Land Use; Energy Supply; Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste Management (AFW)	1) Energy 2) Transportation 3) Residential, Commercial & Industrial	The greatest reductions are expected from RCI (86.0 MMtCO2e) followed by AFW (66.0 MMtCO2e). GHG emissions reductions expected from the Energy sector (ES: 58.8 MMtCO2e) are greater than the Transportation (TLU: 46.7 MMtCO2e).

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Connecticut	Transportation and Land Use (TLU); Energy Supply; Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste Management (AFW); State Government (blended into other sectors); Education	1) Transportation (40%) 2) Energy Consumption in Residential (20%) and in Com/Ind. (10%) 3) Electric Utility (between 18% and 30%)	The greatest reductions are expected from RCI (7.29 MMTCO2e by 2020) followed by Energy (6.89 MMTCO2e by 2020). Emission reductions expected from Transportation are low compared to the sector's contribution to total emissions (3.84 MMTCO2e by 2020).
Florida	Transportation and Land Use (TLU); Energy Supply; Agriculture, Forestry and Waste Management (AFW); State Government (NQ-enabling options)	1) Electricity Consumption (42%) 2) Transportation (36%)	The greatest reductions are expected from ES (44.4 and 106 MMtCO2e by 2017 and 2025 respectively) followed by the AFW (25.4 and 58.2 MMtCO2e by 2017 and 2025). Emission reductions expected from Transportation (TLU) are low compared to the sector's contribution to total emissions (12.7 and 25.1 MMtCO2e by 2017 and 2025 respectively).
Iowa	Transportation and Land Use; Energy Efficiency and Conservation (Energy Demand); Clean and Renewable Energy (Energy Supply); Agriculture, Forestry, and Waste Management (AFW); Cross-cutting (NQ)	1) Electricity (32%) 2) Agriculture (23%) 3) Transportation (17%) 4) Industrial (13%)	The greatest reductions are expected from ES (233.5 MMtCO2e between 2009 and 2020) and AFW (233.0 MMtCO2e). Emission reductions expected from Transportation (TLU) are low compared to the sector's contribution to total emissions (55.0 MMtCO2e).
Illinois	Electric; Transport; Agriculture; Commercial Industrial; fugitive/waste; government; and multi-sector	1) Energy (31%) 2) Transportation (25%) 3) Industrial (15%) 4) Residential (10%)	Cannot assess. Reduction goals are not quantified for each sector as a whole, unless calculated from data provided in appendices that include expected reductions from each measure.

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Kentucky	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste; Cross-cutting (NQ)	1) Electricity Consumption (50%) 2) Transportation (20%) 3) RCI (17%)	The greatest reductions are expected from ES (755.9 MMtCO2e between 2011 and 2030) followed by RCI and TLU (408.2 MMtCO2e each). Reductions from transportation measures are somewhat small compared the sector's contribution to total emissions.
Maine	Transportation and Land Use (TLU); Energy and Solid Waste; Buildings, Facilities, and Manufacturing (BFM); Agriculture and Forestry; Lead by Example (included in BFM)	The sources of emissions are not discussed in the plan.	Data not available.
Maryland	Transportation and Land Use (TLU); Energy; Agriculture and Forestry; Waste; Lead by Example; Green Buildings	1) Electricity use (39%) 2) Transportation (28%) 3) RCI (16%)	45.6% of annual emissions reduction come from the Energy sector, 25% from Transportation, 2.1% from Land Use.
Massachusetts	Transportation; Energy; Buildings; Lead by Example	1) Transportation (39%) 2) Heating for Buildings and Other Processes (30%) 3) Electricity Use (21%) 4) Other (10%)	Cannot assess. The emissions reduction categories in the plan are different from the inventory. Emission reduction categories in the plan are classified based on policy groups (buildings, transportation, etc.), whereas emissions categories in the inventory are based on emissions sources (e.g. residential, commercial, industrial and transportation emissions from fossil fuel combustion).

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Michigan	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (non-electricity-RCI); Agriculture, Forestry and Waste (AFW); Cross-cutting (NQ)	1) Electricity Consumption (36%) 2) Transportation (24%) 3) Residential and Commercial Fuel Use (14%) 4) Industrial Fuel Use (10%)	Greatest reductions are expected from RCI (524.6 MMtCO2e between 2009 and 2025) followed by ES (220.3 MMtCO2e) and AFW (147.0 MMtCO2e). Emission reductions expected from TLU are small compared to sector's contribution (95.1 MMtCO2e).
Minnesota	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (non-electricity-RCI); Agriculture, Forestry and Waste (AFW); Lead-by-Example (NQ)	1) Electricity (including imported electricity) (34%) 2) Transport (24%) 3) Agriculture (14%) 4) Residential and Commercial Fuel Use and Industrial fuel use (10% each)	Greatest reductions are expected from Agriculture, Forestry and Waste sector (279 MMtCO2e between 2008 and 2025) followed by TLU (91.2 MMtCO2e) and ES (37.55 MMtCO2e). Emission reductions expected from ES and TLU sectors are small compared to AFW.
Missouri	Electric Generation; Residential and Commercial Buildings; Transportation; Agriculture and Forestry; Solid Waste Management	1) Transportation (~33%) 2) Residential (~26%) 3) Commercial (~21%) 4) Industrial (~20%)	Insufficient data
Montana	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste (AFW); Lead-by-Example NQ for most measures	1) Electricity Use (26%) 2) Agriculture (26%) 3) Transportation (20%)	Greatest reductions are expected from RCI (25.3 MMtCO2e between 2007 and 2020) and ES (21.9 MMtCO2e). Emission reductions from AFW (17 MMtCO2e) and TLU (6.1 MMtCO2e) are low compared to these sectors' contributions to total emissions.

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
North Carolina	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (RCI); Agriculture, Forestry and Waste (AFW); Cross-cutting (NQ)	1) Electricity Use including electricity imports (42%) 2) Transportation (29%) 3) Industrial Fuel Use (11%) 4) Residential Fuel Use and Agriculture (6% each).	Greatest reductions are expected from ES (375 MMtCO2e between 2007 and 2020). GHG reductions from TLU are slightly low compared to the sector's contribution to total emissions (232.3 MMtCO2e). GHG reductions from RCI (218.7 and 228.8 counting recent actions plus 7.9 from non-electricity options) and AFW (213 MMtCO2e) are close to that of TLU.
New Hampshire	Transportation; Electricity Generation; Building Actions (Residential, Commercial, Industrial); Natural Resource Actions (Land, Water, and Wildlife); Lead by Example (NQ)	Electric Generation, Transportation, and Direct Fuel Use in Buildings each contributed roughly one-third of the state's total emissions.	The greatest reductions are expected from improvements in the Building sector (13.02 MMTCO2e/yr by 2050 and 8.43 by 2025), followed by the Transportation (7.91 MMTCO2e/yr by 2050 and 5.01 by 2025) and the Electric Generation (6.57 MMTCO2e/yr by 2050 and 3.44 MMTCO2e/yr by 2025) sectors. Reductions expected from Transportation and Energy Generation are low compared to these sectors' contributions to total emissions.
New Jersey	Transportation and Land Use (3 core measures-- New Jersey Energy Master Plan (EMP); New Jersey Low Emission Vehicle (LEV) program; and, Regional Greenhouse Gas Initiative (RGGI) program); Energy; Residential and Commercial; Industrial; Terrestrial Sequestration; Waste Management	1) Transportation (~35%) 2) Electric Generation (~24%) 3) Residential/Commercial (~20%) 4) Industrial (~14%)	Greatest reductions are expected from the Energy sectors (21.9 MMtCO2eq by 2020). Reductions expected from Transportation and Land Use measures are low compared to the sector's contribution to emissions (9.9 MMtCO2eq by 2020).

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
New Mexico	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial and Industrial (RCI); Agriculture and Forestry; Cross-cutting Issues (NQ)	1) Electricity (40%) 2) Fossil Fuel Industry (23%) 3) Transportation (17%) 4) Agriculture (7%)	Greatest reductions are expected from ES (109.9 MMtCO2e between 2007 and 2020), followed by RCI (66.0 MMtCO2e). Reductions expected from TLU measures are low compared to the sector's contribution to total GHG emissions (50.5 MMtCO2e between 2007 and 2020)
Nevada	Recommendations are general and sectoral reduction goals are not specified.	1) Electric Sector (42%) 2) Transport (32%) 3) Residential and Commercial Fuel Use (8%) 4) Industrial fuel use (5%)	Insufficient data
New York	Transportation and Land Use (TLU); Power Supply and Delivery; Residential, Commercial and Industrial; Agriculture, Forestry and Waste	1) Residential, Commercial and Institutional (38%) 2) Transportation (34%) 3) Power Supply (23%)	Greatest reductions are expected from TLU (364.6 MMtCO2e between 2011 and 2030) followed by RCI (357.1 MMtCO2e) and Power Supply and Delivery (290.3 MMtCO2e).
Ohio	Recommendations are general and sectoral reduction goals are not specified.	--	Insufficient data
Oregon	Transportation; Electric Generation and Supply; Energy Efficiency (for RCI); Biological Sequestration; Materials Use, Recovery and Waste Disposal; State Government	1) Electricity Use--including purchased electricity (42%) 2) Transportation (38%) 3) Industrial (12%) 4) Residential (5%); 5) Commercial (3%)	Cannot comment on whether reductions are commensurate to emissions.

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Pennsylvania	Land Use and Transportation; Electricity Generation, Transmission, and Distribution; Residential & Commercial; Industrial; Agriculture; Forestry; Waste	1) Electricity Consumption (30%) 2) Industrial Activities (28%) 3) Transportation (24%) 4) Residential and Commercial Fuel Use (14%)	Greatest reductions are expected from Residential and Commercial (214.5 MMtCO2e between 2009 and 2020) followed by Electricity Generation, Transmission, and Distribution (120.1 MMtCO2e between 2009 and 2020). Emissions reductions expected from Land Use and Transportation and Industrial sectors are low compared to the sectors' contribution.
Rhode Island	Transportation and Land Use (TLU); Energy Supply and Solid Waste; Buildings and Facilities (for RCI) Measures are categorized into High Priority Consensus; Low Priority Consensus; Non-consensus; etc.	--	The greatest reductions are expected from Energy Supply and Solid Waste (265.4 estimates of thousands of metric tons in 2020 of GHGs expressed as carbon equivalent from High Priority Consensus measures). Cannot comment on whether reductions are commensurate to emissions because of the way the inventory is structured.
South Carolina	Transportation and Land Use (TLU); Energy Supply (ES); Residential, Commercial, and Industrial (RCI); Agriculture, Forestry, and Waste Management (AFW); Cross Cutting (NQ)	1) Electricity Use--excluding exported to other states (35%) 2) Transportation (34%) 3) Industrial Fuel Use (15%) 4) Residential and Commercial (4% each)	Greatest reductions are expected from RCI (141.6 MMtCO2e between 2008 and 2020) followed by AFW (135.0 MMtCO2e between 2008 and 2020). Reductions expected from TLU measures are low compared to the sector's contribution (29.3 MMtCO2e between 2008 and 2020).

State	Sectors Considered	Largest Sectoral Contributors	Reduction Goals vs. Sectoral Emissions
Utah	GHG emissions reductions expected from each of the sectors or measures have not been quantified. Reduction goal or potential of each measure calculated by other states have been provided	--	Reduction potential of measures have been qualitatively discussed (e.g. moderate, high, etc.).
Virginia	Transportation; Energy Supply; Energy Conservation and Efficiency (for RCI); State Government	1) Transportation (32%) 2) Electricity (38%) 3) Fuel Use (19%)	Greatest reductions are expected from Energy Supply (40 million metric tons CO2e) followed by Energy Conservation and efficiency (20 million metric tons CO2e). Emissions reductions expected from transportation are low compared to the sector's contribution (10 million metric tons CO2e).
Vermont	GHG emissions reductions expected from each of the sectors or measures have not been quantified	--	Reduction potential of measures have been qualitatively discussed (e.g. moderate, high, etc.).
Washington	Transportation and land use (TLU); Energy Efficiency; Agriculture; Waste; Lead by Example		Goals are based on specific measures for each sector. Sectoral goals can be calculated.
Wisconsin	For some specific policy measures GHG emissions reductions have been reported. Where measures are discussed for each sector, emissions reductions are not quantified	1) Utilities (34%) 2) Transportation (24%) 3) Industrial (13%) 4) Residential (9%) 5) Agriculture (9%).	Insufficient data

D. Targets

State	Near Term Target	Interim Target	Ultimate Target
Arizona	Reach 2000 emissions levels by 2020	--	50% below 2000 emissions levels by 2040
Arkansas	Reduce emissions by about 17.6 MMtCO2e in 2015 (equivalent to about a 5% reduction below 1990 levels)	Reduce emissions by about 35.5 MMtCO2e in 2020 (equivalent to about a 10% reduction below 1990 levels)	Reduce emissions by about 53.3 MMtCO2e in 2025 (equivalent to about a 15% reduction below 1990 levels)
California	Reach 2000 emission levels (473 MMTCO2E) by 2010	Reach 1990 emission levels (426 MMTCO2E) by 2020	By 2050 reduce emissions to 80% below 1990 levels
Colorado	20% below 2005 levels by the year 2020	--	80% below 2005 levels by 2050
Connecticut	Reduce emissions to 1990 levels by the year 2010	An additional 10% below 2010 levels by the year 2020	80% below 2001 levels by 2050
Florida	30% below the reference case by 2017	--	More than 64% below the reference case by 2025
Iowa	Scenario 1 (50% reduction by 2050): a 1% reduction by 2012; Scenario 2 (90% reduction by 2050): a 3% reduction by 2012	Scenario 1: approximately 11% reduction by 2020; Scenario 2: a 22% reduction by 2020	Two scenarios designed to reduce emissions by 50% and 90% from a 2005 baseline by the year 2050
Illinois	--	--	Reduce emissions to 1990 levels by 2020
Kentucky	Reduce emissions by about 63.7 MMtCO2e in 2020 (equivalent to a 10% reduction below 1990)	--	Achieve a 20% reduction of GHGs below 1990 levels by 2030 (equivalent to 128.3 MMtCO2e)
Maine	Reduce emissions to 1990 levels by 2010	10% below 1990 levels in 2020	Reduce emissions by a sufficient amount to avert the threat of global warming over the longer term, which could be as much as 75%.

State	Near Term Target	Interim Target	Ultimate Target
Maryland	Achieve a 25% reduction in emissions from 2006 levels by 2020	--	Reduce emissions by up to 90% from 2006 levels by 2050
Massachusetts	Reduce emissions to 1990 levels by the year 2010	Reduce emissions to 25% below 1990 levels by the year 2020.	Reduce emissions sufficiently to eliminate threat to the climate as specified by scientists (80% below 1990 levels by 2050).
Michigan	20% below 2005 levels by 2020	--	80% below 2005 levels by 2050
Minnesota	At least 15% below 2005 levels by 2015	At least 30% below 2005 levels by 2025	At least 80% below 2005 levels by 2050
State	Near Term Target	Interim Target	Ultimate Target
Missouri	--	--	--
Montana	Reach 1990 levels by 2020	--	Reach 80% below 1990 levels by 2050
North Carolina	--	--	Approximately 47% from 256 MMtCO2e in the reference case forecast to 137 MMtCO2e by 2020, or within 1% of 1990 levels
New Hampshire		A mid-term goal of reducing emissions 20% below 1990 levels by 2025 (the plan also includes 5 interim targets to meet the 2025 target)	A long-term reduction in emissions of 80% below 1990 levels by 2050
New Jersey	Reduce statewide emissions to 1990 levels by 2020, approximately a 20% reduction below estimated 2020 business-as-usual emissions	--	Further reduction of emissions to 80% below 2006 levels by 2050
New Mexico	Reduce emissions to 2000 levels by 2012	Reduce emissions 10% below 2000 levels by 2020	Reduce emissions 75% below 2000 levels by 2050
Nevada	--	--	--

State	Near Term Target	Interim Target	Ultimate Target
New York	--	Interim benchmark of 40% below 1990 levels by 2030	Reduce emissions 80% below 1990 levels by 2050
Ohio	--	--	--
Oregon	Reach 1990 levels by 2010	10% below 1990 levels by 2020	At least 75% below 1990 levels by 2050
Pennsylvania	--	--	30% reduction in emissions below year 2000 levels by 2020
Rhode Island	Reduce emissions to the 1990 levels by 2010; 2013 update: 2019 limit--Reduce emission to or below the 2019 limit	10% below 1990 levels by 2020; 2013 update: 2024 limit—20% less than 1990 levels	85% below 1990 levels over the long term 2013 update: 2054 limit—80% less than 1990 levels
South Carolina	--	--	Reduce emissions to 5% below 1990 levels by 2020
Utah	--	--	--
Virginia	--	--	30% below the business-as-usual projection of emissions by 2025
Vermont	Reduce emissions 25% from 1990 levels by 2012	Reduce emissions 50% from 1990 levels by 2028	If practical, reduce emissions by 75% from 1990 levels by 2050
Washington	Return to 1990 levels by 2020	Reduce 25% below 1990 levels by 2035	Reduce 50% below 1990 levels by 2050
Wisconsin	Reduce GHGs to 2005 levels by 2014	Reduce GHGs to 22% below 2005 levels by 2022	Reduce GHGs to 75% below 2005 levels by 2050

E. Implementation Provisions

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Arizona	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Cost or cost savings per ton GHG removed is calculated and included in the summary table of each sector. However, for the implementation of several measures it is stated that "funding mechanisms that are needed to achieve these goals" must be developed. In sum, funding sources are discussed in the document, but there is ambiguity in several measures about "what" those sources are or "how" those mechanisms should be developed.	Not quantified Co-benefits: Economic development and job growth, greater energy reliability and security, public health, reduced local air pollution, more livable and healthy communities, neighborhood revitalization and increased tax revenues through increased density, decreased sprawl and infill development	The discussion about the risks of inaction is limited to the adaptation section.	A potential policy option being considered by a TWG was accepted as a "priority for analysis" and developed for full analysis only if it had a "supermajority of support" (defined as five or fewer "no" votes or objections) from CCAG members. Cost-effectiveness analysis was conducted. Cost/cost savings per ton GHG removed was calculated.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Arkansas	Some, but not all, implementation roles and responsibilities are discussed. For example, in the cross-cutting issues section, for some policy measures "parties involved" are specifically mentioned.	Costs are calculated. The CAP includes recommendations to identify and implement creative financial mechanisms: Examples include establishing a State Revolving Loan Fund to finance products and services with low-carbon intensity, promoting the use of "green products" procurement preferences, and establishing and promoting greener buying cooperatives.	Not quantified Co-benefits: jobs, energy security, public health, reducing other air pollutants, promoting sustainable growth, improved quality of life due to smart growth strategies and pedestrian bicycle infrastructure	Not discussed	Net Present Value (NPV) and Cost-effectiveness calculations as well as level of support from MAG members are reported to be used for prioritization.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
California	In the Mitigation Measures and Adaptation Strategies List, all responsible agencies for particular measures have been identified. The CAP has a separate implementation section, a separate implementation plan, implementation is also blended in policy option.	Costs are calculated. Funding sources are identified. AB 32 authorized the collection of a fee from sources of GHGs to cover annual expenses for ARB and other State agencies to implement AB 32. Another source of funding is the Greenhouse Gas Reduction Fund (GGRF), which is used for a variety of long-term GHG reduction projects. Funding for the GGRF comes from auction proceeds that are part of ARB's Cap-and-Trade program.	Quantified Co-benefits: In 2020 the implementation of strategies is expected to increase jobs and income by additional 83,000 and $4 billion respectively above and beyond the substantial growth that will occur. Air quality and public health: Examples of costs saved as a result of reduced pollution-related health incidents are provided. Not quantified: environmental co-benefits, energy efficiency and security, social benefits and environmental justice	The plan includes a whole section on potential climate change impacts under different scenarios.	Cost Effectiveness has been considered. The 2013 Scoping Plan Update defined ARB's climate change priorities for the next five years. Cost-effective measures (with a potential to help the state meet its long-term climate objectives) that simultaneously support a range of economic, environmental, water supply, energy security, environmental justice, and public health benefits are prioritized.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Colorado	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options	Funding sources as well as Costs/savings and cost-effectiveness of implementing policy recommendations are reported for most of the measures. Some measures generate revenues that can be used for implementing another action. For example, RCI-5, involves increasing block rates and is set to generate revenue to support aggressive Demand Side Management (DSM). Also, some cross-cutting recommendations focus solely on funding. For example, CC8 recommends establishing a pro-active public-private partnership to seek investment capital and philanthropic funding for reducing emissions and supporting development of the new energy economy.	Not quantified: jobs, energy security (reduced risk of power shortages), improved public health as a result of reduced pollutant emissions by power plants, lower water pollution, healthier forests with lower fire risk through the development of markets for forestry residue, support of Colorado agricultural producers in the production of biofuels crops.	Risks of inaction are discussed.	Cost-effectiveness analysis has been conducted and cost-savings have been reported.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Connecticut	In each section, Lead Agencies for implementation are identified. Additionally, the 2006 implementation report discusses in detail the stakeholders involved and their role in the implementation of each measure. The CAP has a separate implementation plan. Implementation plan is also blended in policy options.	Costs are calculated. Each action includes a section on "estimated cost". For the majority of the measures, the emissions reduction cost is estimated per MTCO2e, and some funding sources are discussed. For some measures, costs were not estimated, and for some measures it is stated that "The working group and stakeholders were not able to consider whether [the existing] level of funding was sufficient". The Connecticut Clean Energy Fund (CCEF) is identified as a major funding source. The CCEF provides incentives for new renewable generation capacity and pilot programs. One potential use of CCEF is to directly purchase Renewable Energy Credits.	Using a desktop modeling tool developed under the direction of the EPA, three of the 55 recommended actions or RA's (RA2: GHG Feebate Program and RA32 and RA33: Creating Heating Oil and Natural Gas Conservation Funds) were analyzed extensively to identify local economic effects and co-benefits (e.g. The state's energy efficiency program: a $3 to $1 direct return on investment based on electricity savings, and an additional $4 to $1 payback in terms of reduced health costs). Jobs, GSP, output impact, real disposable personal income, and state revenues are quantified.	The CAP does not discuss risks of inaction. However, the Department of Energy and Environmental Protection provides an adaptation plan that discusses the impacts of climate change on the state's agriculture, infrastructure, natural resources and public health.	Prioritization is primarily based on stakeholder consensus/comments. Cost effectiveness of measures is considered for most measures. Aggressive implementation of the 38 measures already underway, combined with the start-up of new recommended actions in 2005; 17 other measures undergoing further analysis.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Florida	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	In the Government Policy and Coordination section, the first policy recommendation focuses on specific administrative, goal-setting, and accountability measures necessary to implement many of the policies recommended for other sectors. In this section funding is discussed. For example, it is stated that the state should fund "Florida Green Governments Grant Program and similar programs that support local and regional government initiatives".	Quantified Co-benefits: "Green Jobs": 148,000 net job gains; Energy security: net savings of 53.5 billion gallons of petroleum, 200.2 million short tons of coal, and 6.4 billion cubic feet of natural gas; net savings of 53.5 billion gallons of petroleum, 200.2 million short tons of coal, and 6.4 billion cubic feet of natural gas. Not quantified co-benefit: public health	Risks of inaction are discussed.	Cost-effectiveness, Net Present Value (2009-2025), and Energy Security Fuel Savings are reported for each action.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Iowa	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Costs are calculated. Some funding options/mechanisms have been identified. Decarbonization Fund: levies a fee based on the GHGs from electric generation to transition to a new, non- or low-emitting sources of electricity by funding specified activities such as low income weatherization, energy efficiency, research and development and renewable sources of energy. A small fee per kWh of electricity to generate significant funding for R&D and commercialization.	Not quantified Co-benefits: Jobs, stimulating energy independence and security, public health, advancing future regional or federal GHG programs. According to the CAP, about half of the policy options will not only reduce GHG emissions but are highly cost-effective and will save Iowans money.	Iowa has a "climate change impacts on Iowa" report published in 2011 that discusses the impacts of climate change on the state's climate; agriculture; plants and animals; public health; economy, infrastructure and emergency services.	The supporting subcommittees served as advisers to the ICCAC and helped generate initial options on Iowa-specific policy options to be added to the catalog of existing state actions; priority policy options for analysis; draft proposals on the design characteristics and quantification of the proposed policy options; specifications and assistance for analysis of draft policy options; and other key elements of policy option proposals, including related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Illinois	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Net Present Value is calculated for all recommendations. Some funding sources are identified to implement curtain measures. For example, it is recommended to implement a state development impact fee and use the revenue developed through the fee along with 1% of the Hotel Operators Tax to fund and expand Illinois Local Planning Fund to encourage smart growth.	Quantified Co-benefits: Jobs: Under Scenario #3 with a link to RGGI, employment increases 0.75%, or about 61,000 additional jobs per year in 2020. Not quantified Co-benefits: energy security, public health, Gross State Product and personal disposable income growth.	Risks of inaction are not discussed.	The Illinois Climate Change Advisory Group voted on policy measures. Implementation and administrative costs; potential net impact on state revenue; examples of States with similar or proposed policies; and macroeconomic benefits or costs (net present value) have been considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Kentucky	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options	For each policy measure, Net Present Value and Cost Effectiveness have been calculated. Some funding options have been discussed.	Co-benefits--such as jobs, energy security, public health, and developing revenue associated with future federal GHG mandates by developing the required infrastructure in advance--are discussed separately for the majority of policy measures but not quantified (e.g. improvement of forest stocking and expansion of forest acres bring associated co-benefits of watershed protection, improved wildlife habitat, biodiversity conservation, and enhanced aesthetics and recreation; smart growth measures produce various community and economic benefits)	Risks of inaction are not discussed.	The KCAPC recommendations were guided by four decision criteria that included: GHG reductions, monetized costs/savings of various policies, other potential co-benefits and costs (e.g., social, economic, and environmental) and feasibility considerations. It is stated that "the numbering used to denote the policy recommendation in [policy summary tables, such as NPV] is for reference purposes only; it does not reflect prioritization among these important recommendations." It is also stated in the executive summary section that TWGs prioritized the policy recommendations.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Maine	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Cost per ton CO2 savings have been reported for each measure. It is stated that almost half of the options either reduce carbon at a negative cost (i.e., "save" money over the program life) or cost very little. Some funding sources are discussed (e.g. fuel tax revenues targeted towards low-GHG travel alternatives such as funding transit, hybrid vehicles, etc.).	Not quantified Co-benefits: Jobs, energy security, public health, forestry Benefits (improve silviculture to produce more and higher-quality wood), efficiency rewards, trade possibilities (gaining a competitive advantage by establishing a GHG baseline and registry. As more states develop GHG plans, along with the many countries with existing or contemplated plans, Maine may be in a position to "trade" carbon allowances if aggressive policies are pursued).	The CAP includes a whole section on global risks of inaction, and discusses current effects on Maine. The state website includes an adaptation page focusing on programs and resources related to climate adaptation.	The leadership of the 122nd Legislature, and the House and Senate chairs of the relevant committees, will be asked to appoint a group of legislators representing the committees. This group could be charged with reviewing the CAP and determining additional legislative action. It could then coordinate the process of moving the measures through the legislative process. It would also be asked to oversee implementation of the CAP, including the establishment of priorities for action. Stakeholder consensus, cost-effectiveness, and carbon savings potential are considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Maryland	All implementation roles and responsibilities are discussed. For every policy measure lead agencies are identified. The implementation section for each policy also includes whether or not the policy is mandated or in the process of being implemented. Implementation plan is blended in policy options.	Job creation and economic benefits of each policy measure are calculated and reported. There is an emphasis on cost effectiveness of policy measures. However, costs of each action are not reported. For most of the policy measures, funding sources are identified or discussed in the implementation section (e.g. The EmPOWER Maryland programs are mandated and funded by State law; DHCD received the $20 million competitive award from the U.S. Department of Energy in 2010 to promote energy efficiency through its Energy Efficiency and Conservation Block Grant retrofit program).	Quantified Co-benefits: Jobs supported annually, annual Gross State Product; and wages annually have been calculated and reported for each sector. The CAP would result in estimated economic benefits of $1.6 billion and support over 37,000 jobs. Not quantified Co-benefits: Energy security through diversification of energy sources, and promotion of renewable energy; public health; air quality benefits; Chesapeake Bay restoration benefits; preserving valuable agricultural and forest land.	Risks of inaction have been discussed (e.g. Chesapeake and Coastal Bays restoration goals will be more difficult to achieve; urban flooding will likely worsen because rainfall events will be more intense; and risk of diseases caused by bacteria and viruses will increase due to higher temperatures).	The plan includes a section on legislative priorities that discusses priorities for 2013 and future legislation. Cost-effectiveness and ease of implementation have been considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Massachusetts	Implementation roles and responsibilities have been discussed. The CAP has a separate implementation section. Implementation plan is also blended in policy options (each policy package has a section discussing implementation issues, legal authority, uncertainties, policy design issues, equity issues, costs, other benefits, and experience in other states).	The CAP reports the costs of each action; for some actions estimates have been provided. Funding sources are discussed to a certain degree. Each policy package includes a section that discusses the costs of implementing the policy. The focus is primarily on savings in the long run for each policy measure as well as use of existing funding sources to support a program.	Quantified Co-benefits: Jobs: a total of 42,000 to 48,000 jobs as a result of the implementation of the CAP. Not quantified Co-benefits: Energy security/independence; public health; protection of natural resources; preserving quality of life.	The state's Adaptation Report explains in detail the potential impacts of climate change on the state's natural resources and habitat, key infrastructure, human health and welfare, local economy and government, and coastal zone and oceans. The report also cites two reports estimating the damage to assets due to sea level rise and evacuation costs.	Cost-effectiveness has been considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Michigan	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Cost per ton CO2 savings have been reported for each measure. Funding sources are discussed to a certain degree. Yet, "Seek Funding for Implementation of MCAC Recommendations" is a policy measure.	Not quantified Co-benefits: deployment of new investment and technologies; save energy and money; create new jobs and income; promote energy independence and sustainability; and diversify and grow our economy	Risks of inaction have not been briefly discussed.	Net Present Value (NPV) and Cost-effectiveness have been calculated. Selection and prioritization has been based on a variety of factors, such as considering related policies and programs, key uncertainties, co-benefits and costs, feasibility issues, and potential barriers to consensus.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Minnesota	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	NPV and cost effectiveness are reported. Some, but not all measures have dedicated funding sources. In the challenges section of some measures, funding is listed as a challenge. For example, for "Voluntary Fleet Emission Reductions", it is stated that "funding resources for retrofits and other technology-based efficiency solutions are limited and may be restricted to specific vehicle types." For other measures, it is stated that funding mechanisms need to be identified. For example, for Land use approaches, it is stated that "To achieve these reductions, the state will need to work closely with [various entities] to identify …funding mechanisms."	Not quantified Co-benefits: Clean air and public health	Risks of inaction have not been discussed.	The TWGs served as advisers to the MCCAG and helped generate initial recommendations on priority policy recommendations for analysis. Cost effectiveness, net present value and level of support have been considered for the prioritization of measures.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Missouri	--	--	--	--	--
Montana	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Cost effectiveness and net present value are calculated and reported for all policy measures. Funding sources could include federal R&D funding for high-altitude advanced fossil demonstration project(s) in Montana as authorized by the Energy Policy Act of 2005, a small pool of state funding for R&D efforts, industry contributions (e.g., licensing fees), and the coal severance tax (e.g., for clean coal, sequestration, and compressed air storage, among others).	Not quantified Co-benefits: Creation of jobs in the biomass energy and liquid biofuels feedstock/production industries; energy reliability and security; clean air and public health; and healthier forests with lower fire risk.	Risks of inaction have not been identified.	Policy options are not prioritized for implementation. However, policy options have been prioritized for inclusion in the CAP. A potential policy option being considered by a TWG was not accepted as a priority for analysis and developed for full analysis unless it had a super-majority of support from CCAC members (with a super-majority defined as five or fewer “no” votes or objections). Cost-effectiveness, net present value and level of support have been considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
North Carolina	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options	For each policy measure, net present value and cost-effectiveness have been calculated and reported. Some funding sources are briefly discussed (e.g. Energy Efficiency Funds; Utility-funded Demand-Side Management programs; Under the authority of the NC Utilities Commission, a Public Benefits Charge is collected on electricity sales, a portion of which is managed by the Advanced Energy Corporation and used to fund energy efficiency and economic development programs). Identifying funding sources has been mentioned as a challenge for several measures.	Not quantified Co-benefits: Stimulating economic growth and creating much needed jobs in the state; energy security through portfolio diversification and thus penetration of renewable energy resources into the energy marketplace; air pollution-related public health and visibility impacts decline with reduced fossil fuel fired emissions from electricity generation.	"Climate Ready North Carolina: Building a Resilient Future" report published in 2012 by North Carolina Interagency Leadership Team discusses risks, impacts and vulnerabilities in NC.	Through the CAPAG process, 56 mitigation options were selected based on cost-effectiveness, net present value, level of support and co-benefits.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
New Hampshire	All implementation roles and responsibilities are discussed (e.g. the New Hampshire Energy & Climate Collaborative to oversee and guide early implementation) The CAP has a separate implementation section. Implementation plan is also blended in policy options. Each policy measure includes a section that discusses in detail: resources required; parties affected; etc.	Annual economic benefits and avoided emission reductions of each action is reported. Each recommendation includes a subsection on implementation that discusses specific considerations for implementation. In this subsection, funding is also briefly discusses. For example, for many recommendations, it is stated that "sustainable funding mechanisms" should be developed. For other measures, it is stated that "funding to establish and administer the program" must be provided.	Quantified Co-benefits: economic benefits reported for each measure Not quantified Co-benefits: Jobs and economic growth through development of in-state sources of energy from renewable and low-emitting resources, and green technology development; state and regional energy security; public health; improved environmental quality; reducing costs of responding to a changing climate to the state's infrastructure, economy, and the health of our citizens; preserving the unique quality of life that the state provides.	A detailed discussion of risks of inaction and climate change impacts on the state have been provided (e.g. human health impacts; increased coastal flooding, erosion, and private property and public infrastructure damage; Increased frequency and severity of heavy, damaging rainfall events and summer droughts; etc.)	Actions that provide the greatest net economic benefits and economic opportunities to New Hampshire, while also considering energy security, public health, and environmental benefits have been selected. It is also stated that all of the recommended actions can be implemented immediately or through a phased-in approach that can expand implementation as technology evolves and economic means become available. For each recommendation, the subsection on implementation includes brief information about the timing of the implementation.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
New Jersey	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options	Net present value benefits of supporting measures have been calculated and reported. Some funding sources or mechanisms have been identified (e.g. The Local Government GHG Reduction Grant Program will be a funding source for municipalities striving to develop and implement both conventional and innovative smart growth policies that will reduce VMT and increase other mobility options; expand the use of the New Jersey Brownfield Reimbursement Fund (BRF) to provide financial incentives to build renewable energy projects on brownfield sites).	Quantified Co-benefits: green jobs: Net impact of all measures = 12,000 jobs in nonagricultural employment by 2020; Net impact as % of 2020 baseline= +0.3%. The core and supporting recommendations and related actions taken as a whole are projected to result in a slight gain in total employment and slight decreases in personal income and Gross State Product (GSP) in 2020. Not quantified Co-benefits (due to time and resource constraints): Energy security; public health; environmental benefits.	Risks of inaction have been briefly mentioned (e.g. Climate-related risks to public health, the environment and the economy; economic risks to New Jersey's ports and agricultural tradition).	There are three sets of measures: 1) 3 core measures that are prioritized (New Jersey Energy Master Plan (EMP); New Jersey Low Emission Vehicle (LEV) program; and Regional Greenhouse Gas Initiative (RGGI) program); 2) "actions now for future impact" that are for longer term reductions; and 3) Beyond the 2020 recommendations and related actions.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
New Mexico	Some, but not all, implementation roles and responsibilities are discussed (e.g. e.g. The CCAG recommends that New Mexico task a state agency with regulatory authority to provide technical resources for carbon sequestration, including an evaluation of suitable storage sites, and possibly the administration of incentives). Implementation plan is blended in policy options.	Net present value has been calculated for each policy measure. Some funding sources are identified (e.g. the State Public Project Revolving Loan Fund, federal Congestion Mitigation Air Quality funds, An Energy Innovation Fund to develop new technologies for clean energy.). However, for a number of policy measures identification of funding sources to support implementation has been mentioned as a challenge.	Not quantified Co-benefits: Jobs (e.g. creation of jobs in the biomass energy and liquid biofuels feedstock/production industries; increase in related jobs in New Mexico as energy investment shifts from fuel production to the manufacture of renewable technologies on a relative basis); clean air and public health.	Risks of inaction are not discussed.	A potential policy option being considered by a TWG was not accepted as a “priority for analysis” and developed for full analysis unless it had a supermajority (defined as five or fewer “no” votes or objections) of support from CCAG members. Cost-effectiveness; net present value; and level of support have been considered.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Nevada	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Costs are discussed, but not quantified. For example, for some proposals the cost is “minimal” or “unknown”. The final recommendations include a section on “impacts” that addresses cost, funding source, staffing, and regulation or law modification related to the actions.	Not quantified Co-benefits: Jobs; energy security due to increased diversity of energy sources; clean air and public health; reduced threat of catastrophic wildfire.	Potential impacts of climate change on public health, water, wildfire, air quality, agriculture and recreation are assessed.	The Committee agreed to identify six priority recommendations. These recommendations were chosen based on importance and implementation feasibility in the near term with current or minimal additional resources.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
New York	Some, but not all, implementation roles and responsibilities are discussed. Implementation plan is blended in policy options.	Net present value, and net costs/savings per avoided emissions have been calculated and reported for each measure. Funding is discussed for every policy option, but sources are not necessarily identified (e.g. NY could explore expanding the scope and funding for statewide consumer education programs and electronically accessible energy efficiency tools and resources for all fuels).	Not quantified Co-benefits: Jobs; energy security; public health.	The Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State was initiated in 2008 to provide decision makers with cutting-edge information on the state's vulnerability to, and its ability to derive benefits from, climate change and to facilitate adaptation strategies. Scenarios have been developed for risks.	Prioritization is mostly about adaptation measures. It is mentioned that TWGs selected priority policies in the process. Economic analyses (net present value and net cost-savings per avoided emissions) have been considered.
Ohio	--	--	--	--	--

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Oregon	The CAP has a separate implementation plan (i.e. detailed roadmaps to move from planning to achieving results). Implementation plan is also blended in policy options. Recommended organizational actions as well as lead agencies for each sector are provided.	Costs are broadly discussed, but not necessarily quantified for each action. Funding is discussed for almost every policy measure in the 2020 roadmap report. For some measures, sources of funding are identified and a detailed discussion is provided. For others, it is stated that funding sources should be developed (e.g. developing new, stable sources of funding for climate-friendly transportation).	Not quantified Co-benefits: Jobs; energy security; public health; education values; demonstration values; and overlap with the West Coast Governors' Global Warming Initiative. Technical committee recommended actions tables provide a column for co-benefits, risks and trade-offs, etc. However, for the majority of measures the columns are not filled with data.	The Oregon Climate Change Adaptation Framework (2010) provides comprehensive suite of information to understand climate change impacts in Oregon and how the state should prepare for and adapt to those changes.	A list of immediate state actions has been provided in the 2004 plan for each sector (e.g. energy efficiency immediate actions). The Advisory Group used a systematic evaluation tool that considered: quantities of GHGs reduced, avoided or sequestered; whether the reductions are captured early or delayed; technically feasibility; its costs compared to the costs of alternative actions (or inaction); whether the measure requires new legislation or regulatory action; political barriers; and collateral benefits or costs.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Pennsylvania	Implementation plan is blended in policy options. Some, but not all, implementation roles and responsibilities are discussed.	Costs (NPV) and Cost-Effectiveness ($/tCO2e) have been calculated for each policy measure and reported. Economy-wide Stepwise Marginal Cost Curve has also been provided. Some funding sources have been identified (e.g. DCED's Land Use Planning and Technical Assistance Program (LUPTAP) funding can assist in preparation of community comprehensive plans with a focus on implementing smart growth principles).	Quantified Co-benefits: the recommendations are expected to result in the net creation of 65,000 new full-time jobs and add more than $6 billion to the state's gross state product in 2020. Not quantified Co-benefits: Macroeconomic benefits due to energy bills savings; reduced peak demand, electricity system capital and operating costs, reduced risk of power shortages, energy price increases and price volatility; improved public health; reduced dependence on imported fuel sources and greater energy security.	Pennsylvania State University conducted an assessment report as directed by the Pennsylvania Climate Change Act on impacts of climate change on Pennsylvania.	Some discussion of prioritization is included, but policy measures have not been prioritized (e.g. Waste-to-Energy MSW: DEP could implement this work plan by prioritizing projects with economic development benefits or enhanced renewable energy technologies).

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Rhode Island	Implementation plan is blended in policy options However, it is stated that in Phase III, an implementation plan must be developed. With the exception of the 2013 Act that discusses some agency responsibilities, the plan does not discuss responsibilities.	For every policy measure, Cost of Saved Carbon (CSC) and Net co-benefits (a savings, thus negative) per metric ton of carbon equivalent reduced by the option have been calculated and reported. For every policy option some funding mechanisms/sources are suggested (e.g. Efficient Residential Electric Cooling Initiative: using SBC or other public benefit funds for education, program marketing and/or contractor training, as well as financial incentives).	Not quantified Co-benefits: Jobs; energy independence and security; public health.	A number of potential risks have been identified (e.g. flooding, saltwater contamination of drinking water, extreme weather events, and damage to local crops).	The Working Groups prioritized the options into four bins: high priority, medium priority, low priority, and non-consensus through stakeholder evaluation.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
South Carolina	Implementation plan is blended in policy options. Some, but not all, implementation roles and responsibilities are discussed.	Cost-effectiveness and net present value have been calculated for all of the measures with the exception of cross-cutting issues. Funding sources are discussed for some but not all measures (e.g. the state should provide additional funding of $20 million for clean energy initiatives that encourage collaborations among R&D, government, academic, and commercial sectors). For some measures, on the other hand, funding has been considered to be a challenge (e.g. "funding is always a challenge for transportation strategies and infrastructure improvements).	Not quantified Co-benefits: Jobs (green collar employment expansion and economic development); energy security and independence (reduced dependence on imported fuel sources); public health.	Risks of inaction are not discussed. Yet, it is recommended to develop a Climate Change Adaptation Plan to include potential risks and costs of inaction.	In developing its recommendations, the CECAC considered the potential benefits, costs, savings, and feasibility of furthering building and infrastructure efficiency, and related energy policy and economic opportunities.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Utah	Implementation plan is blended in policy options. Some, but not all, implementation roles and responsibilities are discussed.	Cost of actions has been qualitatively discussed (high, low, etc.). Examples of calculated cost of reducing emissions per each measure by other states have been provided. Potential funding sources have been identified for some but not all recommendations (e.g. e.g. DSM: A small charge – typically equivalent to a $0.27 to $2.50 - is placed on a consumer's electricity bill in order to secure funding for investment in energy efficiency programs).	Not quantified Co-benefits: Jobs (Again, quantifications of other states have been referenced); energy security; better air quality and public health; reduced water pollution; wildlife habitat and recreational opportunities preservation; water and air filtration; and reduced risk of fires.	Risks are discussed in the "Climate Change and Utah: The Scientific Consensus" report. Its summary is included in the CAP (e.g. decline in Utah's mountain snowpack and severe and prolonged episodic drought in the state).	Evaluation of associated environmental, economic, and other co-benefits was conducted as a part of the recommendation selection process.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Virginia	For every policy option, roles and responsibilities are explained (see the protocol). Implementation plan is blended in policy options.	Cost per Ton CO2e Reduced is calculated and reported for each measure. Funding is discussed for each policy measure (e.g. The General Assembly should ensure stable funding for an expanded Weatherization Assistance Program). Yet, for some measures it is stated that "either new funding sources, redirection of existing resources, or both, will be required".	Not quantified Co-benefits: Jobs; public health. Co-benefits of specific measures have also been discussed (e.g. Reductions in VMT has several co-benefits including reduced congestion, improved air quality, lower transportation costs for households and businesses, and lower impacts on Virginia's transportation infrastructure).	Relatively detailed discussion of risks has been provided (e.g. Effects on the built environment and insurance: sea level rise and storm surge may affect certain areas of coastal Virginia)	Measures have not been prioritized. However, for some policy measures developing a priority mechanism is mentioned (e.g. the Secretary of Transportation should work with stakeholders to develop specific goals and priority measures for the coming reauthorization of the federal surface transportation act that will reduce the GHG emissions from transportation). It is also stated that action focus first on no-cost and low-cost GHG reduction strategies and those with co-benefits and over time explain the need for long-term mitigation actions and those that may increase energy costs.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Vermont	Roles and responsibilities have only been discussed for the six prioritized measures. Implementation plan is blended in policy options.	Both upfront and long-term costs are discussed qualitatively (high, medium, low). Funding is discussed, but specific sources or mechanisms have not been necessarily identified (e.g. the Commission is not recommending a specific approach to funding but, rather, making it clear that greater investment will be necessary to counter the increasing contribution of single-occupant vehicles (SOV) to the problem of climate change).	Not quantified Co-benefits: Jobs; energy security; community benefits; broader environmental benefits.	Some impacts on public health, natural resources and the economy are discussed.	The six overarching recommendations have been prioritized. The Commission developed a matrix reflecting high, medium, and low rankings against a number of attributes, including GHG reduction benefits, potential for cultural change, upfront cost, long-term cost, challenges to implementation, and collateral benefits and/or damages.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Washington	Roles and responsibilities have only been discussed (e.g. The legislator required the Departments of Ecology and Commerce to track progress). Implementation plan is blended in policy options.	The plan includes some suggestions for exploring new revenues and funding options to be used for implementing certain projects. For example, parking tax for dense urban locations is suggested to be used for projects and programs in the CTOD and tax credits for lower parking ratios.	Quantified Co-benefits: Jobs (Green job growth projections in the Pacific Northwest--Oregon and Washington: 30,703 green jobs by 2020; and 41,241 green jobs by 2025) Not quantified Co-benefits: Energy security; public health;	There are several reports categorized under "Preparing Washington for a changing climate" that focus on risks and potential adverse climate impacts on infrastructure and built environment, human health, natural ecosystems, etc.	There is no evidence of systematic prioritization mechanism.

State	Roles & Responsibilities	Costs & Funding	Externalities or Co-benefits	Risks of Inaction	Selection & Prioritization of Actions
Wisconsin	Affected sectors, sub-sectors and/or entities responsible are identified for all measures. In the "recommended Action" section of each policy all steps are discussed and entities involved or responsible are identified. Implementation plan is blended in policy options.	Costs of actions have been calculated for some but not all of the policy options. Funding sources are identified for some but not all of the policy options. In the full description of each policy, there is a section on funding.	Not quantified Co-benefits: "Green collar" jobs; energy security; public health; forest health; other environmental co-benefits such as reduced soil erosion and phosphorus run-off to water resources, reforestation, afforestation, etc.	Risks of inaction have not been discussed.	Some early actions or priority actions have been identified.

F. Implementation, Monitoring and Evaluation

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Arizona	2006	Executive Order 2005-02 directed the Climate Change Advisory Group (CCAG), under the coordination of the Arizona Department of Environmental Quality.	No or limited evidence of implementation	No sign of monitoring/evaluation
Arkansas	2008	Act 696 of the Arkansas 86th General Assembly (HB2460), established the Governor's Commission on Global Warming (GCGW).	No or limited evidence of implementation	No sign of monitoring/evaluation
California	2006	Executive order S-03-05 signed in 2005 established emissions reduction goals for California. AB 32, the California Global Warming Solutions Act of 2006 set a binding economy-wide target for GHG emissions. SB 375 set regional land-use GHG emissions targets	Implementation is underway. AB 32 directs the California Air Resources Board (ARB) to be the lead agency to implement the law. The Climate Action Team, made up of relevant state agencies, is charged with helping direct state efforts on the reduction of GHG emissions and engaging state agencies.	ARB annually updates a statewide GHG inventory. AB 32 requires ARB to develop a Scoping Plan which lays out California's strategy for meeting the goals. First Update to the Climate Change Scoping Plan highlighting progress towards the 2020 target was approved in 2014.
Colorado	2007	Executive Order D 004 08 issued in 2008 declared the state's GHG reduction goals, directing the Colorado Department of Public Health and Environment ("CDPHE") to develop regulations to address climate change.	There is evidence of progress in the implementation of several measures reported on the Colorado Climate Scorecard.	Two Colorado Climate Scorecards (2011; & 2013) that show the implementation status of the Colorado CAP and Rocky Mountain Climate Organization's Climate Action Panel Recommendations.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Connecticut	2005	CT Global Warming Solutions Act (Public Act 08-98) reaffirms CT's commitment to GHG targets for 2020 and 2050	A 2011 implementation update report published in 2014 shows progress towards goals.	In the Department of Energy and Environmental Protection website, there is a "climate change" link that provides information on the state's climate actions through time. Inventories showing progress are posted regularly.
Florida	2008	House Bill 7135 ("The Energy, Climate Change, and Economic Security Act of 2008"). Executive Order 07-127 set emission reduction goals. Executive Order 07-128 created the Action Team to develop recommendations for mitigation and adaptation to achieve or surpass the statewide targets.	There is evidence of some implementation. House Bill 7135 of 2008, enacted a number of energy and climate change policies.	No sign of monitoring/evaluation
Iowa	2008	Senate File 485 established the Iowa Climate Change Advisory Council (ICCAC).	As part of the 2010 State Government Reorganization (Senate File 2088), the Iowa Climate Change Advisory Council was disbanded on July 1, 2011.	No sign of monitoring/evaluation
Illinois	2007	Executive Order 2006-11 on October 5, 2006 created the Illinois Climate Change Advisory Group.	The 2007 CAP includes appendices showing the implementation status of each policy measure. However, there is no further information on Illinois EPA website.	No sign of monitoring/evaluation

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Kentucky	2011	--	No or limited evidence of implementation	No sign of monitoring/evaluation
Maine	2004	A 2003 Maine law (PL 237) required the Department of Environmental Protection (DEP) to develop and submit a Climate Action Plan (CAP or Plan).	The website of Maine Department of Environmental Protection has a climate change link with some evidence of programs and monitoring. However, the page does not include detailed information about implementation of the CAP.	There is some evidence of monitoring provided in the climate change webpage of the DEP. The Monitoring, Mapping, Modeling, Mitigation and Messaging Report released in 2014 focuses mainly on adaptation.
Maryland	2008 2013	Executive Order 01.01.2007.07 established a Climate Change Commission and tasked the Commission to develop a CAP. Greenhouse Gas Emissions Reduction Act of 2009 (SB 278/ HB 315) established a mandatory goal of reducing the state's GHG emissions. Sustainable Communities Act of 2010 implements a GHG reduction initiative similar to that contained in California's Senate Bill 375.	There is information about legislative actions, executive orders, and several related reports posted on the state's climate change website.	There is a progress link on the state's climate change webpage that directs the user to the Department of Information Technology Open Data Portal.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Massachusetts	2004 2010	Executive order 438 established the Massachusetts State Sustainability Program that focuses on waste reduction, mercury elimination, and GHGs reduction. The Global Warming Solutions Act (GWSA) signed in 2008 created a framework for reducing GHGs.	Implementation is underway. The Energy and Environmental Affairs website provides detailed information about the Massachusetts Global Warming Solution Act, such as strategies to reduce GHG emissions by 2020, sectoral progress towards goals, and information about the Regional Greenhouse Gas Initiative Auction Process. The state has established an Implementation Advisory Committee and Implementation Subcommittees.	5-year progress reports are published regularly. The Energy and Environmental Affairs website provides information about progress towards the 2020 goal.
Michigan	2009	Executive Order 2007-42 signed in 2007 created the Michigan Climate Action Council (MCAC) to prepare a CAP with recommended GHG reduction goals and potential actions to mitigate climate Change.	There is some evidence of implementation (e.g. Climate Action P2 Projects 2010 provided grants for local governments to develop CAPs).	No sign of monitoring/evaluation.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Minnesota	2003 2008	The Next Generation Energy Act of 2007 includes requirements to increase energy efficiency, expand community-based energy development, and establish a statewide goal to reduce GHG emissions.	Implementation is underway. There are several recent statutes related to the implementation of the plan (e.g. 216H07 Emissions Reduction Attainment; Policy Development process)	The CAP is the most recent document posted on the Minnesota Pollution Control Agency's webpage related to climate change. There is evidence of more recent meetings related to the implementation of the CAP (i.e. 2014 MN Climate Solutions & Economic Opportunities (CSEO) Stakeholders Meeting)
Missouri	2002	--	--	--
Montana	2007	The Environmental Quality Council (EQC) is an interim committee of the Montana Legislature. The EQC has polled public support for the recommendations. However, broad-based legislation addressing climate change has not emerged.	No or limited evidence of implementation	No sign of monitoring/evaluation
North Carolina	2008	The Clean Smokestack Act (CSA) signed in 2002 tasked the Department of Environment and Natural Resources' (DENR) Division of Air Quality (DAQ) to study options for reducing carbon emissions from coal-burning power plants and other sources.	No or limited evidence of implementation	No sign of monitoring/evaluation. With the exception of an adaptation plan (i.e. Climate Ready North Carolina: Building a Resilient Future) published in 2012, there are no other progress reports published.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
New Hampshire	2009	Executive Order 2007-3 established the Climate Change Policy Task Force to develop GHG reduction goals and recommend specific actions. House Bill 1434 authorized a cap-and-trade program. HB 1561 (Laws of 2008, codified as RSA-O:5-a) established an Energy Efficiency and Sustainable Energy Board.	Implementation is underway. The website of NH Department of Environmental Services provides information about several programs and legislative action related to the CAP. There is also a Greenhouse Gas Emissions Reduction Fund (GHGERF) established to support energy efficiency and renewable energy Initiatives.	The website of NH Department of Environmental Services which provides information about CAP implementation has been updated in 2014.
New Jersey	2009	Executive Order 54 signed in 2007 set a reduction target in NJ. The New Jersey Global Warming Response Act (P.L. 2007, c.112) enacted on July 6, 2007 established statewide limits on GHG emissions.	The 2007 Global Warming Response Act (GWRA)	NJ's Department of Environmental Protection provides a link to the plan, inventories and other related publications. In GWRA's webpage progress towards targets is illustrated in graphs.
New Mexico	2002 2006	Executive Order 05-33 signed in 2005, establishes the New Mexico Climate Change Advisory Group (CCAG) to prepare a CAP.	Limited evidence of implementation. In 2012, the Environmental Improvement Board (EIB) approved the repeal of 20.2.300 NMAC - Reporting of Greenhouse Gas Emissions, 20.2.301 NMAC - Greenhouse Gas Reporting - Verification Requirements, and 20.2.350 NMAC - Greenhouse Gas Cap-and-Trade Provisions.	The latest inventory is 2000-2007 published in 2010.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Nevada	2008	Executive order signed in 2007 created the Nevada Climate Change Advisory Committee (NCCAC).	A final CAP was not developed as recommended by the 2008 Advisory Committee Final Report. No or limited evidence of implementation.	No sign of monitoring/evaluation.
New York	2010	Executive Order 24 signed in 2009 established a goal of reducing GHG emissions 80% below 1990 levels by 2050, and named the Climate Action Council to determine how to meet the goal.	Except for information about Regional Greenhouse Gas Initiative (RGGI), The Community Risk and Resiliency Act (CRRA), and The Climate Smart Communities program (the latter two are more adaptation-focused) there is no evidence of implementation.	No sign of monitoring/evaluation.
Ohio	2011	--	--	--
Oregon	2004 2008	House Bill 3543: Global Warming Actions codifies GHG reduction goals, establishes a Global Warming Commission, and creates the Oregon Climate Research Institute in the Oregon University System.	Implementation is underway. The 2015 Biennial Report shows that the 2010 goal is met. Yet, the report projects project Oregon's 2020 emissions to be 11 million MTCO2e above the target level, with the gap between emissions and goals widening each year to 2050 unless additional action is taken.	Four biennial reports have been published (2009; 2011; 2013; & 2015)

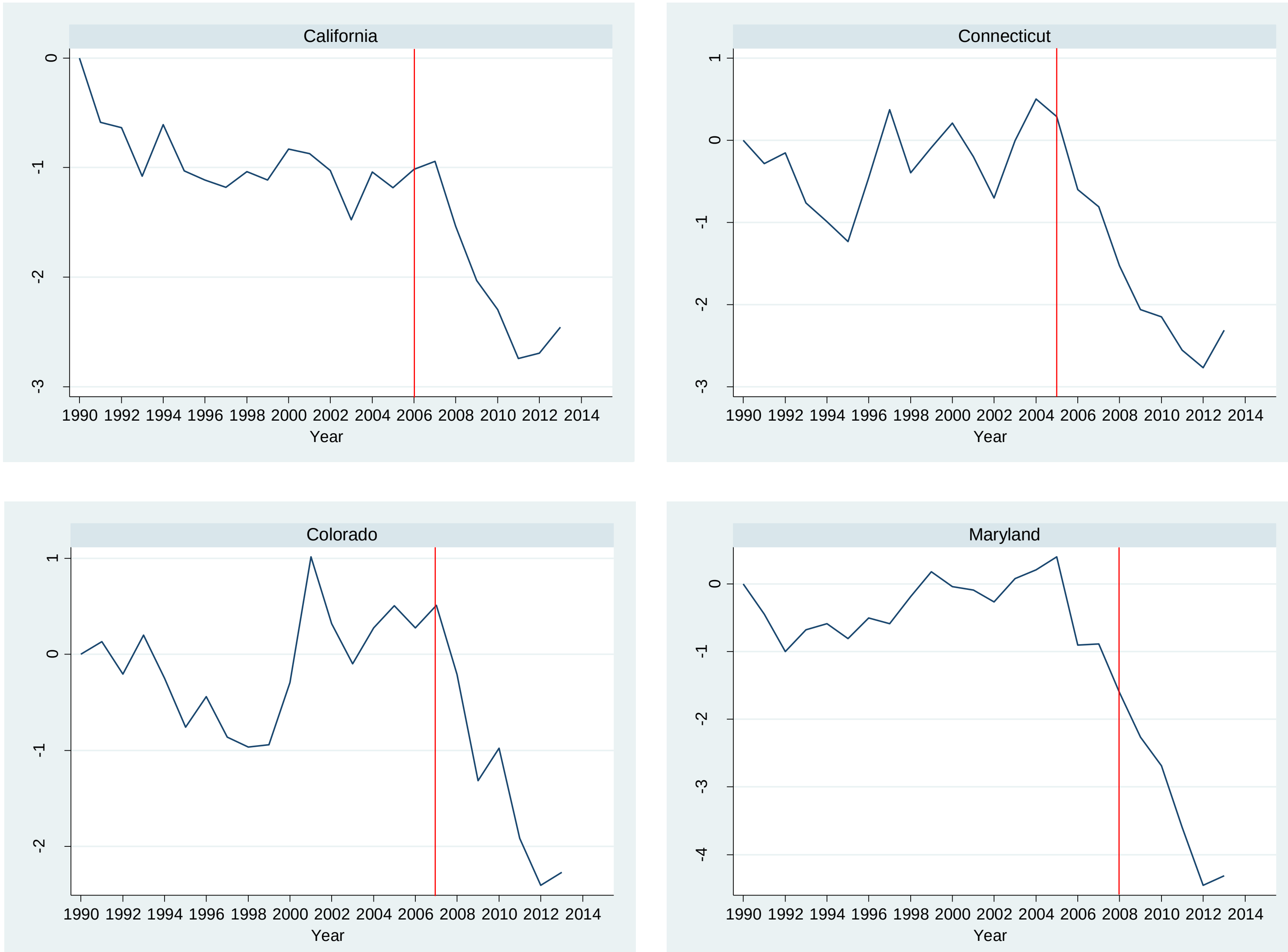
State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Pennsylvania	2009 2013	The Pennsylvania Climate Change Act 70 signed in 2008 requires the Department of Environmental Protection to develop an inventory and a CAP.	There is some evidence of implementing certain programs, such as Natural Gas Energy Development Program and Pennsylvania Sunshine Program. Yet, it can be inferred from the webpage that most of the progress is attributable to either federal level regulations or "broad-based changes to Pennsylvania's economy and energy portfolio"—that result in GHG emissions reduction--as opposed to implementation.	Pennsylvania Climate Change Action Plan Update was published in 2013.
Rhode Island	2002 2013	Rhode Island Energy Independence and Climate Solutions Act signed in 2013 sets GHG limits and provides a framework for developing strategies to reach targets. Executive Order 14-01 signed in 2014 created the Rhode Island Executive Climate Change Council (EC3) to assess and coordinate efforts.	The initial CAP process lasted six years: from 2001 to 2007. In 2007 the process stopped due to lack of funding. However, a 2013 review of the CAP has determined that approximately 65% of the 52 program and policy options have been implemented.	The 2013 review evaluates the outcome of the CAP. A 2016 update to the CAP is underway.
South Carolina	2008	Executive Order No. 2007-04 establishing the Governor's Climate, Energy, and Commerce Advisory Committee (CECAC) to develop a Climate, Energy, and Commerce Action Plan containing specific recommended actions for mitigating GHG emissions.	No or limited evidence of implementation.	No sign of monitoring or evaluation except for a report published by South Carolina Department of Natural Resources in 2013 about Climate Change Impacts to Natural Resources in South Carolina (adaptation).

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Utah	2007	--	No or limited evidence of implementation.	No sign of monitoring/evaluation.
Virginia	2008	Executive Order 59 signed in 2007 established the Governor's Commission on Climate Change. E.O.59 to create a CAP that Identifies the actions (beyond those identified in the Energy Plan) to be taken to achieve the 30% reduction goal. In 2014, Governor McAuliffe signed Executive Order convening Climate Change and Resiliency Update Commission.	Implementation is underway. The 2014 report shows some progress.	Virginia Accomplishments Since the 2008 Climate Action Release report was published in 2014. The Commission is charged with evaluating the 2008 CAP, updating its recommendations, and identifying funding sources.
Vermont	2007	Executive Order 07-05 signed in 2005 established the Governor's Commission on Climate Change (GCCC) and specified a target of reducing Vermont's GHG emissions. The targets specified by this executive order were subsequently affirmed and reinforced by Vermont's General Assembly in the passage of Act No. 168 (S.259) in 2006. The Climate Cabinet established in 2011 was reconstituted in 2012 by Executive Order 15-12.	There are several initiatives on the State's Agency of Natural Resources website related to the CAP. Examples include the VTrans Climate Change Action Plan (2008) and Clean Energy Development Fund (2005). It is stated in the 2015 inventory that Vermont did not achieve its 2012 goal of reducing GHG emissions to 25% below 1990 levels.	The most recent inventory was published in 2015.

State	CAP Date	Major Legislation/ Executive Order	Implementation	Monitoring & Evaluation
Washington	2008	Executive Order 07-02 Washington Climate Change Challenge signed in 2007 established goals for reducing GHG emissions. Executive Order 09-05 Washington's Leadership on Climate Change signed in 2009 requires the state to develop strategies and collaborations with other West Coast States to meet the targets and prepare for climate impacts. RCW 70.235.020 sets state GHG emissions reductions limits.	There is some evidence of implementation. However, Path to a Low Carbon Economy report published in 2010 shows that the state is not on track to meet its statuary reduction limit for 2020 and beyond.	With the exception of the two progress reports released in December 2012 and June 2015 related to state government emissions only and the interim report of 2010, there are no progress reports published on the implementation of the CAP.
Wisconsin	2008	Executive Order 191 created The Global Warming Task Force in 2007 to reduce GHG emissions in Wisconsin and make Wisconsin a leader in implementation of global warming solutions.	No or limited evidence of implementation.	No sign of monitoring/evaluation.

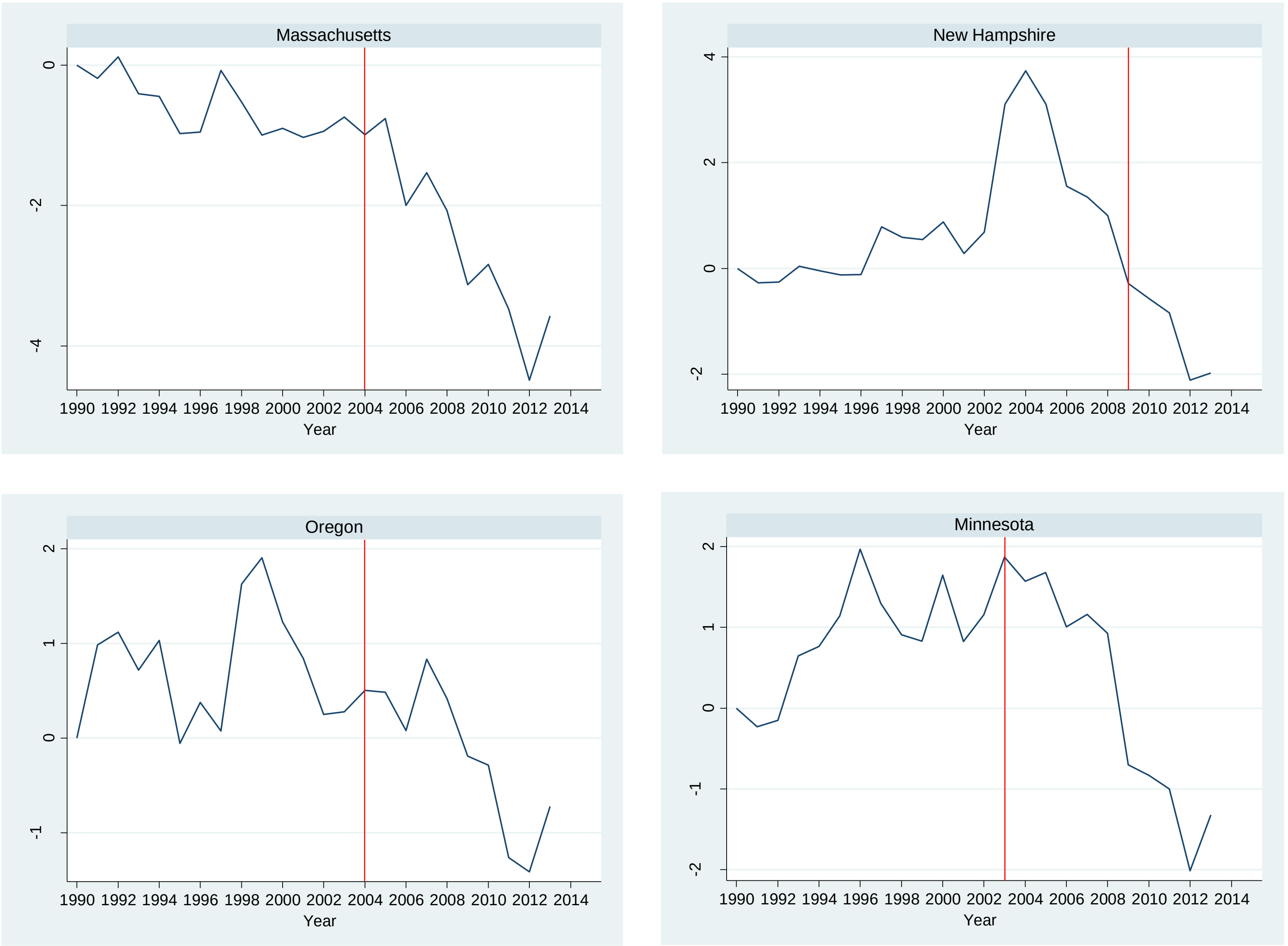
G. CAP Types

Type 6 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



Note: The red line marks the year the CAP was first implemented.

Type 6 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



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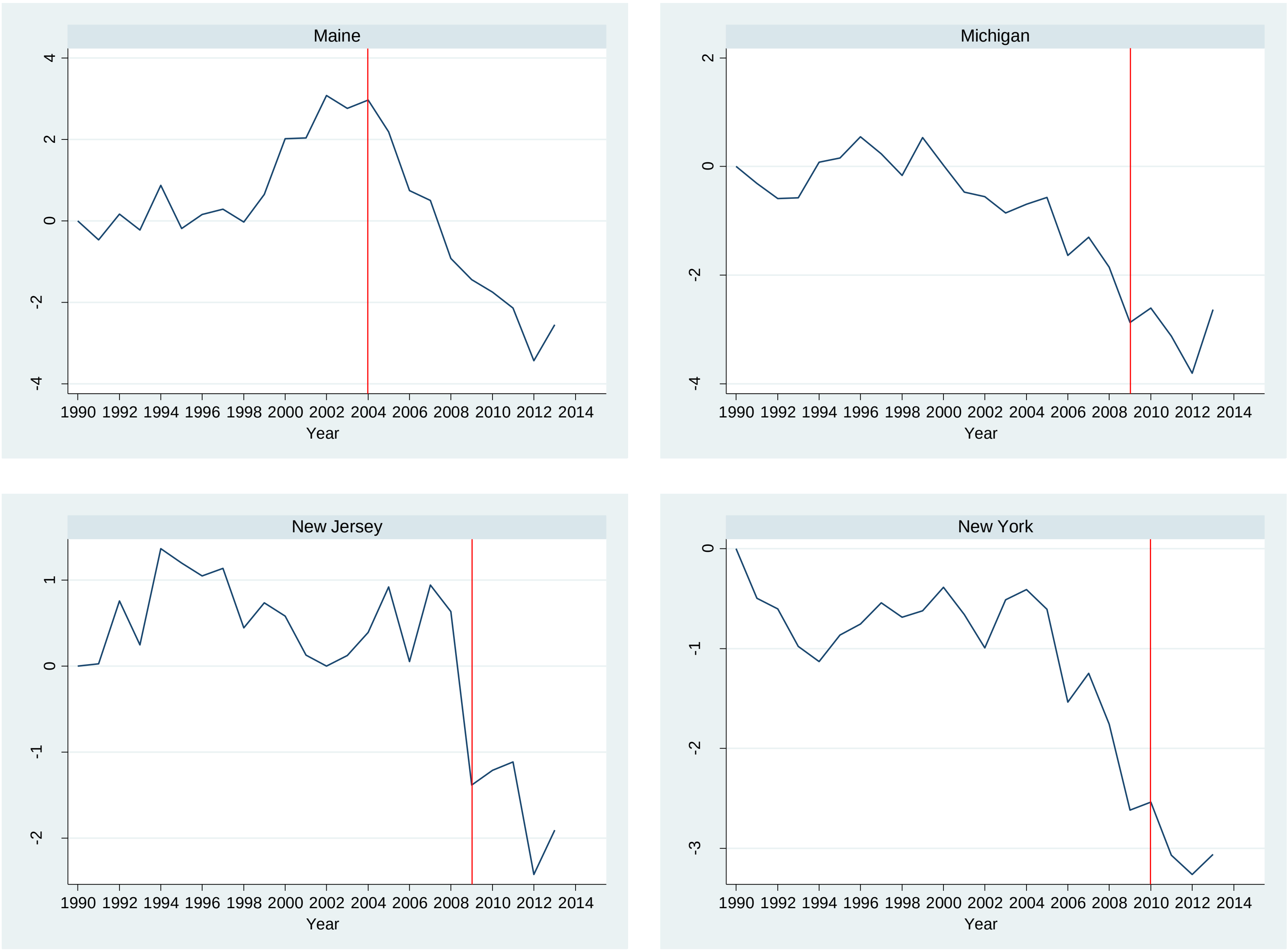
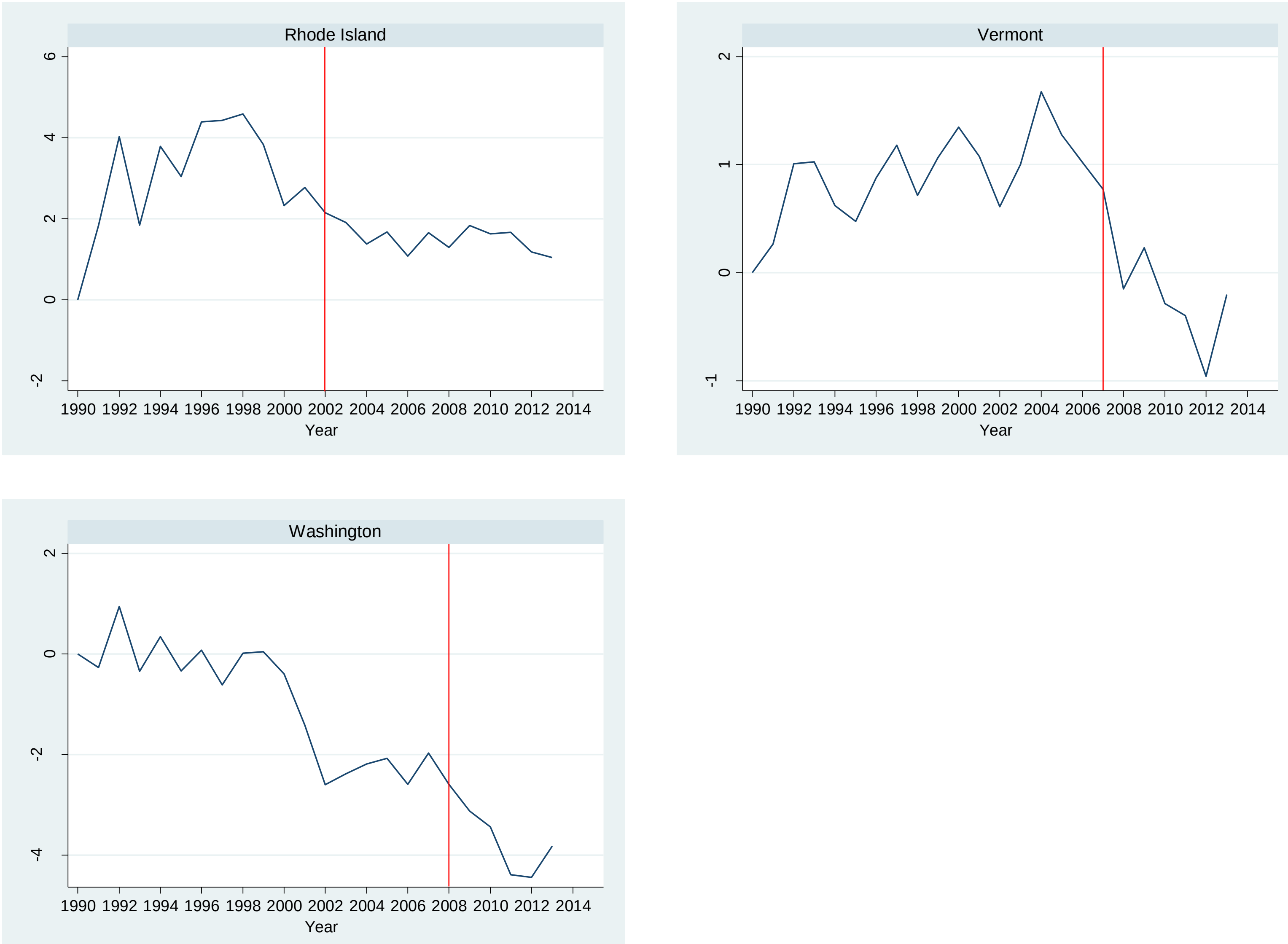


Type 5 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



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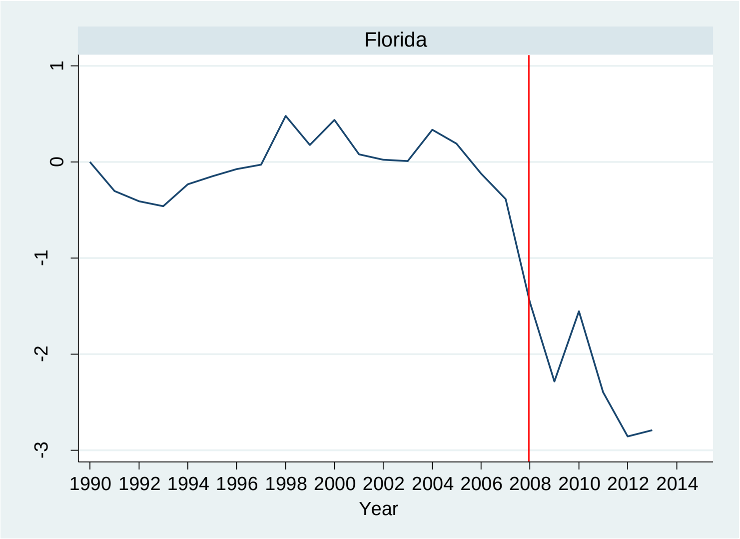
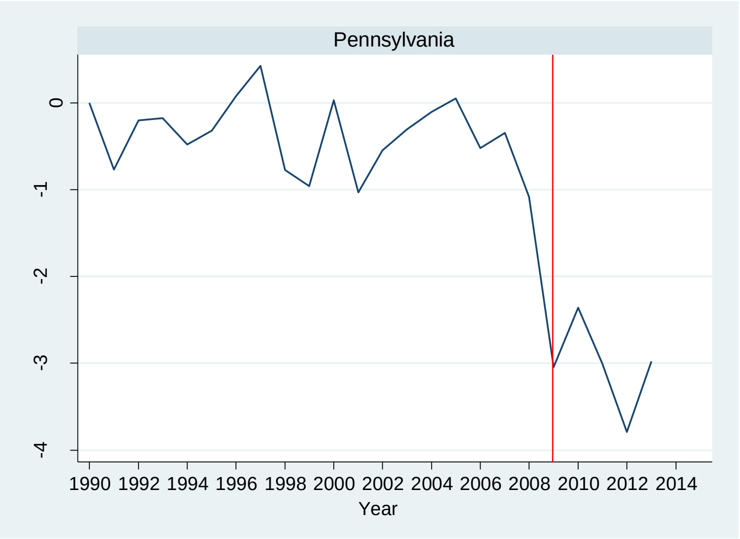
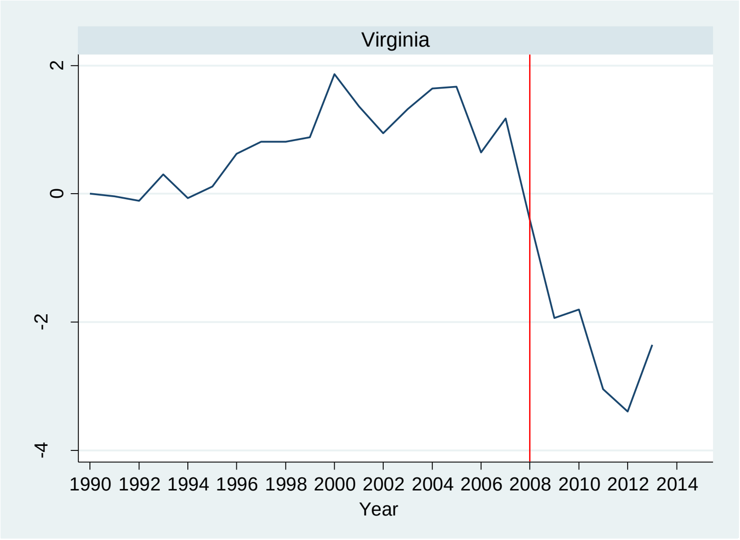
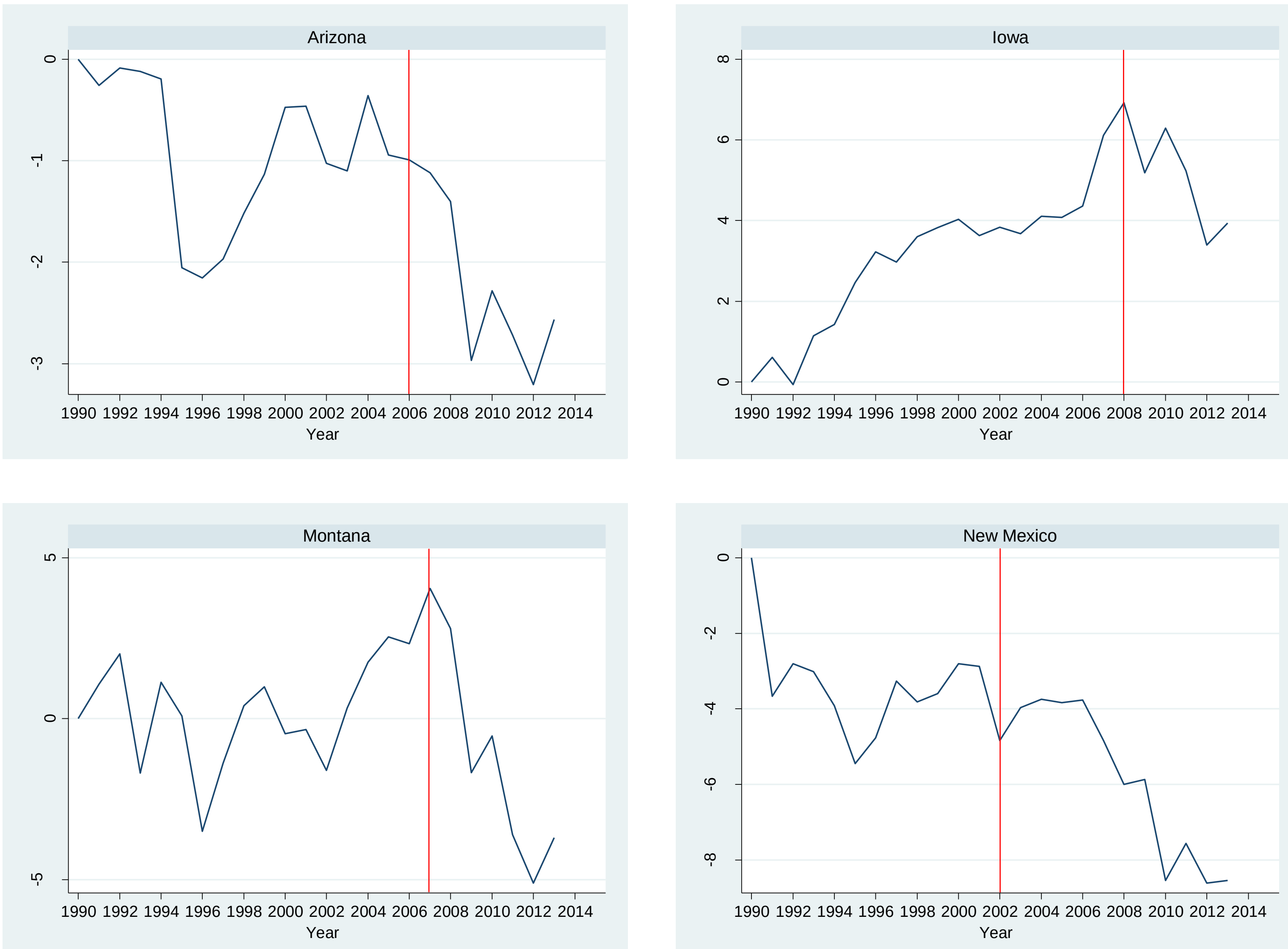


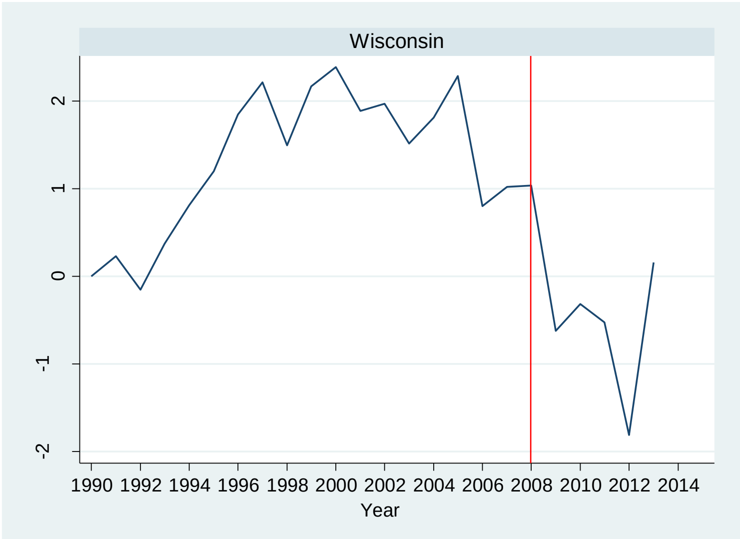




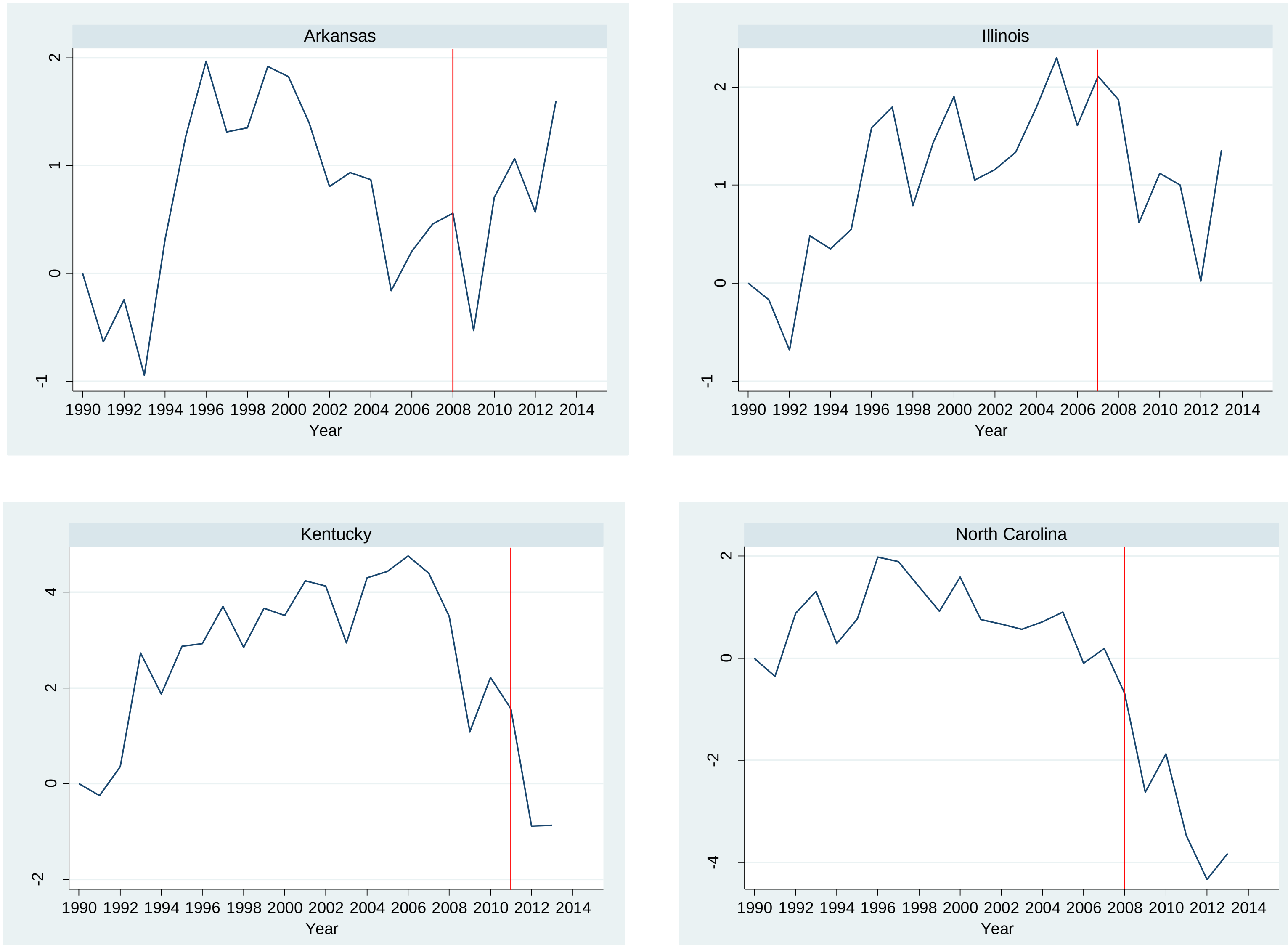
Type 3 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



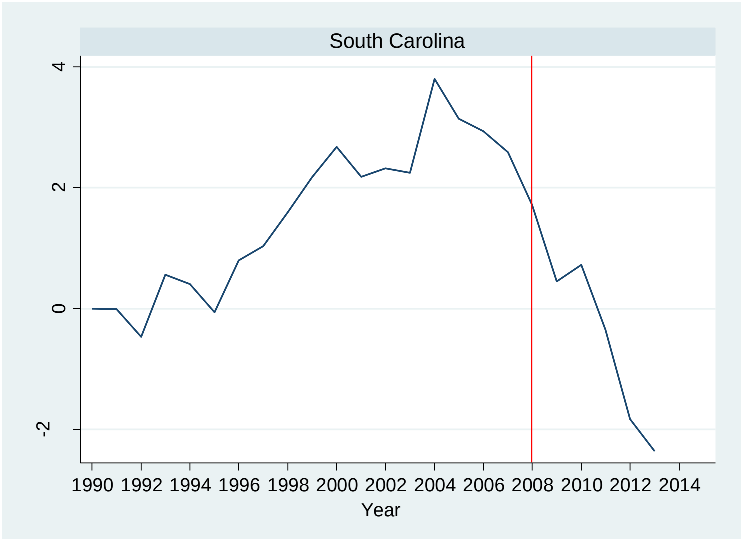
Type 3 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



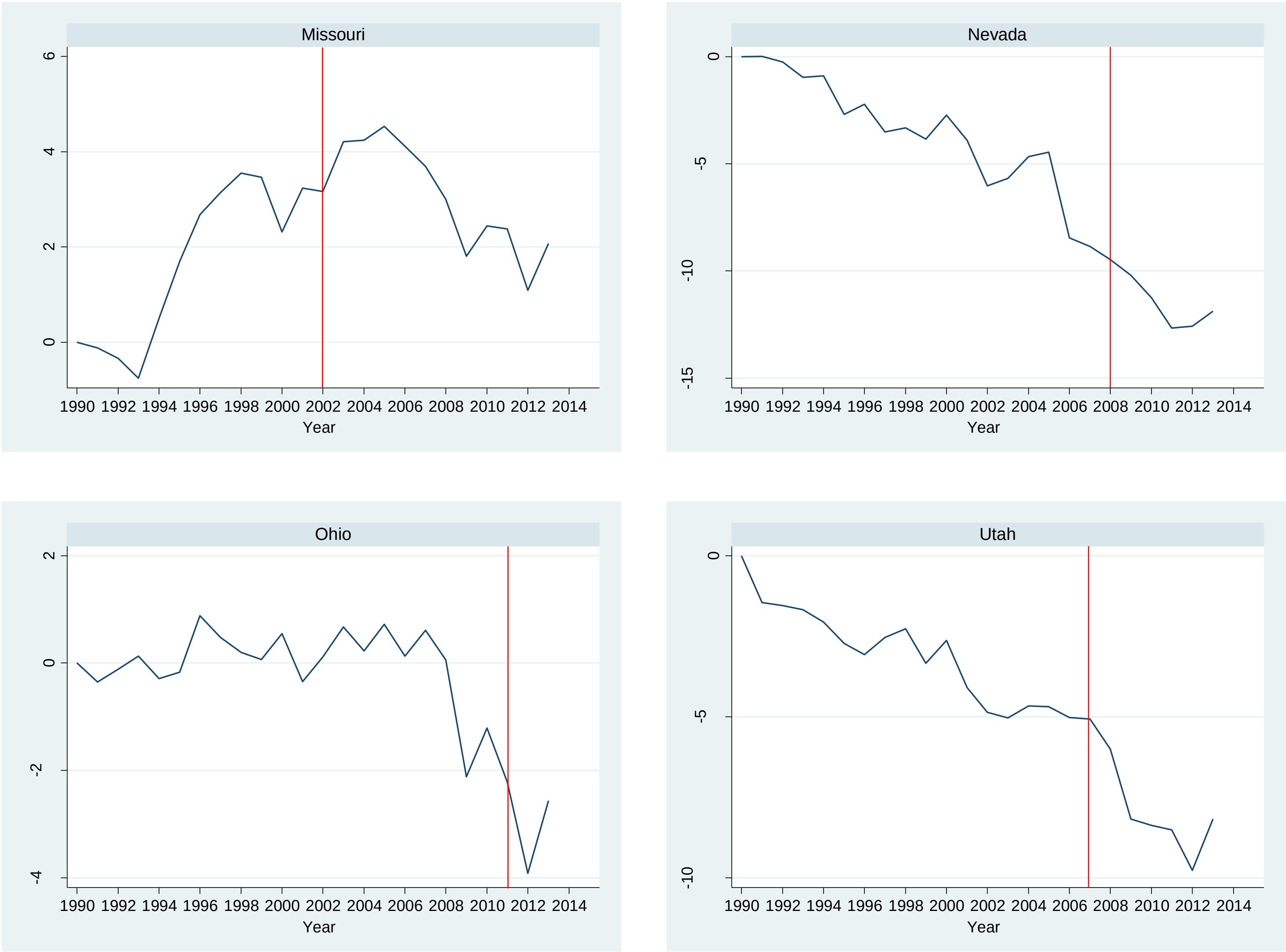
Type 2 Climate Action Plans and Change in Per Capita CO_2 Energy Emissions (1990-2013)



Type 2 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



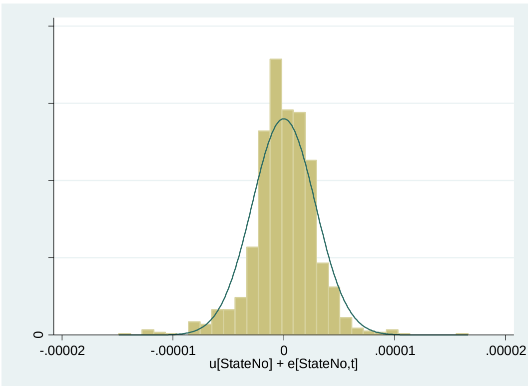
Type 1 Climate Action Plans and Change in Per Capita CO2 Energy Emissions (1990-2013)



H. Stata Output of the Model Predicting Effects of State Climate Action Plans on Per Capita CO2 Energy Emissions

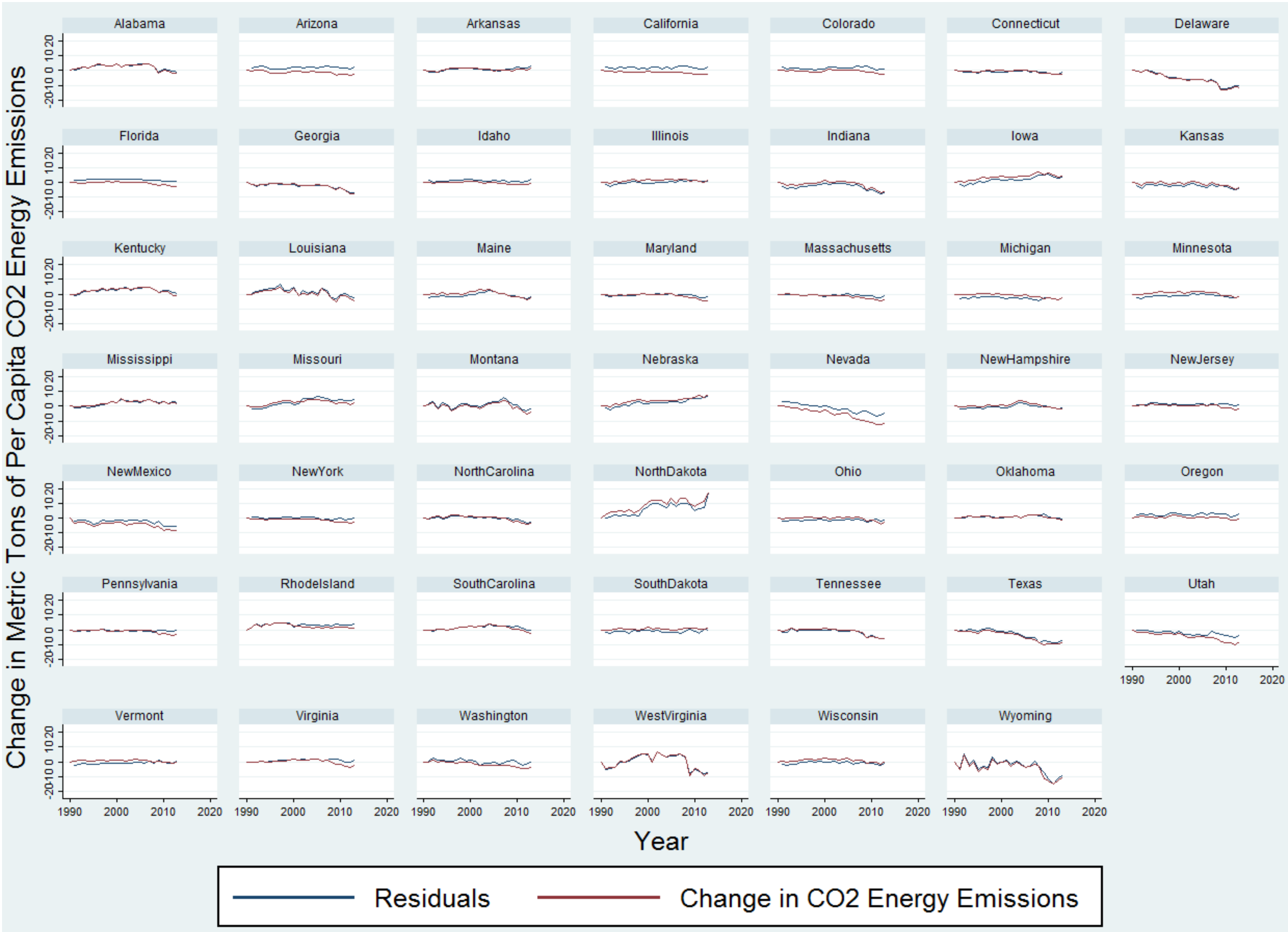
CorDifPCC2AllSectors	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
CAP_Imp						
1	-2.738705	.4704369	-5.82	0.000	-3.660744	-1.816665
2	-1.160499	.4315049	-2.69	0.007	-2.006233	-.3147653
3	-.8332563	.37403	-2.23	0.026	-1.566342	-.100171
4	-2.36251	.6782613	-3.48	0.000	-3.691878	-1.033143
5	-1.546992	.3661815	-4.22	0.000	-2.264694	-.8292891
6	-1.096547	.3278496	-3.34	0.001	-1.739121	-.4539741
CDD	-.0004712	.0003843	-1.23	0.220	-.0012244	.000282
HDD	.0001331	.0001618	0.82	0.411	-.000184	.0004502
GDPCO2InsMnf						
D1.	-4.979222	8.482682	-0.59	0.557	-21.60497	11.64653
GDPCO2InsNonMnf						
D1.	12.54649	6.146446	2.04	0.041	.4996724	24.5933
Energy_Price						
D1.	.010386	.0053661	1.94	0.053	-.0001314	.0209034
PCTDemVote	1.108312	1.624061	0.68	0.495	-2.07479	4.291413
Compactness_in	-.0602424	.0163587	-3.68	0.000	-.0923048	-.02818
PC_personal_income						
D1.	.0002443	.0000995	2.46	0.014	.0000493	.0004393
avgunemp						
D1.	.1368203	.0723019	1.89	0.058	-.0048887	.2785294
EnergyInterstateTrade_						
D1.	4.30e-08	1.51e-08	2.86	0.004	1.35e-08	7.26e-08
West	-2.791596	.9359555	-2.98	0.003	-4.626035	-.957157
South	-.8061115	.9547297	-0.84	0.398	-2.677347	1.065124
Northeast	-.6447329	1.006465	-0.64	0.522	-2.617367	1.327902
Midwest	0	(omitted)				
cons	5.765357	2.052358	2.81	0.005	1.74281	9.787904

```
Number of obs      =      1,104
Number of groups   =         48

Obs per group:
             min =           23
             avg =         23.0
             max =           23

Wald chi2(19)      =     221.75
Prob > chi2        =     0.0000

Random-effects GLS regression
Group variable: StateNo

R-sq:
     within  = 0.1630
     between = 0.2984
     overall = 0.2450

corr(u i, X)   = 0 (assumed)
```



Histogram of Residuals

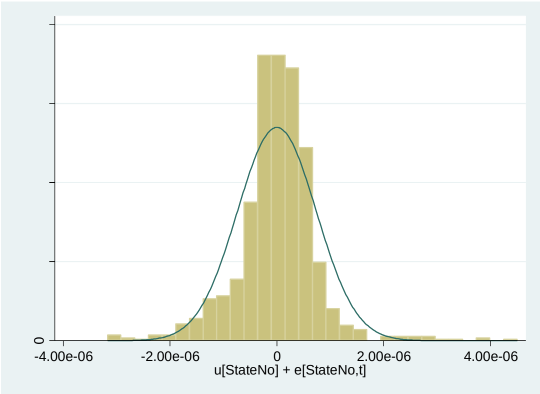
I. Dependent Variable and Residuals Plot



J. Stata Output of the Model Predicting Effects of Compactness on Per Capita Transportation CO2 Emissions

```
Random-effects GLS regression                   Number of obs     =      1,104
Group variable: StateNo                         Number of groups  =         48

R-sq:                                           Obs per group:
     within  = 0.2523                                         min =         23
     between = 0.4332                                         avg =       23.0
     overall = 0.3622                                         max =         23

                                                Wald chi2(9)      =     390.88
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

CorDifPCCO2Tran~n	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Compactness_in	-.0176663	.0056021	-3.15	0.002	-.0286462	-.0066863
change_PCP_Income	.0000639	8.39e-06	7.62	0.000	.0000474	.0000803
change_unemp	-.1502725	.0102218	-14.70	0.000	-.1703068	-.1302381
Energy_Price						
D1.	-.0004639	.0010458	-0.44	0.657	-.0025136	.0015859
CDD	-.0001226	.0000964	-1.27	0.204	-.0003115	.0000664
HDD	.0000712	.0000398	1.79	0.074	-6.81e-06	.0001493
West	-.4099271	.2239518	-1.83	0.067	-.8488646	.0290104
South	.0878208	.2269651	0.39	0.699	-.3570227	.5326642
Northeast	-.0657239	.2458225	-0.27	0.789	-.5475271	.4160793
Midwest	0	(omitted)				
_cons	1.435372	.5935814	2.42	0.016	.2719744	2.598771
sigma_u	.49856403					
sigma_e	.49879214					
rho	.49977128	(fraction of variance due to u_i)				



Histogram of Residuals

[1] ICLEI USA does not currently provide a list of member cities in the United States. For more information, please visit http://icleiusa.org/membership/.

[2] The general interview protocol is available in Appendix II. Interview procedures and questions were approved by the Institutional Review Board (IRB) at Cleveland State University on May 13, 2015.

[3] Center for Climate Strategies is a non-profit organization that helps U.S. States and other territories in their climate action planning efforts through facilitation, technical analysis, policy design, implementation, and financing. For more information, please visit http://www.climatestrategies.us

[5] With the exception of Arizona's CAP that sets a 2040 ultimate target, and Rhode Island's CAP update that sets a 2054 target.

[6] Virginia's CAP does not specify a baseline year. Instead, it compares emissions reductions to the business-as-usual alternative.

[7] According to New Mexico Environment Department, The Environmental Improvement Board (EIB) consist of seven members appointed by the governor, by and with the advice and consent of the State Senate. EIB is responsible for the promulgation of rules and standards related to various environmental topics, such as air quality management and water supply. For more detailed information, please visit https://www.env.nm.gov/eib/board.htm.

[8] For more information about The Regional Greenhouse Gas Initiative, please visit http://www.c2es.org/us-states-regions/regional-climate-initiatives/rggi

[9] For more information about the Georgetown Climate Center, please visit http://www.georgetownclimate.org/about-us.

[10] The aim of this section is not to evaluate the validity of these claims or the quality of analyses conducted to estimate co-benefits.

[11] A detailed discussion of why I included each dependent variable in my main model as well as information about data sources and the expected sign of regression coefficient for each variable are provided in the methods section.

[12] The state level score used in my models is the average of compactness score of all metropolitan counties within the state. Data were not available for a limited number of counties. These counties were not included in computing state level compactness score used in this study.

[13] For more information about transportation sector greenhouse gas emissions, please visit https://www.epa.gov/sites/production/files/2016-06/documents/420f16020.pdf.

[15] For more information regarding The Cleveland Climate Action Plan and Sustainable Cleveland 2019, please visit http://www.sustainablecleveland.org/.