Spring 5-1-2014

Adapting to a Changing Climate: Local Drivers for Policy Response

Andrew J. Bilich
University of Connecticut - Storrs, andy.bilich@uconn.edu

Adapting to a Changing Climate: Local Drivers for Policy Response

By Andy Bilich (Natural Resources 2014)

Abstract

Responding to the present and looming effects of global climate change presents a challenging task for policymakers at all levels of governance. The outcomes of climate change do present serious adaptation problems for global policy makers, but the implications of climate change are more immediately experienced by local communities and policy makers. Historical policymaking models suggest that economic well-being is an influential driver in local policy adoption. This particular analysis explores the relationship between economic variables and the development of climate adaptation policies by Connecticut municipalities. To test the degree of interaction present, adaptation policy data in the form of relevant capital improvement and zoning policies was collected from the individual municipalities. The towns were then grouped by several economic variables to assess the impact of wealth on policy generation. The analysis indicated that economic variables were not significant drivers of climate adaptation at the local level of governance. Instead, the data suggests that town policy is influenced by other policy drivers particularly the perceived and realized threat levels for climate change within individual towns.

Introduction

There is a growing volume of literature that is linking higher concentrations of atmospheric carbon to higher incidence of diseases (Epstein 2001; Epstein 2000; Epstein et. al 1998), increased storm frequency and intensity (Najjar et al., 2000; Meehl GA et. al 2000; Fowler and Hennessey 1995), rises in sea levels (Cazenave et al. 2008; Rahmstorf 2006; Church and White 2006), and a host of other serious problems for both natural and socioeconomic systems (IPCC AR4 WG2, 2007). Even if you choose to question the link between anthropogenic

carbon dioxide and global climate change, it is important to realize that with growing populations, energy demands, and global gross domestic product, the range, frequency, and severity of these effects is only going to increase (IPCC TAR SYR, 2001). Figure 1 below displays a simplified interaction of these climate change impacts and policy responses.

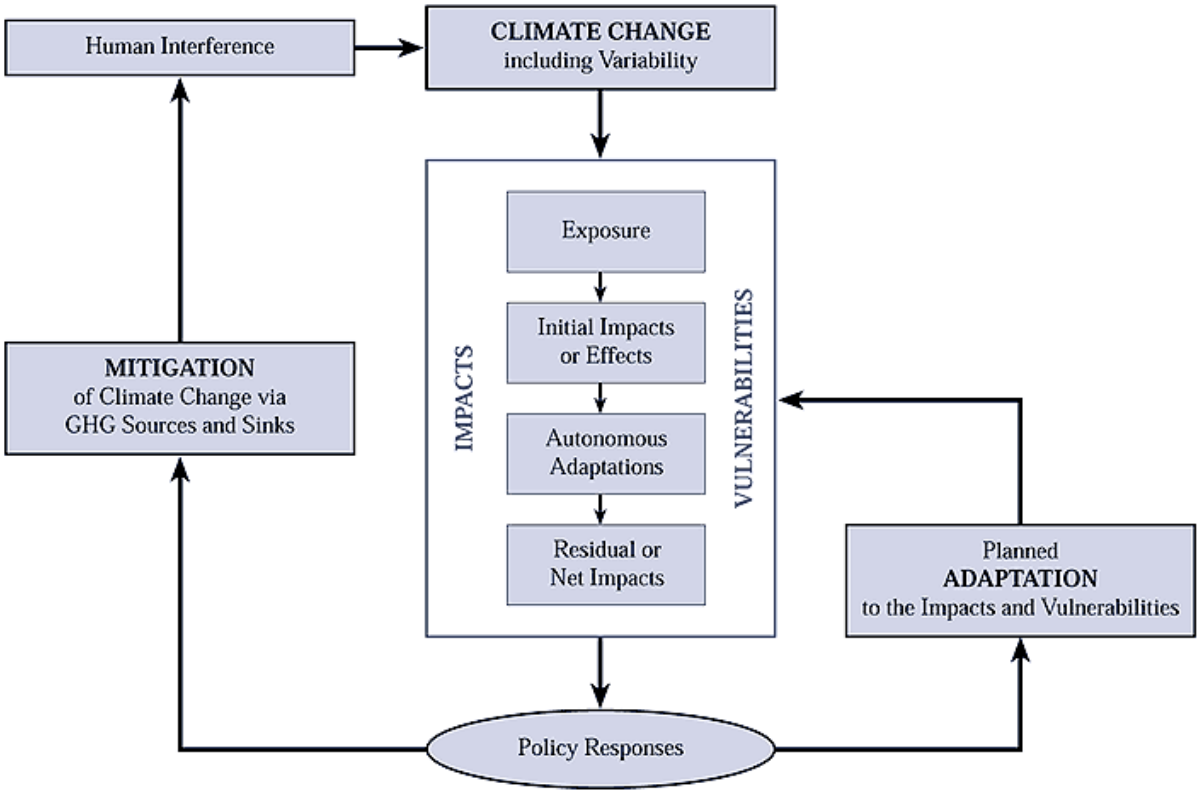


Figure 1: Interaction of Policy Response and Impacts (IPCC TAR WG2, 2001)

As identified in Figure 1, the two major types of policy responses are mitigation and adaptation. Mitigation responses work to reduce potential threats (e.g., GHGs), while adaptation responses include actions that increase the ability to oppose, survive, and/or absorb threats and return to an original state. Both responses are important to addressing the issue of

climate change, but here I focus solely on adaptation through policy implementation by institutions of governance.

Hiskes (2009) and Bryner (2011) both make strong cases that policymakers have a responsibility to protect the environmental rights of current and future generations (e.g., the rights to clean air, water and environmental quality). The effects of global climate change threaten these environmental rights, making responding to climate change a challenging task for policymakers at all levels of governance.

Even more challenging is the idea that many of the impacts of climate change, like rising global temperatures, increasing extreme weather incidents, and changing weather patterns, are born by people around the world regardless of whether they were contributing to climate change. Climate mitigation and adaptation can therefore be framed as global public goods because they are non-excludable and jointly produced (Samuelson, 1954). That is to say, the benefits of adaptation and mitigation initiatives (reduced greenhouse gas emissions, flood control, etc.), once in place, are experienced by everyone (even individuals or organizations who didn't contribute to the initiatives). The realization of these benefits by individuals also doesn't change the benefits available to other individuals. Additionally, working to improve or preserve environmental quality in the context of specific climate change impacts (severe weather frequency/intensity, higher temperatures, ocean acidification, incidence of disease, etc.), has transboundary and global effects.

Even though climate change presents a serious problem for policy makers at all levels of governance, the implications of climate change are more immediately experienced by

communities and policy makers at the local level. As a result of this, municipalities in the United States have become climate change policy leaders (Gore and Robinson 2009). Ostrom (2010) argued that these efforts at a less-than-global scale can help reduce emissions to some extent, and they can also spur their own governments to take necessary national and international efforts." United States' local governments come in a wide variety of shapes and sizes. In the context of climate adaptation, some local governments and communities take immediate initiative in responding to current or future threats (e.g., Figure 2), while other governments are much more delayed in their responses to impacts.

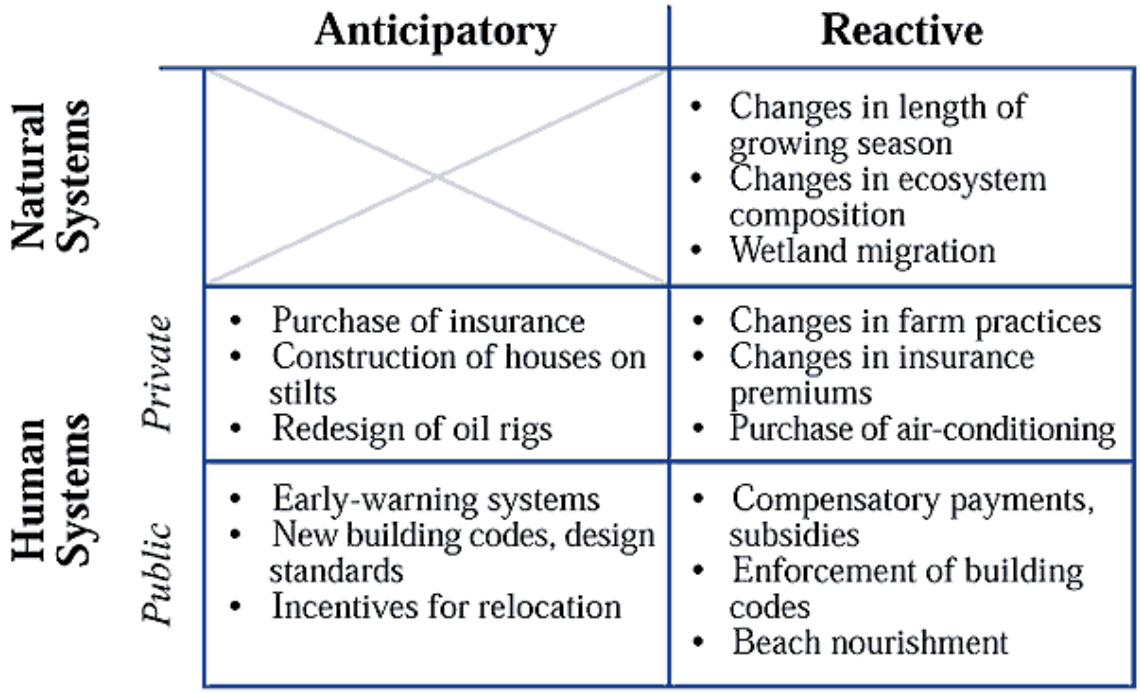


Figure 2: Examples of Adaptation Responses (IPCC TAR WG2, 2001)

This study asks the following questions: what drives local and municipal policy makers to develop climate adaptation policy in the midst of many competing policy demands? What

determines whether a town will be proactive or reactionary in their dealings with climate change?

To help answer questions like this, Feiock and West (1993) identify a set of explanatory drivers of local policy adoption. Feiock and West's discussion of policy drivers include:

- **Need/Response Policymaking Model**: focuses on governments responding to an objective need for a policy.

- **Diffusion of Innovation Model**: focuses on the degree to which some governments become policy leaders regarding the adoption of innovative approaches to policy problems and the degree to which others then follow and diffuse such innovation.

- **Political Institutions Model**: focuses on electoral competition and governmental structure as influential in understanding policy choice.

- **Federalism Model**: focuses attention on the degree to which localities adopt and implement policy mandates from above (mostly state governments).

- **Economic Model**: argues that more affluent communities with greater fiscal resources will be policy innovators.

- **Interest Group Influence Model**: competing demands from constituencies produce demands for policy change.

- **Administrative Capacity**: focuses attention on the expertise and personnel resources as drivers of innovation in adoption and implementation. A corollary to this explanation

is Rabe's (2004) findings about the impact of **policy entrepreneurs** within administrative settings.

For the purposes of this analysis, we will primarily focus on Feiock and West's economic model to examine the degree to which economic forces drive action on climate adaptation. The economic model suggests that more affluent communities with greater fiscal capacity will engage in policy development and initiation to a greater extent than less affluent communities. At the state level, fiscal capacity has been the best predictor of policy outputs (Dye 1966; 1979). At the local level, fiscal constraints may be even more important. Paul Peterson (1981) argues that many activities, particularly those with distributive or redistributive consequences, are not in the "unitary" fiscal interest of cities. This economic explanation suggests that fiscal capacity can create a barrier to the adoption of new policies for some communities (Feiock and West, 1993).

A number of studies have built upon the Economic Model suggested by Feiock and West. One such study was Krause (2011) which found that local governments' fiscal and human capacities are the primary drivers of climate mitigation action in their jurisdictions. Boschken (1998) came to a similar conclusion in finding that socioeconomic status is a significant factor for understanding the siting of transit infrastructure. Specifically, more affluent communities were more likely to develop mass transit.

In order to understand climate change adaptation at the local level, it is important to recognize how social and political realities influence and shape one another. In addition to drawing out the factors that *enable* municipalities to adopt climate change policy, the study

also adds the dimension of *constraints* on adaptation. Following the logic of Adger et. al. (2009), climate change adaptation is a social and political process, and as such limits is not exclusively exogenously imposed. This means that external factors such as funding and leadership (state, federal, international) on climate change (or lack thereof) are not the only factors that determine adaptation policy. Rather, "adaptation to climate change is limited by the values, perceptions, processes and power structures within society" (Adger et. al. 2009 pp.349). Thus, climate change adaptation is constrained by communities and the built, economic, social, and natural environments in which they exist. For example, a municipality's climate adaptation efforts can be limited by constraints on funding and staffing that stem from its economic environment (tax base, etc.), while also experiencing pressure from its social environment in the form of skepticism on climate change.

The following discussion and analysis is part of a larger project[1] that examines how state and local governments in the northeastern United States are engaging with climate change in the relative vacuum of coherent and proactive global and federal policy. Although the perception is that California has been the leader among US states in climate change policy over the past decade, Connecticut and other Northeastern states were actually addressing climate change policy first. The array of policies adopted by the State of Connecticut, other states in the region, and various municipalities represents an aggressive approach to climate action when compared to most other governmental units around the United States (Stoddard, 2010). The policy developments in the Northeast are viewed as some of the leading edge programs nationally (Selin and Van Deveer 2009).

[1] The reader should note that this entire project is covered by UConn IRB protocol HR #10-108.

Together, the various pieces of the Connecticut Climate Change Project (Boyer 2012; 2013; 2014) thus far describe the trajectory of climate change policy in a state known for leading in this issue area, explore the coastal response to the threats and impacts of a changing climate, and identify policy drivers for climate adaptation policy at the local level of governance. In this particular paper I seek to build on these outcomes by expanding the discussion of economic policy drivers to include the relationship between specific economic variables and climate adaptation policy in Connecticut.

As identified, there are several facets to the larger project. One piece focuses on the evolution of Connecticut climate policy and what implications it has for other regions of the United States (see Boyer (2013). That portion of the project centers on interviews of policy-makers involved in the development of Connecticut climate mitigation policy.

A second portion of the project builds on earlier work performed by Connecticut's Department of Energy and Environmental Protection (DEEP) to map climate change policy development across the 169 municipalities in the state. The current project builds on that effort through the gathering of policy data being shared between DEEP and the UConn research team. In this particular paper, I address the question to what extent do economic factors drive and/or influence how municipalities respond to the challenges of climate adaptation.

To answer this question, I will work to accomplish two main objectives:

1. Explore the extent to which wealth is impacting the creation of climate adaptation policy at the local level of governance by examining adaptation policies across Connecticut

municipalities with varying levels of economic prosperity as measured by selected economic variables.

2. Identify and discuss alternative policymaking models and the towns' barriers to local climate adaptation.

Methodology

There has been three primary stages in the data collection process for the "169" project. First, various demographic, social, geographic, and economic data were gathered for the 169 Connecticut towns from the American FactFinder (AFF) and American Community Survey (ACS) Census Bureau databases. This data provide socio-economic statistics for the towns so that the relative progress of climate adaptation policy generation could be compared across a range of indicators.

The next part collected data on climate policy initiatives for the individual towns by combining existing policy data with data gathered from an examination of town documents. Such documents included Plans of Conservation and Development (POCD), zoning regulations, capital improvement plans, fiscal budgets, stormwater management and erosion plans, state-mandated Natural Hazard Mitigation Plans, and other documents related to sustainability practices and capital improvement. The relevant climate adaptation policy data gathered from these documents were split into two major classifications. The first classification was capital improvement policies which focused on developing infrastructure and purchasing to respond to future and current climate change impacts. The second classification was zoning policies which focused on limiting and controlling the impacts of current and future development on

adaptation capabilities. The data collected from town documents were then augmented by phone calls to planning, zoning and land use officials in each town. In addition to developing a better understanding of the town's policy action, these interviews also helped assess the perceived and realized barriers each town had for taking further action on climate adaptation. These three data pieces provide a representative, if macro-level, body of information on adaptation policies in Connecticut towns.

This particular analysis focuses on understanding the degree of interaction between economic prosperity and the development of proactive climate adaptation policies and identified barriers to adopting adaptation policies. In addition to the ACS and AFF data, economic data for this analysis was also gathered from the Connecticut Department of Revenue Services (DRS) and the CT Office of Policy and Management (OPM). The economic variables considered for this analysis were mill rate, equalized net grand list, town percentage of total CT earned income tax credits (EITC), income tax revenue per capita (by claims), and income per capita (YPC). The definitions for these variables as well as their data source for this project are displayed in Table 1 below.

Table 1: Selected Economic Variables for CT Towns

Economic Variable	Definition	Data Source
Income per Capita	Average income of all individuals within the town (total income/population)	ACS 2012
Earned Income Tax Credit (EITC)	A refundable tax credit for low to moderate income working individuals and couples—particularly those with children. The amount of EITC benefit depends on a recipient's income and number of children. (Number of EITCs for individual town/Total EITCs for CT) (Data Source: DRS, 2012)	DRS 2012
Income tax per capita	Average income tax revenue per individual within a town (Total CT Income Tax Revenue/Number of returns from the town) (Data Source: DRS, 2012)	DRS 2012
Mill Rate	The amount of tax payable per dollar of the assessed value of a property. Used to assess property tax values for CT towns (Data Source: AFF, 2012)	AFF 2012
Equalized Net Grand List	The full-value estimate of all taxable property within the CT Townships (Data Source: OPM, 2012)	OPM 2012

All of the variables in Table 1 can be representative of a town's overall economic well-being which makes them ideal for testing to what extent affluence and economic status influences climate adaptation policy at the local level of governance. To test this idea, town financial barriers, capital improvement policies, and zoning policies were viewed in the context of these economic variables. Specifically, towns were grouped into different tiers based on the recorded values for the economic variables. Once grouped, policy counts were conducted and median and average policy generation values for both capital and zoning policies were recorded for the different classes or tiers of economic prosperity. This process helped to "control" for wealth as a policy driver. The towns are also grouped by geographic location (coastal, river, and

inland towns) to aid in the development of alternative models. This examination of economic drivers for climate policy will help test the influence of those factors relative to other causes of policy action as discussed **earlier/further on**.

Data and Analysis

The following analysis begins by exploring the validity of Feiock and West's (1993) Economic Policymaking Model in the context of local climate adaptation policies in Connecticut, specifically whether or not wealthy towns are actually acting as policy innovators for climate adaptation. From there, the analysis looks at other policy drivers and offers a look at how comparatively significant the economic policy drivers are.

The first part of the analysis examines town capital improvement and zoning policies controlling for selected economic variables. The economic variables considered are town income per capita (YPC), percentage of total CT earned income tax credits (EITC), income tax revenue per capita (by claims), mill rate, and equalized net grand list. Tables 2-6 display the results of the categorized policy counts.

Table 2: CT Town Capital Improvement and Zoning Adaptation Policy

(Controlled for Income per Capita)

Town Type	Income Per Capita ($)	Total Towns	Median Capital	Avg. # of Capital Policies per Town	Median Zoning	Avg. # of Zoning Policies per Town
Coastal	<30000	5	6.00	5.40	8.00	8.60
	30000<x<50000	14	5.00	5.54	9.50	9.93
	>50000	5	5.00	6.20	7.00	8.00
Riverine	<30000	8	3.50	4.13	6.00	6.50
	30000<x<50000	30	2.00	2.77	8.00	7.83
	>50000	4	2.00	2.25	4.50	4.75
Inland	<30000	26	3.00	3.31	7.50	8.00
	30000<x<50000	58[2]	3.00	2.83	7.00	7.60
	>50000	15	3.00	2.20	8.00	8.47
Total	<30000	39	3.00	3.74	8.00	7.77
	30000<x<50000	102[3]	3.00	3.11	7.00	7.95
	>50000	24	3.00	3.25	7.00	7.90

In Table 2, zoning and capital adaptation policies by town are controlled for income per capita. As can be seen there is little to no pattern in policy creation for towns with varying income per capita levels. Both Boschken (1998) and Feiock and West (1993) identified the idea that more affluent communities would be stronger policy developers and innovators. Income per capita is one of the clearest ways of showing affluence, and the data suggests that affluence is playing little to no role in climate adaptation policy at the local level.

[2] 57 for Zoning

[3] 101 for Zoning

Table 3: CT Town Capital Improvement and Zoning Adaptation Policy

(Controlled for Percentage of Total CT EITCs)

Town Type	Percent of total EITCs	Total Towns	Median Capital	Avg. # of Capital Policies per Town	Median Zoning	Avg. # of Zoning Policies per Town
Coastal	<.5%	13	5.00	5.15	10.00	9.92
	.5%<x<1%	4	6.50	6.50	7.50	8.50
	>1%	7	5.50	6.17	9.00	8.43
Riverine	<.5%	35	2.00	2.91	7.00	7.03
	.5%<x<1%	3	3.00	2.67	4.00	6.00
	>1%	4	2.50	3.75	10.50	10.50
Inland	<.5%	81	3.00	2.99	8.00	8.09
	.5%<x<1%	7[4]	2.00	2.57	6.00	7.29
	>1%	11	2.00	2.09	5.50	6.20
Total	<.5%	129	3.00	2.91	7.00	7.88
	.5%<x<1%	14[5]	3.50	4.14	9.00	8.62
	>1%	22	5.00	5.00	7.00	7.64

Connecticut town capital Improvement and zoning adaptation policies controlled for percentage of EITCs are shown in Table 3. EITCs, or earned income tax credits, are refundable tax credits for low to moderate income individuals. They are calculated and distributed based on income level and number of dependents particularly children. If Connecticut towns were all equal in population and wealth, each town would get 1/169 or approximately .5% of the EITCs. However, this is not the case and lower income towns will generally have a higher percentage of the total EITCs distributed by the state. The table controls for towns taking varying percentages of EITCs. If Feiock and Wests (1993) suggested Economic Model was influencing

[4] 6 for Zoning

[5] 13 for Zoning

climate adaptation policy, we would expect to see the towns taking a larger percentage of EITCs having less policy generation. The data in Table 3 suggests that this isn't the case, and in fact the opposite appears to be true for capital improvement adaptation policies.

Table 4: CT Town Capital Improvement and Zoning Adaptation Policy

(Controlled for Income Tax per Capita)

Town Type	Income Tax per Capita ($)[6]	Total Towns	Median Capital	Avg. # of Capital Policies per Town	Median Zoning	Avg. # of Zoning Policies per Town
Coastal	<2000	5	7.00	7.60	9.00	8.80
	2000<x<6000	12	5.00	5.00	9.50	9.00
	>6000	7	5.00	5.29	10.00	10.00
Riverine	<2000	8	2.50	2.88	8.00	7.38
	2000<x<6000	30	2.00	3.07	7.00	7.47
	>6000	4	3.00	2.50	5.50	5.75
Inland	<2000	19	2.00	2.68	6.50	7.50
	2000<x<6000	67[7]	3.00	2.73	7.00	7.96
	>6000	13	3.00	3.77	7.00	7.69
Total	<2000	32	3.00	3.77	7.00	7.48
	2000<x<6000	109[8]	3.00	3.08	8.00	8.10
	>6000	24	3.00	3.54	7.00	7.54

Table 4 shows the same policy data, but controlled for income tax per capita. No real trend appears from the data when it is controlled for income tax per capita. From Feiock and West's (1993) model, it would be expected that towns with higher income tax revenue per capita (wealthier towns), might have greater policy innovation.

[6] Calculated by returns
[7] 66 for Zoning
[8] 108 for Zoning

Table 5: CT Town Capital Improvement and Zoning Adaptation Policy

(Controlled for Mill Rate)

Town Type	Mill Rate	Total Towns	Median Capital	Avg. # of Capital Policies per Town	Median Zoning	Avg. # of Zoning Policies per Town
Coastal	<20	10	5.00	5.80	10.00	10.30
	20<x<30	7	4.50	5.00	9.00	8.43
	>30	7	7.00	6.00	8.00	8.57
Riverine	<20	12	2.00	2.17	6.50	7.33
	20<x<30	27	3.00	3.11	7.00	7.19
	>30	3	4.00	5.00	8.00	8.00
Inland	<20	10	3.00	2.70	9.50	9.80
	20<x<30	74[9]	2.50	2.86	7.00	7.84
	>30	15	3.00	2.93	6.00	6.53
Total	<20	32	3.00	3.47	9.00	9.03
	20<x<30	108[10]	3.00	3.05	7.00	7.71
	>30	25	4.00	4.04	7.00	7.42

Table 5 shows the policy generation data controlled for mill rate. As can be seen there is little to no pattern in policy creation for towns with varying mill rates. Zoning adaptation policy creation tends to decrease with increasing mill rates while capital improvement policy tends to increase. While mill rate doesn't specifically measure the wealth of a town, affluent towns tend to have lower mill rates because they make a lot of money off of low property taxes on properties with high values. Poverty-stricken towns have trouble raising appraisal rates in less-than-attractive neighborhoods, and that's when mill rates start to increase. This in mind, if

[9] 73 for Zoning Policies
[10] 107 for Zoning Policies

Feiock and West's (1993) suggested Economic Model was significantly affecting climate adaptation policy at the local level of governance; we could reasonably expect that as mill rate increased, policy generation would decrease.

Table 6: CT Town Capital Improvement and Zoning Adaptation Policy (Controlled for Net Equalized Grand List)

Town Type	Net Equalized Grand List ($)	Total Towns	Median Capital	Avg. # of Capital Policies per Town	Median Zoning	Avg. # of Zoning Policies per Town
Coastal	<1 billion	0	N/A	N/A	N/A	N/A
	1 billion<x<5 billion	12	5.00	5.25	10.00	10.00
	>5 billion	12	6.00	6.09	9.00	8.50
Riverine	<1 billion	8	2.00	2.64	6.00	6.36
	1 billion<x<5 billion	30	3.00	3.19	7.50	7.42
	>5 billion	4	2.00	2.60	8.00	8.60
Inland	<1 billion	37	2.00	2.14	8.00	8.03
	1 billion<x<5 billion	50	3.00	3.22	7.00	7.88
	>5 billion	12[11]	3.00	3.58	7.00	7.00
Total	<1 billion	45	2.00	2.25	7.00	7.65
	1 billion<x<5 billion	92	3.00	3.49	8.00	8.03
	>5 billion	28[12]	4.00	4.39	7.00	7.93

Table 6 displays the policy generation controlled by the town's net equalized grand list values. Of the five economic variables, net equalized grand list had the clearest trend. As can be seen, as the grand list values increased, towns tended to have greater policy generation,

[11] 11 for Zoning
[12] 27 for Zoning

particularly capital improvement policy. It is a small trend, but none the less, it is the trend that would be expected if Feiock and West's (1993) economic model was driving the creation of town level climate adaptation policy.

In addition to the count tables, correlation tests were also run between the economic variables and policy variables to better characterize the count table results. The policy variables for these tests were number of capital improvement policies (NCapital), number of zoning policies (NZoning), and interview response indicating that funding was a barrier (BarrFund). The results are shown in tables 7 and 8.

Table 7: Policy Correlations and P-values- Mill Rate, YPC, Income Tax per Capita

	Mill Rate		YPC		Income Tax per Capita	
	Pearson Coefficient	P-Value	Pearson Coefficient	P-Value	Pearson Coefficient	P-Value
NCAPITAL	0.091	0.242	-0.041	0.595	0.102	0.188
NZONING	-0.150	0.052	0.071	0.362	0.015	0.848
BARRFUND	-0.028	0.722	-0.109	0.157	-0.104	0.178

Table 8: Policy Correlations and P-values- %EITC and Grand list (Highlights indicate weak correlations and significance at .001 level)

	%EITC		Grand List	
	Pearson Coefficient	P-Value	Pearson Coefficient	P-Value
NCAPITAL	0.296	0.000	0.415	0.000
NZONING	-0.046	0.555	0.022	0.777
BARRFUND	0.040	0.609	-0.131	0.088

Table 7 shows the correlation results for all of the economic variables except net equalized grand list and %EITC. The correlation tests for the other three variables indicate no relationship between the economic variables and the number of capital improvement or zoning adaptation policies. These results support the "no trend" observations from the previous tables. In table 8, both the correlation coefficient between net equalized grand list and the number of capital improvement policies and the correlation coefficient between EITC and capital improvement policies indicate a weak statistical correlation (highlighted). These outcomes were significant at the .001 level. This supports the trend that towns with higher grand list values tended to have greater capital improvement policy generation which was observed in table 6. It also suggests that towns with more valuable properties (higher net equalized grand list), are investing more effort/resources (as evidenced by greater policy generation) into protecting the properties through adaptation.

Another important thing to note from the correlation coefficients is that none of the economic variables had a significant statistical correlation with interview responses indicating that funding was a barrier (BarrFund). This is a particularly interesting finding because 71% percent of the towns that had interviews conducted (89%[13]), responded that for their town, funding was a significant barrier to taking further action on climate change (Table 9).

[13] 151 out of 169 towns had interview data (89%)

Table 9: Barriers to Climate Policy Action by Town Type

Type of Barrier	Coastal (n=24[14])	Riverine (n=44[15])	Inland (n=89)	All types (n=151)
Lack of funding	66%	75%	71%	71%
Insufficient state/federal coord.	42%	50%	43%	44%
Lack of public information	33%	45%	33%	35%
Other issues take priority	13%	39%	38%	34%
Climate change skepticism	8%	18%	34%	26%
Insufficient private/public coord.	13%	18%	12%	14%
Insufficient staff	13%	16%	21%	19%
Other barriers	8%	2%	2%	3%

While it is probably true that funding will be an issue regardless of the town or policy action, it is interesting to see an apparent disconnect between economic status (tested variables) and "funding" as an issue. It certainly raises the question of to what extent funding is actually a barrier versus just a stated barrier.

Even with the weak correlation of grand list, EITC and capital adaptation policy, it is evident that the economic drivers of policy as identified by both Boschken (1998) and Feiock

[14] Coastal towns included towns designated as both coastal and riverine. Overlapping towns: Groton, Milford, New London, Old Saybrook, Stratford, Waterford.

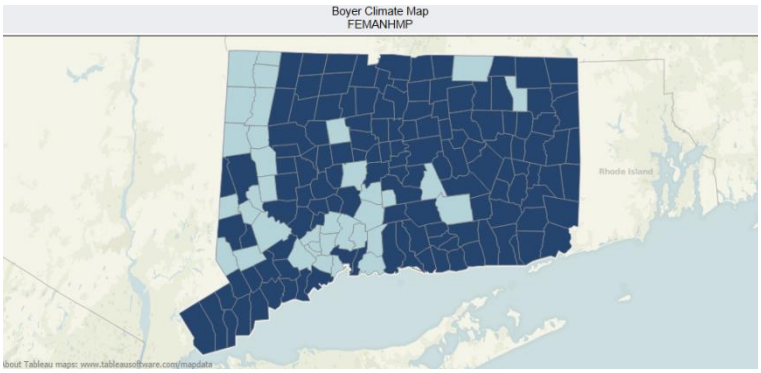
[15] Riverine towns included towns designated as both coastal and riverine

and West (1993) are having little, if any, influence on climate adaptation policy at the local level of governance. This, of course, begs the question…what is?

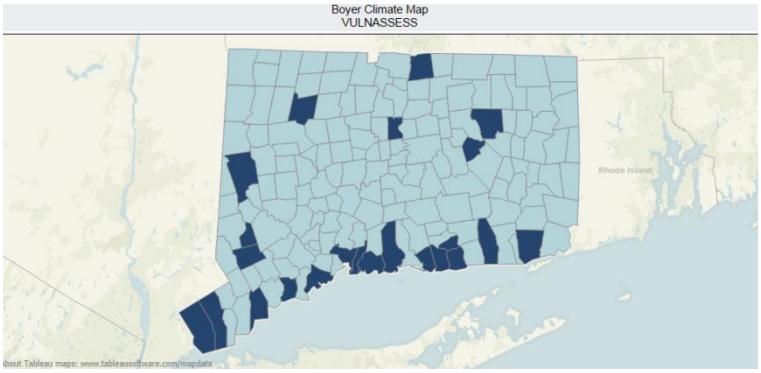
As part of the larger project (see Boyer, 2014), the capital and zoning policy data was similarly controlled for town population, population density, and education levels. It was thought that these variables might be influencing policy generation[16], but when there was little variation across the control variables. This indicated that the suggested factors were not influential as policy drivers for local climate adaptation.

In addition to these controls, the larger research project (Boyer (2014)) also explored other policy driver models from Feiock and West (1993) in the context of climate adaptation policy. The results of this analysis are talked about in the discussion below.

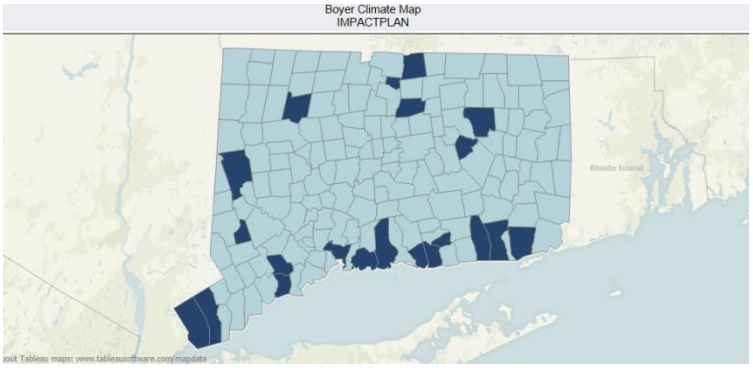
[16] Larger population towns might have more resources to take policy action; population density could drive a need for adaptation because of more concentrated loss/damage; towns with higher educational attainment might have less climate change skepticism



Towns with State-Mandated Natural Hazard Mitigation Plans



Towns with State-Recommended Climate Change Vulnerability Assessments



Towns with State-Recommended Climate Change Action Plans

Figure 3 – Climate Planning in Connecticut

Table 10: Climate Change Plans by Town Type

	Plan type		
Town type	**Climate change action plan**	**Climate change vulnerability assessment**	**Natural Hazard Mitigation Plan**
Coastal[17]	46% (N=24)	58% (N=24)	92% (N=24)
Riverine[18]	13% (N=39)	10% (N=39)	63% (N=43)
Inland[19]	5% (N=91)	5% (N=91)	81% (N=102)
All types	14%[20] (N=154)	15%[21] (N=154)	79%[22] (N=169)

Figure 3 and Table 10 provide strong evidence for the existence of the Need/Response Policymaking Model (Feiock and West (1993)) within climate adaptation policy. The data shows that nearly half of Connecticut coastal towns are engaged in significant adaptation planning with a climate change action plan, compared to just 13% of riverine towns and only 5% of inland towns. Compared to inland and riverine towns, coastal towns are impacted more by climate change, particularly rising sea levels and severe weather damage like storm surge and flooding. The need and desire to respond to these threats has become even more prominent as Hurricane Sandy, Hurricane Irene, and several other major coastal storms have had harsh impacts on coastal communities. Coastal town governments need to consider the management of dense coastal development, flood threats, and emergency response to natural disasters

[17] Coastal includes towns that are both coastal & riverine. Overlapping towns: Groton, Milford, New London, Old Saybrook, Stratford, Waterford. There are 24 coastal towns, a 100% response rate.
[18] Riverine excludes towns that are both riverine and coastal. There are 43 inland towns, a 90% response rate for action plans and vulnerability assessments, and a 100% response rate for riverine town NHMP data.
[19] There are 102 inland towns, an 89% response rate for action plans and vulnerability assessments, and a 100% response rate for inland town NHMP data.
[20] N=154 for climate change action plans, 91% response rate
[21] N=154 for climate change vulnerability assessments, 91% response rate
[22] N=169 for NHMPs, 100% response rate

more as they plan for the future. Table 10 also points out that coastal towns are far more likely than riverine or inland towns to have completed a climate change vulnerability assessment, indicating that the impacts of climate change necessitated a policy response.

Table 11: Capital & Zoning Adaptation Policies by Town Type

	Types of Adaptation Policies			
Town type	**Median no. of capital policies**	**Most common capital policies**	**Median no. of zoning policies**	**Most common zoning policies**
Coastal[23] (N=24)	**5**	▪ Drainage infrastructure ▪ Open space ▪ Stormwater management	**9**	▪ Restrict coastal development ▪ Water quality ▪ Wetlands
Riverine[24] (N=42)	**2**	▪ Drainage infrastructure ▪ Open space ▪ Bridges	**7**	▪ Open space ▪ Floodplains ▪ Erosion
Inland[25] (N=99 for capital, N=98 for zoning)	**3**	▪ Drainage infrastructure ▪ Open space ▪ Bridges or roads	**7**	▪ Water quality ▪ Open space ▪ Wetlands

Table 11 further supports Feiock & West's (1993) Need/Response policymaking model, as coastal towns have a noticeably higher median number of capital improvement and zoning policies related to climate change adaptation. .

As the reader will note, there are more climate-relevant zoning policies overall than capital projects, but both support a proactive adaptation agenda. Improving drainage

[23] Coastal includes towns that are both coastal & riverine. Overlapping towns: Groton, Milford, New London, Old Saybrook, Stratford, Waterford. There are 24 coastal towns, a 100% response rate.
[24] Riverine excludes towns that are both riverine and coastal.
[25] Inland towns are neither coastal nor riverine.

infrastructure was the most common capital policy across all three categories of towns, which included cleaning, maintaining, and replacing pipes, drains, and culverts. Purchasing or conserving open space was the second most frequent capital project after drainage, but was described in town Plans of Conservation and Development (POCDs) as reducing strain on drainage infrastructure by collecting and absorbing stormwater.

Top municipal priorities for zoning were much more heterogeneous. Coastal towns emphasized restricting or reducing the density of coastal development in an effort to lessen property damage from coastal storms and pressure on drainage systems from increasing impervious surfaces. They also focused on protecting coastal wetlands and open space and minimizing the extension of sewer systems to reduce the risk of contaminating water supplies. Riverine and inland towns were also concerned about water quality, flooding, and protecting wetlands and animal habitats, but did not face the additional challenge of high population density in particularly vulnerable areas that was seen in almost all coastal communities.

Table 12: Barriers to Climate Policy Action by Town Type

	Town type			
Type of Barrier	**Coastal (n=24[26])**	**Riverine (n=44[27])**	**Inland** (n=89)	**All types (n=151[3])**
Lack of funding	66%	75%	71%	71%
Insufficient state/federal coord.	42%	50%	43%	44%
Lack of public information	33%	45%	33%	35%
Other issues take priority	13%	39%	38%	34%
Climate change skepticism	8%	18%	34%	26%
Insufficient private/public coord.	13%	18%	12%	14%
Insufficient staff	13%	16%	21%	19%
Other barriers	8%	2%	2%	3%

The interview responses in Table 12 (Table 9 reprinted) also support the Feiock and West (1993) Need/Response model. The highlighted data displays the percent of each town type responding that the barriers to taking further action on climate adaptation were other issues taking priority and climate change skepticism. It is interesting to note that coastal towns had a significantly lower response rate for these barriers which suggests that climate change is a more serious/prevalent issue for coastal towns than it is for riverine and inland towns.

[26] Coastal includes towns that are both coastal & riverine. Overlapping towns: Groton, Milford, New London, Old Saybrook, Stratford, Waterford.

[27] Riverine includes towns that are both coastal & riverine

Table 13: Anecdotal Comments from Town Calls

Town type	Interview comments
Coastal	▪ Constituent Buy-In - Particularly in poor communities tying our actions to efforts that are understandable to people is very important; meaning that in order to get buy-in there needs to be a recognition that it affects someone personally in the short term. In the short term this is most understandable from the flooding, natural disaster side and tying our efforts into mitigation strategies. ▪ It's an election year, and climate change has become a political issue. ▪ Towns are already developed, and it's not like we can make up regulations that require people to elevate their homes or move further back from the coast, because they're already there. ▪ The greatest barrier to addressing climate change lies in convincing policy makers of the problem. ▪ There's a historic tradition of building/living on the coast, and we have to educate people as to where they should live. This isn't Holland, and we can't engineer our way out of the sea level rise- people can't just build walls around their coastal houses, because the walls will cave in.
Riverine	▪ Money is the big issue in addressing climate change. We have the time but we do not have the financial resources. ▪ The John Birch Society and its anti-UN Agenda 21, anti-ICLEI rhetoric has come to town and if it gains traction, it could make our upcoming Plan of Conservation and Development adoption in 2015 problematic if we include too much discussion on sustainability issues, as it has around the country. ▪ Budgeting constraints. Other projects take precedence over climate change. ▪ Because of the size of the community and limited resources members do not know their exact role in addressing climate change ▪ We haven't encountered any barriers because none of this has gone anywhere yet. ▪ There are still influential individuals who hold that the concept of anthropogenic climate change is based on manipulated data and has no basis in fact. To date there seems to be insufficient political will on the part of town leadership to pursue the task of developing a comprehensive policy at the municipal level.
Inland	▪ Guidelines on climate change from the DEEP and State would help, as would grants to help us prepare a climate change report. ▪ "Specific information on the identifiable impact that climate change will have on the town… would be helpful"

	▪ "I do not think [our town] will be affected by climate change because it is not close to the shores." ▪ It's not that we don't take climate change seriously; it's that small towns are faced with sinking budgets, and have a number of statutory mandates they have to satisfy. Small towns are less likely to have the money to pay for a climate change study, especially when there is an ongoing debate over climate change. For instance, the Public Works Director does not believe in climate change. ▪ Our Natural Hazard Mitigation Plan addresses flooding issues and vulnerabilities to natural disasters. ▪ "The effects of that hurricane [Sandy] were visible in [our town], even though we aren't prone to flooding as they are on the coast. …Large swaths of pine stands in the centennial forest were devastated by the hurricane, and whether or not the intensity of those hurricanes was caused or can be shown to be caused by climate change, it is certainly very visible and a cause for complaint…" ▪ "We're seeing some acknowledgement of the impacts of climate change in regional plans of climate change. For example, [one regional Council of Governments] included a chapter on climate change in their regional plan. We never would have seen that 10 years ago." ▪ No one steps forward to say, "This stuff is important and here is what I want my town to do about it now!" ▪ Educating our local land use board members and the public would help.

Table 13 provides some qualitative data anecdotes from telephone and e-mail interviews with town planning and conservation staff members, as well as regional planning organizations. This data gives a glimpse into how municipal and regional planners within the different town categories perceived climate change, whether they prioritized adaptation and the obstacles they faced. The anecdotal quotes in table 13 were selected to showcase town priorities and obstacles rather than represent the most frequent types of comments.

The comments further illustrate the differences between the coastal, riverine, and inland towns. Coastal towns tended to prioritize the framing of climate change within policy and community discussions. Many towns talked about the need for constituent and

policymaker buy-in. In addressing this, towns are faced with an interesting dynamic of balancing the immediacy of the climate change problem without politicizing the issue to a point of inaction. Coastal towns also focused on the problem of existing infrastructure. To a far greater extent than riverine and inland towns, coastal towns have to adapt around existing infrastructure and more significantly, entrenched behavioral norms. For example, a coastal municipality might need to erect flood and drainage infrastructure like sea walls or elevated buildings to effectively respond to the current and future impacts of climate change, but it might prove to be difficult to move existing buildings to higher ground or build sea walls outside of people's longtime beach homes.

Riverine and inland towns both appeared to prioritize other issues over climate change. With regards to climate change, a large priority for both town types was the need for more resources, both financial and educational, to catalyze action and address skepticism. The anecdotal comments for riverine and inland towns also highlights the wide variety of responses and focuses which indicates that climate change is not too pressing of an issue for the towns at the moment.

Summary of Findings and Policy Implications

Somewhat unexpectedly, Feiock and West's (1993) Economic Policymaking Model and Boschken's (1998) conclusion that wealthier towns were more likely to be on the forefront of policy development don't appear to be influencing climate adaptation policy at the local level of governance. Economic variables certainly might play a role in the type of projects or response a town is capable, or at least more likely, to implement, but they don't seem to be driving policy

generation for Connecticut townships. The significance findings for the interaction of EITC and grand list with capital improvement policies suggest that the two causal variables should be examined within a multivariate statistical model to better characterize the interaction of policy drivers. Economic variables tend to be at the forefront of discussion for town officials, and will therefore act as both perceived and realized barriers for policy generation. The finding discussed here is important for local and state policymakers to consider in addressing these barriers and their validity in future planning efforts.

This conclusion is also valuable because it highlights the importance of other policy drivers for both local and state policymakers. The Connecticut Climate Change Project (Boyer 2012; 2013, 2014) identifies some of the other drivers in play including policy entrepreneurship, federalism, and political culture. Probably the most influential driver identified by the larger project and discussed in this analysis is the Need/Response Model. Greater generation of capital and zoning climate adaptation policies and attention to climate change in general was observed in coastal towns than in inland and riverine towns largely due to the fact that coastal towns were experiencing, and therefore responding, to a wider variety of threats and indeed greater effect from these threats of climate change. The Need/Response Model was supported by the capital and zoning adaptation policy generation as coastal towns across the board had greater adaptation policy generation than did riverine and inland towns. The higher barrier response rates for climate change skepticism and other issues taking priority by inland and riverine also indicated the influence of the Need/Response Model. Finally, the anecdotal interview comments (Table 13) also highlighted the Need/Response Model because coastal

towns' responses indicated more concerned with the issue of climate change and the need for a corresponding effective response than did inland and riverine towns'.

An important next step in the overall project should be the development of a multivariate statistical model to view the interaction between potential policy drivers including the economic drivers and the need/response model discussed in this analysis.

Going forward the analyses presented in this paper as well as the larger climate change project can help Connecticut policymakers to recognize the barriers and drivers for potential adaptation policy within their municipalities. At the town level, this data can help influence the decision making of local officials with regards to climate change. Towns can look to other towns with similar characteristics for frameworks for effective adaptation policies. The database will also promote regional communication between towns on the issue of climate adaptation.

At the state level, it is important for policymakers to consider the different drivers and barriers for the different town classes as state climate adaptation policy and response is developed. The Need/Response Policymaking Model addressed above, shows the importance of coastal proximity and threat. Coastal towns experience climate change impacts, particularly rising sea levels and a higher incidence of severe weather, to a much larger degree than do inland and riverine towns. As a result of this, of the three town types (coastal, inland, riverine), coastal towns tend to have greater acceptance of the issue of climate change, which, in turn, causes greater policy generation on average. The different town types also prioritize adaptation initiatives differently (see Table 11). It is therefore necessary for state and local authorities to change policy objectives depending on the individual towns. For example state

officials may need to provide direct project support for coastal towns (funding/staffing for specific coastal development control projects), while overcoming skepticism in inland and riverine towns through both direct outreach and engagement of NGO's and other potential policy entrepreneurs.

State adaptation efforts should also try to address the towns' perceived barriers to climate change (Table 12, 13). Funding was by far the largest reported barrier for towns. At some rate, funding will always be a policy inhibitor, but at the state level there could be a different allocation or prioritization of funding, staffing, and time to help alleviate the burden of the perceived barrier. More importantly, 44% of the towns responded that insufficient state and federal coordination was a barrier to taking further action on climate change. United States federal constitutional law and state law assert that local governments derive their existence, their territorial scope, their functions, and their powers from their states (Hunter v. Pittsburgh 1907). Over time courts and states have expanded the role of local institutions of governance, but municipalities still tend to look to higher levels of governance, particularly state governments, for leadership and direction on how to respond to issues. In addition, most of the funding for local governments comes from funding allocation by higher levels of government (Briffault, 2010). Presently the lack of centralized climate adaptation policy and response by the state is limiting the effectiveness of adaptation at the local level. Finally, it is the author's opinion that state authorities can work to address the barriers of other issues taking priority and skepticism by generating constituent buy-in through educational outreach (e.g. why should individuals care?). This should include both effects of climate change and climate change solutions for individual community members.

One thing is very clear…it will take a concentrated, coordinated and informed effort by both state and local policymakers to effectively address and respond to the issue of climate change.

Works Cited

Adger, N.W., S. Dessai, M. Goulden, M. Hulme, I. Lorenzoni and D.R. Nelset. 2009. "Are there social limits to adaptation to climate change?" *Climatic Change* 93:335–354.

Boschken, H.L. (1998) "Upper-middle-class Influence on Developmental Policy Outcomes: The Case of Transit Infrastructure," *Urban Studies*, 35(4), 627-647.

Boyer, M.A. (2012) "Adapting to Climate Change: Mapping Connecticut's Coastal Responses to a Global Problem," *Sea Grant Law and Policy Journal*, 5(1), 15-40.

Boyer, M.A. (2013) "Global Climate Change and Local Action: Understanding the Connecticut Policy Trajectory," *International Studies Perspectives*, 14, 79-107.

Boyer, M. A. (2014) "Climate Adaptation in an Evolving Global Policy Landscape: Connecticut Towns Responding to Press and Pulse?" Proc. of ISA 55th Annual: Spaces and Places Geopolitics in an Era of Globalization, Sheraton Centre Hotel, Toronto. International Studies Association

Bryner, Gary. (2011) Protecting the Global Environment. Boulder, CO: Paradigm Publishers.

Richard Briffault, *Local Leadership and National Issues* in Why the Local Matters: Federalism, Localism, and Public Interest Advocacy, Papers from the 11th Annual Liman Colloquium at Yale Law School, 2008 (2010)

Cazenave A, Lombard A, Llovel W. 2008. Present-day sea level rise: a synthesis. C. R. Geosci. 340:761–70

Church, J. A., and N. J. White (2006), A 20th century acceleration in global sea-level rise, Geophys. Res. Lett., 33, L01602,

Dye, Thomas R., and Virginia Gray. The Determinants of Public Policy. N.p.: Lexington, 1980. Print. Policy Studies Organization Ser.

Dye, Thomas R. Politics, Economics, and the Public; Policy Outcomes in the American States. Chicago: Rand McNally, 1966. Print.

Epstein, P.R., Diaz, H.F., Elias, S., Grabherr, G., Graham, N.E., Martens, W.J.M., Mosley-Thompson, E., (...), Susskind, J. Biological and Physical Signs of Climate Change: Focus on Mosquito-borne Diseases (1998) Bulletin of the American Meteorological Society, 79 (3), pp. 409-417.

Epstein, P.R. Is global warming harmful to health? (2000) SCIENTIFIC AMERICAN, 283 (2), pp. 50-57

Epstein, Paul R. "Climate Change and Emerging Infectious Diseases." *Microbes and Infection* 3.9 (2001): 747-54. Print.

Feiock, R.C. and West, J.P. (1993) "Testing Competing Explanations for Policy Adoption: Municipal Solid Waste Recycling Programs," *Political Research Quarterly*, 46(2), 399-419.

Fowler AM, Hennessey KJ. Potential impacts of global warming on the frequency and magnitude of heavy precipitation. Nat Hazards 11:283–303 (1995).

Gore, Christopher and Pamela Robinson. (2009) Local Government Response to Climate Change: Our Last, Best Hope? In Changing Climates in North American Politics, edited by Henrik Selin and Stacy D. Van Deveer. Cambridge, MA: MIT Press.

Hiskes, Richard P. (2009) A Human Right to a Green Future. New York: Cambridge University Press.

Hunter v. City of Pittsburgh, 207 U.S. 161 (1907)

IPCC AR4 WG2 (2007), Parry, M.L.; Canziani, O.F.; Palutikof, J.P.; van der Linden, P.J.; and Hanson, C.E., ed., Climate Change 2007: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, ISBN 978-0-521-88010-7 (pb: 978-0-521-70597-4).

IPCC TAR WG2 (2001), McCarthy, J. J.; Canziani, O. F.; Leary, N. A.; Dokken, D. J.; and White, K. S., ed., Climate Change 2001: Impacts, Adaptation and Vulnerability, Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press

IPCC TAR SYR (2001), Watson, R. T.; and the Core Writing Team, ed., Climate Change 2001: Synthesis Report, Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press.

Krause, R M. (2011) "Political Decision-making and the Local Provision of Public Goods: The Case of Municipal Climate Protection in the US," *Urban Studies*, 49(11), 2399-2417.

Meehl GA, Zwiers F, Evans J, Knutson T, Mearns LO, Whetton P. Trends in extreme weather and climate events: issues related to modeling extremes inprojections of future climate change. Bull Am Meteorol Soc 81:427–436 (2000)

Najjar, R. G. and 15 others: 2000, 'The Potential Impacts of Climate Change on the Mid-Atlantic Coastal Region', Clim. Res. 14, 219–233.

Ostrom, Elinor. (2010) Nested Externalities and Polycentric Institutions: Must We Wait for Global Solutions to Climate Change Before Taking Action at Other Scales? Economic Theory 49 (2): 353–369.

Peterson, Paul E. City Limits. Chicago: U of Chicago, 1981. Print.

Rahmstorf, S. "A Semi-Empirical Approach to Projecting Future Sea-Level Rise."*Science* 315.5810 (2007): 368-70. Print.

Samuelson, P. (1954) The Pure Theory of Public Expenditure. Review of Economics and Statistics 36: 387–389.

Selin, Henrik and Stacy D. Van Deveer (2009) Climate Leadership in Northeast North America. In Changing Climates in North American Politics, edited by Henrik Selin, and Stacy D. Van Deveer. Cambridge, MA: MIT Press.

Stoddard, Lynn. (2010) Personal interview at Connecticut Department of Environmental Protection offices, 20 September.