Think Globally, Act Locally? Local Mitigation Within a Rational Choice Framework

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ABSTRACT

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In the United States, localities were the first – and for the most part, remain the only – level of government to seriously attempt the reduction of greenhouse gas emissions. These local attempts to address the global problem of climate change appear surprising within a rational choice framework – but only if the costs of such efforts are assumed to be high. Four theories within the rational choice framework attempt to explain local mitigation, but tests of these theories have relied on measures which belie the complexity of local mitigation efforts, and lack context regarding their financial and political cost.

In this dissertation, I present research which relies on new measures – measures which do reflect the financial and political costs municipalities incur. This data allows me to differentiate municipalities by these costs, identify leaders and laggards, and explore whether different theories explain their mitigation. It also allows me to answer two additional questions: first, what municipalities are specifically doing to mitigate their emissions. And secondly, whether membership in a municipal climate network predicts the receipt of state or federal mitigation funding.

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ACKNOWLEDGEMENTS

Much of what we learn in life, we learn from others. Our teachers, our friends, our parents.

Or, in this case, our survey respondents.

I can't thank them all by name, but I do owe a profound debt of gratitude to the 1320 people who each spent about 30 minutes of their lives responding to a survey about local environmental governance. I hope their kindness and generosity will someday be repaid.

When I was an undergraduate, I took a class on sustainability co-taught by Mike Shriberg. It was his research and dissertation - regarding sustainable universities - that first got me thinking about local environmental governance. His work and research has inspired mine.

So have the other researchers in my field, notably Rachel Krause, Damian Pitt, Sammy Zahran, Michele Betsill, and Harriet Bulkeley. A more complete accounting can be found in the bibliography.

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Finally, I'd like to thank my girlfriend, Katherine. For years she's endured my research and discussion of statistical analyses. She is a keeper.

DEDICATION

To my parents. Original, I know. But their love for me is the source of almost everything good in my life. I haven't doubted that I could endure hardships, overcome challenges, and bring my ambitions to fruition – and that confidence is a product of their love.

INTRODUCTION

Climate change is a process likely to fundamentally reshape our world. Its consequences may include an increase in the number and severity of extreme weather events; the increased spread of vector-borne diseases such as malaria and encephalitis; rising sea levels; lost agricultural productivity; and the degradation of natural ecosystems (Hurd et al, 2004; Parry et al, 2001; Scheraga and Grambsch, 1998; Smith et al, 2003; White, 2004). However traditional economic theory suggests that rational parties will continue degrading common resources like the global airshed – even to the point of failure – so long as it remains profitable, and the coercive authority to coordinate behavior remains lacking (Hardin, 1968).

Attempts have been made to create a coercive authority that *can* coordinate behavior. A series of international agreements, including the Kyoto Protocol, have placed legally-binding limits on national greenhouse gas emissions. And multiple US laws and regulations to limit emissions have been proposed – but nearly all of these efforts still lack legal force within the United States.

However many local governments have been busily addressing the global challenge of climate change. The obvious mystery here – *why* they're doing so – is the central question my research attempts to answer. In so doing I'll investigate a preliminary question – what local governments are doing to mitigate their emissions, which is largely unaddressed by the existing literature. I'll also evaluate a third question: whether membership in municipal climate networks is associated with the increased receipt of mitigation funding from external sources, like state and federal grants.

I'll address all these questions within two focal areas. The first is geographic: municipal mitigation is a worldwide trend (e.g. Romero Lankao, 2007; Holgate, 2007), but this dissertation is limited to the United States, where the lack of national or international climate commitments make local climate action more clearly voluntary.

Secondly, this dissertation will address mitigation, rather than adaptation. Some municipalities are engaged in both, but municipal adaptation and mitigation are the subject of distinct literatures. Adaptation and mitigation are subject to different motivations and obstacles (Bulkeley et al, 2009; Sippel and Jenssen, 2009) – and adaptation is more obviously the result of rational self-interest. Within this paper, climate policies, plans, and networks – and climate governance in general – therefore refer solely to mitigation.

CHAPTER 1: LOCAL MITIGATION

A. Literature Review & Hypotheses

LOCAL GOVERNMENT IN THE US

In 2012, there were 90,056 distinct local governments in the United States, according to the US Census (Hogue, 2013). And it classified them into two broad categories, distinguished by the degree of services they provide. “Special purpose” governments exist to provide one specific service, or a limited set of related services. “General purpose” governments, in contrast, perform a wider and more diverse array of services, which may include “financial administration, police protection, highway administration, hospitals, utilities, etc.” (Hogue, 2013, p. 1). Each of these categories can be, in turn, further subdivided into various forms of local government. For example, “special purpose” forms of local government include the following:

- **School Districts.** In 2012, there were 12,880 independent school districts in the United States, according to the US Census, each dedicated to the purpose of education (Hogue, 2013).
- **Special Districts.** This US Census term encompasses a broad array of other “special purpose” forms of government, including port authorities, transit authorities, air pollution control districts, soil and water conservation districts, utility districts, water and sewer districts, and mosquito abatement districts. However the most common are fire protection districts (5,865 in the US); water supply districts (3,522); housing and community development districts (3,438); and drainage and flood control districts (3,248) (Hogue, 2013). Overall, there were 38,266 special-purpose governments in the United States in 2012 (Hogue, 2013).

And “general purpose” forms of government include:

- **Counties.** Every US state is divided geographically into a number of counties – ranging from 3 in Delaware to 254 in Texas – that cover its entire land area. In 2012, there were 3,031 counties in the United States, according to the US Census,[1] although 8 Massachusetts counties serve only as judicial and law enforcement districts (lacking any other political function),[2] and the same is true for Connecticut’s 8 counties[3] and Rhode Island’s four counties[4] (Hogue, 2013).

[1] This includes the counties in Louisiana (referred to as ‘Parishes’) and those in Alaska (referred to as ‘Boroughs’).
[2] See http://en.wikipedia.org/wiki/List_of_counties_in_Massachusetts.
[3] See http://en.wikipedia.org/wiki/List_of_counties_in_Connecticut.
[4] See http://en.wikipedia.org/wiki/List_of_counties_in_Rhode_Island.

- **Townships.** In some states, counties are further subdivided into townships, which have authorities and responsibilities that vary from state to state. In New Jersey and Pennsylvania, for instance, townships are analogous to cities and other municipalities, and have many of the same responsibilities and legal authority.[5] However townships in Indiana are limited to maintaining cemeteries, and providing services related to parks and recreation, fire and emergency services, and financial assistance to the poor.[6] In 2012, there were 16,360 townships in the United States, according to the US Census, none of which are located in the Western or Southern regions of the US (Hogue, 2013).
- **Municipalities.** This US Census term encompasses several local government forms, including cities, villages, towns, and (in New Jersey) boroughs. These classifications usually depend on state law, and reflect differences in population (cities are more populous than villages) and form of decision-making (towns often include more elements of direct democracy) (Anderson, 2005). In 2012, there were 19,519 municipalities in the United States, according to the US Census (Hogue, 2013).

LOCAL GOVERNMENT AUTHORITY

Unlike the federal and state governments in the United States, local governments are not mentioned in the US Constitution, and do not derive their legal authority from that document. Instead, state governments – via their own constitutions and statutes – set the conditions under which local governments may exist, and the authority they may exercise (Richardson, 2003). In practice, this means that despite the broad similarity in the types of local government, there are important differences in how these local governments are organized across US states, and the functions they perform.

One of the broadest distinctions occurs between local governments subject to "Dillon's Rule," and those granted "Home Rule" authority by their respective states. Dillon's Rule takes its name from Judge John F. Dillon, an Iowa Supreme Court Justice[7] whose rulings limiting local authority were broadly adopted and later upheld by the US Supreme Court (Richardson, 2003). In *Clark v. City of Des Moines* (1865), he wrote that:

> It is a general and undisputed proposition of law that a municipal corporation possesses and can exercise the following powers and no others: First, those granted in express words; second, those necessarily or fairly implied in or incident to the powers expressly granted; third, those essential to the declared objects and purposes of the corporation, not simply convenient, but indispensable. Any fair, reasonable doubt concerning the existence of the power is resolved by the courts against the corporation, and the power is denied. (via Richardson, 2003, p. 8)

In another seminal decision, *City of Clinton v. Cedar Rapids and Missouri River Railroad* (1868), Dillon wrote that:

> Municipal corporations owe their origin to, and derive their powers and rights wholly from, the legislature. It breathes into them the breath of life, without which they cannot exist. As it creates, so it may destroy. If it may destroy, it may abridge

[5] See http://en.wikipedia.org/wiki/Township_(United_States).

[6] See http://unitedtownships.org/?page_id=22.

[7] At the time in question. He was later appointed to a federal judgeship with the United States Circuit Court by President Grant. See http://en.wikipedia.org/wiki/John_Forrest_Dillon.

> and control…We know of no limitation on this right so far as the corporations themselves are concerned. They are, so to phrase it, the mere tenants at will of the legislature. (via Richardson, 2003, p. 8)

Together, these rulings represent a narrow rendering of local authority, such that governments may only exercise the powers expressly granted to them.

However many local governments are not subject to Dillon's Rule. Often this is because the states in which they reside have adopted some form of "Home Rule," in which certain local governments may assume any powers not explicitly excluded by state law. Dillon's Rule is more common – 31 states apply the rule to all their local governments, and a further 8 apply it to selected local governments (Richardson, 2003). Yet in any specific context, the distinction between Dillons Rule and Home Rule is itself a broad simplification. For example, local governments in a "Home Rule" state would, by default, have the authority to ban or regulate idling by private and commercial vehicles; they'd lack this same authority in Dillon's Rule states. But only by default – Dillon's Rule states can nonetheless grant this authority, and Home Rule states can take it away.

With regards to mitigation, most of the existing literature focuses on the authority that general-purpose forms of local government have to control emissions. In general, they possess some degree of authority in four relevant sectors. The first is land use and urban planning, a role traditionally performed by general-purpose local governments. They have the authority to guide development through long-range, comprehensive planning, and can favor low-carbon forms of infrastructure and development (e.g. high density, spatially-compact, mixed-use) (Brown and Southworth, 2008). Secondly, they can incentivize the use and increase the quality of public transit – as well as other forms of low-carbon transportation such as cycling and carpooling.[8] Thirdly, general-purpose local governments can often reduce the demand for energy via building codes and public information campaigns – and those with municipal utilities, such as Seattle City Light, can incentivize the production of renewable, low-carbon electricity (Jo et al, 2009).[9] Finally, they can mitigate their emissions via waste reuse and recycling programs, or via methane capture from government-run landfills (Kern and Alber, 2008).

These efforts may focus on reducing emissions from government-run operations, or from the community as a whole. Kern and Alber (2008) identify four "modes" through which these policies attempt to mitigate emissions:

> First, ***self-governing*** can be defined as the capacity of local government to govern its own activities, for example by improving energy efficiency in government offices and other municipality-owned buildings. Self-governing relies on reorganisation, institutional innovation and strategic investments. Second, ***governing through enabling*** refers to the role of local government in co-ordinating and facilitating partnerships with private entities and encouraging community engagement. Tools such as persuasion and (positive) incentives are most important for this mode of governing. Third, ***governing by provision*** implies shaping practice through the delivery of particular forms of services and resources. This is accomplished through infrastructure and financial policy. Fourth, ***governing by regulation*** can be characterised as the use of traditional forms of authority, such as control and the use of sanctions. (p. 174; authors' emphasis)

[8] Although in metropolitan areas, regional development and regional transportation systems are only partly subject to the authority of any given jurisdiction, which can make mitigation difficult without a shared commitment and collaboration (Bartholomew, 2009).

[9] Although the use of low-carbon electricity is preferred in terms of climate impacts, cities that already rely on low-carbon electricity mixes, such as Seattle, may find it more difficult to achieve their emission-reduction targets (Pitt and Randolph, 2009).

More is known about how cities are using their authority to reduce greenhouse gas emissions than any other form of local government. The literature in this area stretches back nearly 20 years (e.g. Lambright, et al, 1996) and includes a wealth of both qualitative and quantitative research. Yet on a broad scale and systematic basis, next to nothing is known about the mitigation efforts of school districts, port authorities, and other "special purpose" local governments.

Counties fall much closer to the unknown side of the spectrum. Bedworth and Hanak (2013) survey mitigation efforts by all the counties in California, while Tang, et al (2012) survey counties from California, along the rest of the Pacific coast, and the 100 fastest-growing counties in the US. Both studies provide important insights into the mitigation activities of US counties, but neither survey is representative or generalizable.

In this dissertation, I've chosen to focus specifically on mitigation by "general purpose" local governments. This choice was guided by a two important factors:

- **Mitigative scope.** Virtually all local governments have some ability to mitigate greenhouse gas emissions, no matter what their primary purpose may be. School districts can install solar power on their buildings; water and sewer districts can use hybrid vehicles; ports can install equipment that gives docked ships electrical access without perpetually running their diesel engines. However special-purpose governments are generally limited to the self-governing mode or, in certain cases, the enabling and provision modes.[10] In contrast, general-purpose governments can use the regulatory mode to compel mitigative action by private and commercial parties. Because of their broad authority in multiple areas of public life, general-purpose governments can also use the enabling and provision modes to greater effect than special-purpose governments often can. Therefore most of the mitigation resulting from local government action likely results from the efforts of general-purpose governments, making research in this area of greater practical importance.
- **Availability of data.** Partly because of the prominent role they play in public life, data is more readily accessible for general-purpose local governments. The US Census, for instance, reports data on the population of general-purpose local governments, but not the populations covered by each fire-protection district, mosquito abatement district, and transit authority. Therefore research into special-purpose governments is likely to be more time-consuming and arduous to undertake.

In so doing, I follow the lead of the US Census in distinguishing between counties and other forms of general-purpose local governments. The Census uses the term 'incorporated places' to refer to cities, towns, villages, and townships, and I follow this usage, despite its awkwardness. But there is no term – aside from 'general-purpose local governments' – that encompasses both counties and incorporated places. Since it would be awkward to use this lengthy term repetitively, I repurpose the term 'municipality.'

[10] With some exceptions. For example, some air pollution control districts have regulatory authority over activities that produce greenhouse gas emissions. But this is less frequent among special-purpose local governments.

Strictly-speaking, townships and counties are not municipalities, but throughout this document I use the term to refer to both incorporated places and county governments. From now on, my use of the phrase 'local governments' is similarly limited to these governments of interest: counties and 'incorporated places' in the US.

LOCAL GOVERNMENT MITIGATION

Multiple authors have noted the strong tendency of local governments to prefer the voluntary modes (self-governing and enabling) over the more coercive mode (regulatory) in their mitigation efforts (Wheeler, 2008; Bulkeley and Kern, 2006; Aall et al, 2007; Kern and Alber, 2008; Slocum, 2004; Rutland and Aylett, 2008; Schroeder and Bulkeley, 2009). This preference inspires "little-to-no community resistance" (Pitt

Table 1: Policies from Krause, 2011a

GHG-reducing activity	Percent of cities where implemented
Self-Governing	***Avg = 40.49%***
1. Responsibility for climate protection coordination designated to a specific city department, individual or committee	*55.79%*
2. Climate protection activities have line in municipal budget	*17.02%*
3. Efficient lighting installed in city buildings	*59.00%*
4. Efficient lighting installed in city streetlights	*33.00%*
5. EnergyStar only purchase policy for city equipment and appliances in place	*31.00%*
6. Efficiency standards adopted for all new and retrofit city-owned buildings	*39.50%*
7. Anti-idle policy adopted for city-owned vehicles	*48.32%*
8. Vehicle fleet being made "green" (i.e. converted to hybrids, high efficiency, alt fuels)	*80.85%*
9. City purchases and/or produces clean energy to power its own operations	*37.38%*
10. City has adopted an urban tree canopy cover goal	*38.91%*
11. Inventory conducted on local GHG emissions	*40.72%*
12. GHG reduction goal formally adopted by city	*30.39%*
13. GHG reduction plan developed and formally adopted by city	*14.50%*
Enabling	***Avg = 46.29%***
14. City offer incentives to its employees to use methods other than single occupancy vehicles to commute to work	*32.21%*
15. City provides information to residents on energy efficiency	*76.83%*
16. City provides residents or developers incentives for energy efficiency building/ improvements	*41.03%*
17. City provides outreach and education provided regarding privately owned trees	*56.10%*
18. Residents are offered incentives to take public transit (free days, reduces fares, etc)	*25.30%*
Provision	***Avg = 69.84%***
19. City is served by public transportation	*60.98%*
20. Community-wide hike and bike trails in place	*64.63%*
21. Bicycle lanes present on roadways	*69.51%*
22. Residential yard waste is composted	*62.80%*
23. Curbside recycling is provided to residents	*91.18%*
Regulation	***Avg = 54.30%***
24. City has regulations requiring private/commercial buildings to meet efficiency standards	*21.95%*
25. Tree ordinance adopted specifying planting/removal requirements for developers	*74.70%*
26. Planning and zoning decisions explicitly consider effect on sprawl or GHG	*66.26%*

Table 2: Policies from Pitt, 2009	
GHG-reducing activity	**Percent of cities where implemented**
Self-Governing	***Avg = 15.31%***
1. Enhanced energy efficiency requirements in municipal building code (N=275)	*28.36%*
2. A community-wide inventory of GHG emissions (N=298)	*13.42%*
3. Goals or targets for the reduction of community-wide GHG emissions (N=298)	*10.74%*
4. A plan to reduce community-wide GHG emissions (N=298)	*8.72%*
Enabling	***Avg = 15.14%***
5. Planning incentives (e.g., "fast-track" approval, density bonuses, etc.) for energy-efficient buildings (N=275)	*13.09%*
6. Property tax exemptions or reductions for energy-efficient buildings (N=275)	*1.82%*
7. Free or reduced-rate weatherization or energy conservation supplies (N=275)	*14.18%*
8. Grants or rebates to assist construction of new energy-efficient homes or buildings (N=275)	*4.73%*
9. Grants or rebates to assist weatherization or energy efficiency upgrades to existing buildings (N=275)	*8.36%*
10. Grants or rebates to assist purchase of energy-efficient appliances (N=275)	*8.73%*
11. Planning incentives (e.g., "fast-track" approval, density bonuses, etc.) to developers who include renewable energy systems in new construction (N=275)	*5.45%*
12. Streamlined or "fast track" permitting processes for small-scale renewable energy systems added to existing buildings or properties (N=275)	*4.36%*
13. Building height exemptions for small-scale renewable energy systems (N=275)	*2.91%*
14. Waiver or reduction of permit fees for small renewable energy systems (N=275)	*5.09%*
15. Property tax exemptions or reductions for on-site renewable energy systems (N=275)	*1.82%*
16. Grants or rebates to offset some of the cost of new renewable energy systems (N=275)	*3.64%*
17. Solar access or "solar rights" laws (N=275)	*3.64%*
18. Adopted comprehensive plan goals or objectives to manage growth, reduce sprawl and/or focus development in existing urban areas (N=264)	*57.20%*
19. Adopted comprehensive plan goals or objectives to encourage mixed-use, pedestrian-oriented, and/or transit-oriented development (N=264)	*59.85%*
20. Adopted additional growth management tools such as transfers of development rights (TDR's) or conservation easements (N=261)	*20.31%*
21. Collaborated with nearby jurisdictions and/or regional agencies on regional or metropolitan-area growth management plans	*43.00%*
22. Worked with private sector to provide subsidized transit passes and/or other programs to encourage employees to use alternative transportation modes (N=264)	*14.39%*
Provision	***Avg = 14.04%***
23. Energy audits or other technical assistance for the installation of energy efficiency upgrades (N=275)	*21.09%*
24. Low-interest loans to assist construction of new energy-efficient homes or buildings (N=275)	*2.91%*
25. Low-interest loans to assist weatherization or energy efficiency upgrades to existing buildings (N=275)	*6.18%*
26. Low-interest loans to assist purchase of energy-efficient appliances (N=275)	*4.00%*
27. Low-interest loans to offset some of the cost of new renewable energy systems (N=275)	*2.55%*
28. Increased mass transit service (e.g., increased service frequency, added new bus or rail lines) (N=264)	*32.20%*
29. Built new bicycle lanes, multi-use paths, or other bicycle or pedestrian amenities (N=264)	*62.50%*
30. Technical assistance for the installation of new renewable energy systems (N=275)	*6.91%*
31. Public benefits fund, or local levy to support renewable energy programs (N=275)	*0.73%*
32. Provided carpool matching or "guaranteed ride home" programs for commuters (N=264)	*12.50%*
33. Community choice aggregation to negotiate renewable energy options for private utility customers (N=275)	*2.91%*
Regulation	***Avg = 51.42%***
34. Updated zoning code to manage growth, reduce sprawl, and/or focus development in existing urban areas (N=264)	*53.41%*
35. Updated zoning code to encourage mixed-use, pedestrian-oriented, and/or transit-oriented development (N=263)	*49.43%*

2010b, p. 725) and even extends to places such as Sweden, where climate change, and the need for urgent action, is broadly accepted (Granberg and Elander, 2007).[11] This leads to the first hypothesis:

[H1]: Municipalities are more likely to adopt self-governing and 'enabling' mitigation policies than regulatory policies.

However this hypothesis has *not* been supported by large-n surveys of municipal mitigation, of which there are surprisingly few. Krause (2011a) surveyed all 665 US cities with populations greater than 50,000;[12] Pitt (2009) surveyed 3949 administrators and elected officials from a National League of Cities mailing list.[13] In Tables 1 and 2, I've reproduced their data, sorted by mode, and derived average percentages for each category.[14]

This large-n data doesn't support the conclusions drawn from the small-n case study literature – in fact, regulation appears to be *more* popular than enabling or self-governing policies, not less so. It seems odd that local governments would prefer coercion over persuasion, but neither study was designed to test **H1**, and the limited number of regulation policies they survey may help explain these unusual results. Furthermore, while the Krause data is generalizable to large US cities, it's unclear how well Pitt's data represents incorporated places generally.

B. Methods

POPULATION & SAMPLING

Most existing studies of municipal mitigation – both qualitative and quantitative – select on the dependent variable (often membership in a climate network, particularly the Cities for Climate Protection). Such studies are not generalizable to the larger population of local governments, and cast no light on the mitigation activities that other municipalities may be undertaking. This can lead to two mischaracterizations: first, if climate network members are assumed to be the *only* municipalities adopting and implementing mitigation policies, the prevalence of these activities may be seriously underestimated. Secondly, the mitigation efforts of climate network members may be inaccurately attributed to the

[11] The perceived political feasibility of various mitigation strategies clearly plays an important role in their selection. Energy efficiency emerged as a primary means of carbon mitigation in Portland at least in part because it could advance diverse – and divergent – political goals in tandem (Rutland and Aylett, 2008), and municipalities in Germany have shied away from the politically-sensitive areas of transport and planning, where support for mitigation is often lacking (Bulkeley and Kern, 2006).

[12] Based on 2005 population estimates from the US Census. Her response rate was 49.47%; see p. 202.

[13] Pitt states that 263 municipalities submitted complete responses, but doesn't share how many municipalities those 3949 administrators represent. Therefore it's not possible to calculate his response rate, which he doesn't divulge. Nor is it clear how his population of municipalities – drawn from the NLC list – relates to the population of US municipalities generally. Policies and percentages listed on pages 190-223.

[14] Tang et al (2012, pp. 91-93) also reported data on the environmental activities being undertaken by local governments. His study surveyed planning directors on the county level, but his results are not reported here because they could not be consistently differentiated by mode.

dependent variable in question: climate network membership. Other studies sample the entire population of interest (e.g. US cities with populations over 100,000). This study is the first to select its sample randomly. This has several advantages: first, it avoids the bias associated with selecting on the dependent variable. Secondly, a random sample avoids the difficulty and expense of sampling my entire population of interest – a much larger population than any that's been studied thus far.

Specifically, I sampled 1000 local governments with populations that exceed 25,000, according to the 2012 estimates from the US Census. Most existing research – both qualitative and quantitative – focuses on cities with populations over 50,000; my research is therefore among the first to evaluate mitigation by mid-size local governments. My study is also one of the first to examine mitigation by US counties, responding to the call for a wider scope of research on local mitigation (e.g. Dierwechter and Wessells, 2013; Fitzgerald, 2010).

US Census data identified 1607 counties in 2012 that had populations exceeding 25,000. Additionally, there were 1913 incorporated places with populations greater than 25,000. Together these 3520 local governments are the population to which my findings are generalizable.

The decision to select 1000 as my sample was guided by the need to ensure sufficient statistical power, even allowing for the possibility of a low survey response rate.

I stratified solely on the basis of form of government (counties or 'incorporated places'), yielding a final sample with 500 counties and 500 incorporated places.[15] Stratified random sampling is often used when the researcher wants to focus on specific subgroups within a larger population, as I do with these two forms of government. I chose not to stratify or oversample on the basis of any other variable, partly because the probability of undersampling subgroups declines as the sample size increases – and 1000 is a fairly large sample – and partly to avoid the analytical challenges caused by stratifying on the basis of two or more variables.

I did not exclude overlapping jurisdictions in my sampling procedure – which means that cities and counties in the same geographic area (such as Chicago and Cook County) were occasionally included in my sample. This only introduces error if *including both governments in my sample* increases or decreases the probability that one of them will pursue different forms of mitigation (mass transit service, for example). Clearly this possibility exists when there is a geographic overlap – in theory, a city could pay the surrounding county to provide some service (like curbside recycling) and therefore avoid doing so itself. However this possibility remains regardless of whether both governments are included in my sample. And it would be impossible to avoid, even if my sample focused on one form of government, to the exclusion of the other.[16]

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[15] This is a simplification. In reality, my sample contains 509 cities and 510 counties, because it contains 18 governments which can be considered both cities and counties. This includes consolidated city-counties (like San Francisco, CA) which serve simultaneously as both forms of local government, and independent cities (like Baltimore, MD), which do not reside within any county, yet are treated as county equivalents by the US Census.

[16] Scholarship that explores the influence between counties and cities regarding local mitigation is rare. Krause (2012, p. 2407) writes that, "County governments are less able than states to constrain directly or force city actions. As a result of their peer-like relationship, influence would manifest as a process of horizontal, rather than vertical, policy diffusion." And she finds (p. 2414) that:

SURVEY INSTRUMENT

I used an online survey to collect information about the mitigative efforts being undertaken by local municipalities, as well as their financial cost. Screenshots of the survey I used to collect this data are available in Appendix 1. [17]

While the survey is about mitigation activities specifically, it was presented as a survey about environmental activities generally. Climate change remains a polarizing issue in the United States, and some municipal staff may be less willing to respond to research framed as climate change-related. Since these staff are likely distributed non-randomly, I felt a climate frame could bias response rates and the research results.

Before sending out the survey, I pretested it with a range of colleagues and municipal staff – 13 people in total. They identified several sources of confusion and ambiguity, and while the final survey remains my responsibility, it was greatly improved by their comments and feedback.

SURVEY OUTREACH

Previous studies of municipal mitigation that employed a survey instrument achieved response rates ranging from 6.6% (Pitt, 2010a) to 65% (Bedworth and Hanak, 2013). Maximizing the response rate has several advantages: first, it improves statistical power, due to the larger number of observations. And secondly, it tends to reduce the influence of self-selection bias and improve external validity, because the respondents better represent the random sample, and therefore better generalize to the population at large.

Figure 1: The Map on the Survey's Homepage

For that reason, this study's survey and outreach process was designed to maximize the response rate. I hosted the survey on a unique site (www.localenvironmentsurvey.com), on the assumption that a survey with its own domain, design, and branding would appear more credible to prospective respondents. This also allowed me to build several customized features into the survey:

"Cities in counties that have enacted visible greenhouse gas reducing initiatives score an average of 1 point higher on the MCPI than those located in inactive counties."

[17] This survey owes a significant debt to the work of both Pitt (2010a) and Krause (2011a).

- A map on the homepage – designed to create a bandwagon effect – which showed the geographic location of each respondent government.
- A tool on the final page which respondents could use to invite their colleagues to complete the survey.
- A thank-you email, automatically sent by the survey to each respondent, which included an email they could forward to colleagues to solicit their participation.

The responsibility for administering mitigation policies is not structured consistently across local governments. Krause et al (2015) investigate a different but related question: the locus of responsibility for sustainability administration within city government. They surveyed 445 cities with populations over 50,000,[18] and found that:

> …no single department is home to sustainability efforts in more than a third of the sample cities. On the high end, primary responsibility for sustainability has been assigned to either public works or environmental services departments in approximately 30% of the sample cities and to planning or community development departments for another 25% of cities. Approximately, 15% of cities have placed sustainability in the city manager's office and another 15% have created an independent office or department of sustainability that is not a subunit of any other department. The Mayor's office houses sustainability efforts in just less than 10% of cities, whereas municipally owned utilities are the responsible unit in approximately 4%. (Krause et al, 2015, p. 12).

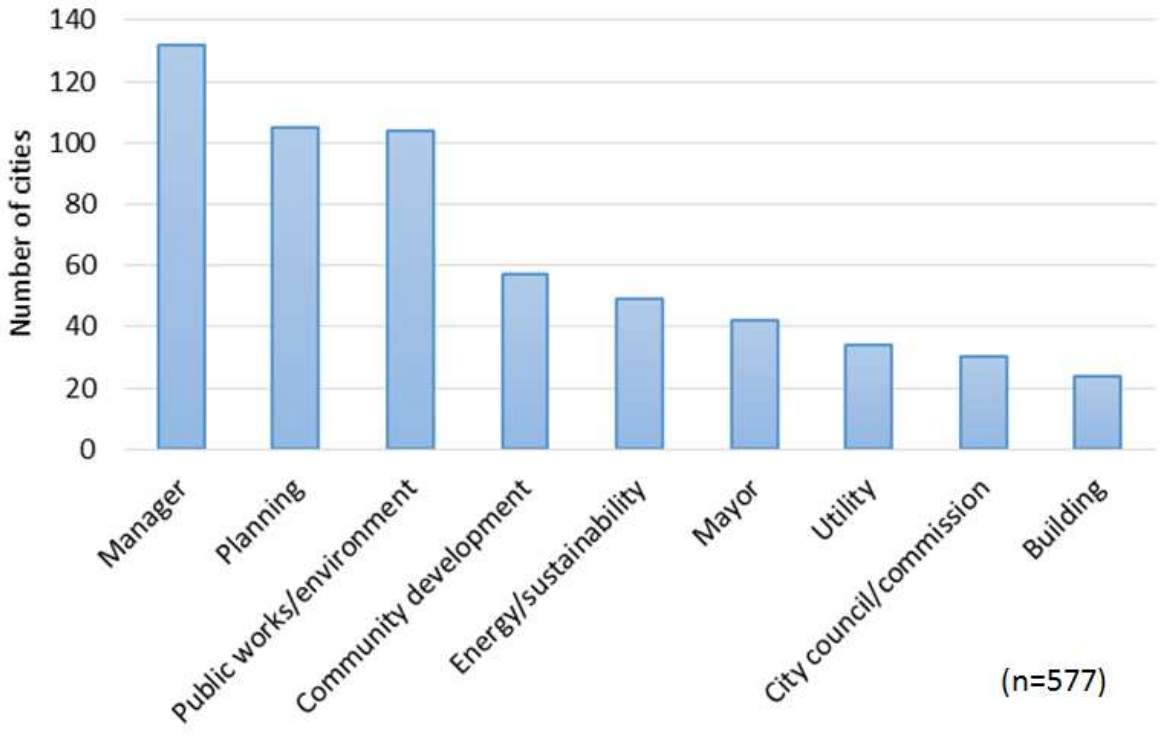

Figure 2: The Locus of Sustainability Administration Across City Departments

(Figure from Krause, 2015)

[18] Which were either (a) members at any time of ICLEI – Local Governments for Sustainability; and/or (b) had city staff designated as responsible for sustainability. See Krause et al (2015), p. 10.

This is represented graphically in Figure 2 (from Krause, 2015). Mitigation and sustainability are analogous but not identical; mitigation efforts may not follow the same distribution. But Figure 2 does indicate how disparately local governments structure the administration and oversight of their environmental efforts.

Regardless, there are often multiple people within local governments responsible for mitigation decision-making. For incorporated places, this may include the Mayor, City Manager, members of the city council, and the leaders and staff of relevant departments. For counties, this may include the County Executive, County Administrator, members of the county board, and the leaders and staff of relevant departments.

Accordingly, I gathered the contact information for multiple potential respondents for each of the local governments in my sample. These were administrators and elected officials who, by virtue of their positions, might be qualified to comment on the mitigative actions undertaken by their municipality. This includes mayors, city managers, city councilors, county commissioners, and leaders within departments such as planning, community development, public works, parks and recreation, finance, utilities, environment, and sustainability. I collected the names, titles, email addresses and phone numbers for these potential respondents by combing through the websites of nearly all the local governments in my sample. I also used Google and several online research tools to find this information – particularly when the local governments in my sample didn't have a website. Finally, local libraries and Chambers of Commerce were occasionally helpful, as a last resort. In the end, I found some form of contact

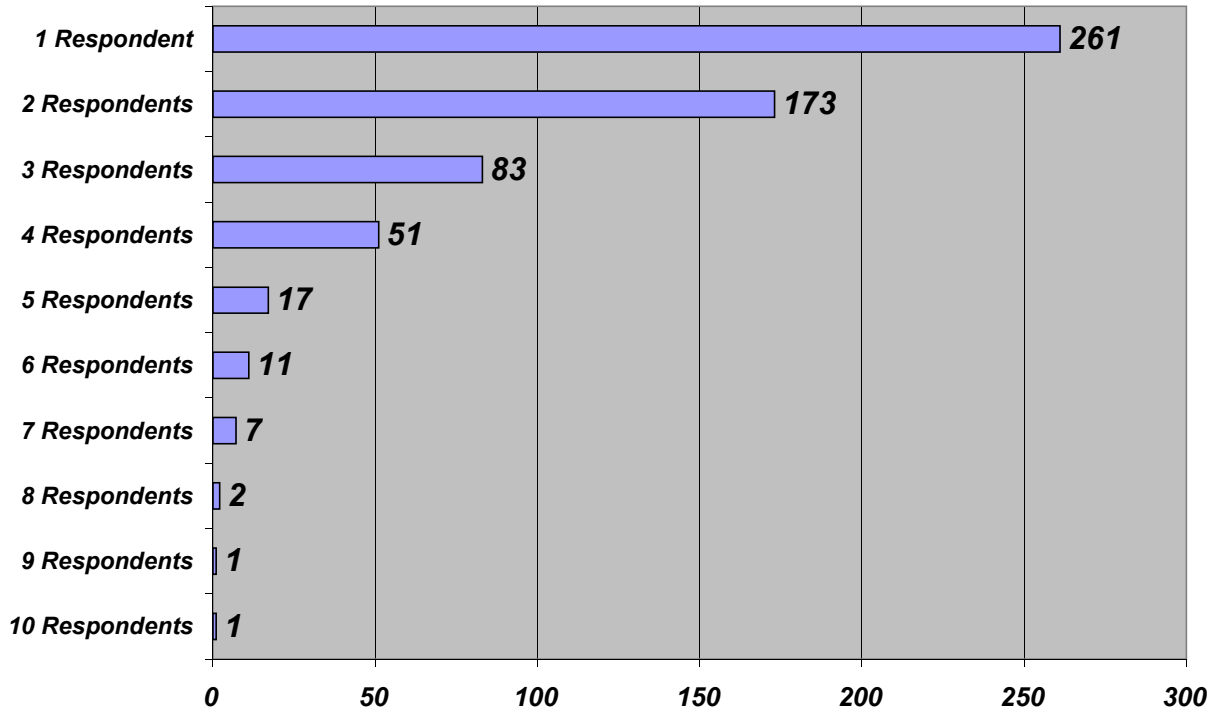

Figure 3: Municipalities by Number of Respondents

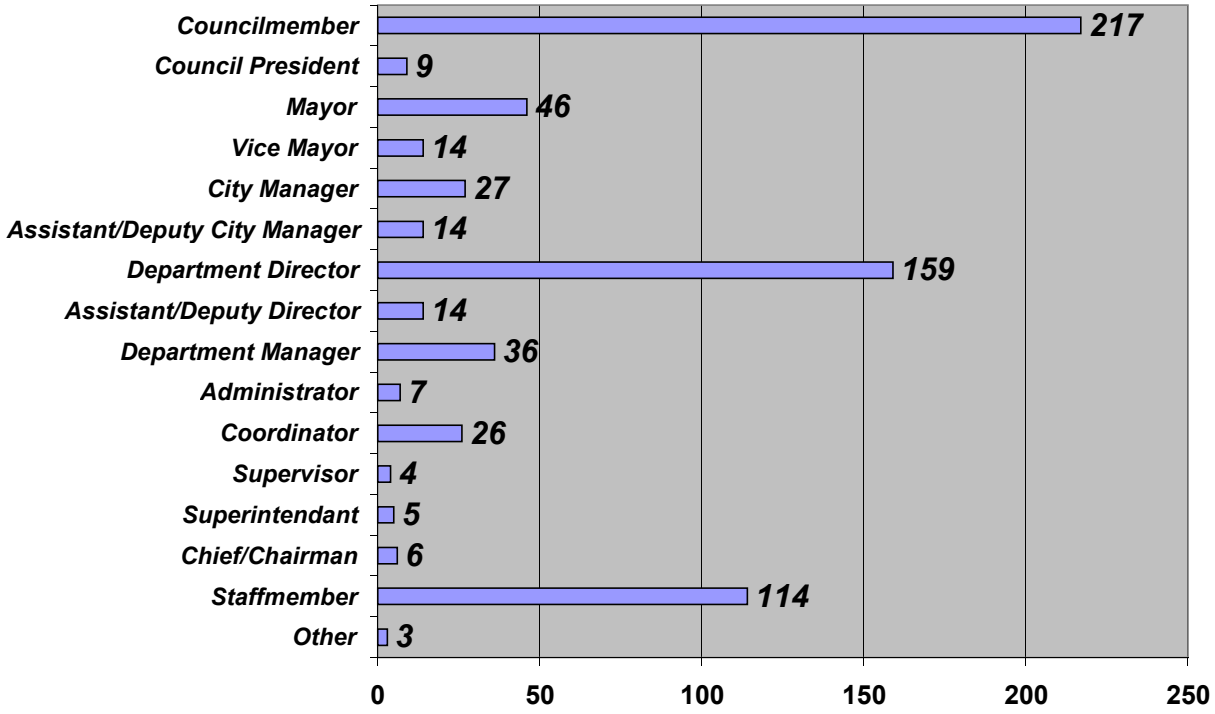

Figure 4: Respondents by Title (Incorporated Places)

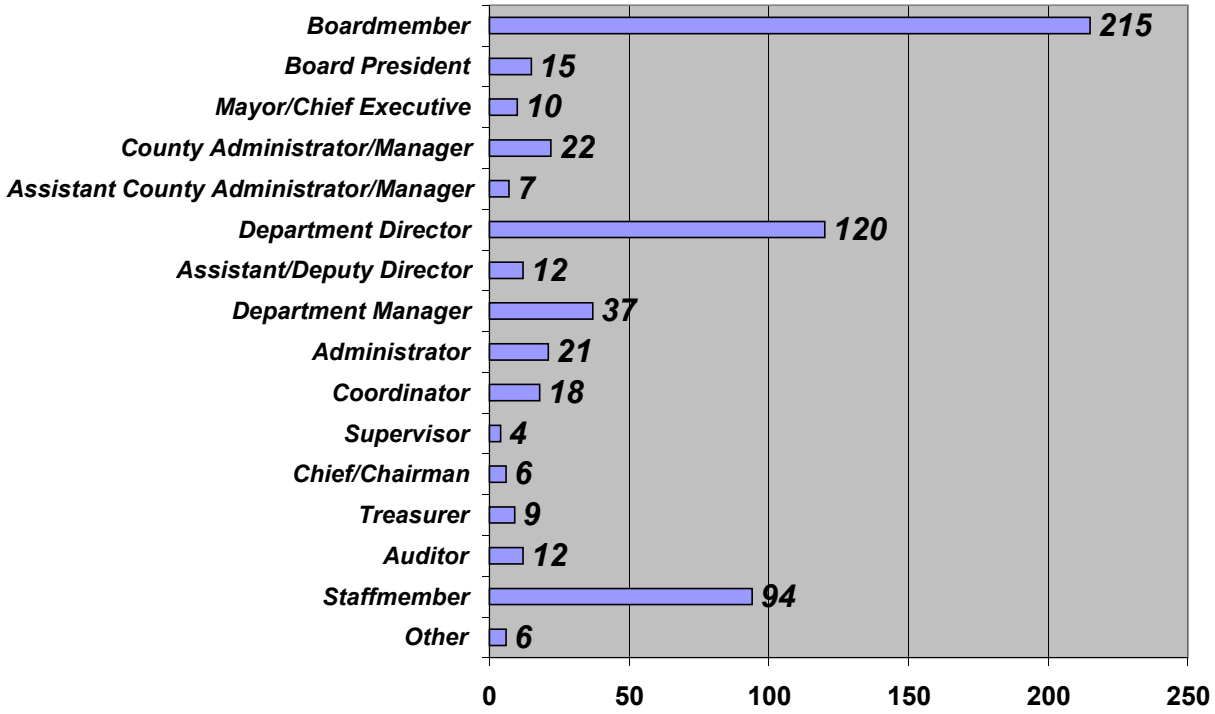

Figure 5: Respondents by Title (Counties)

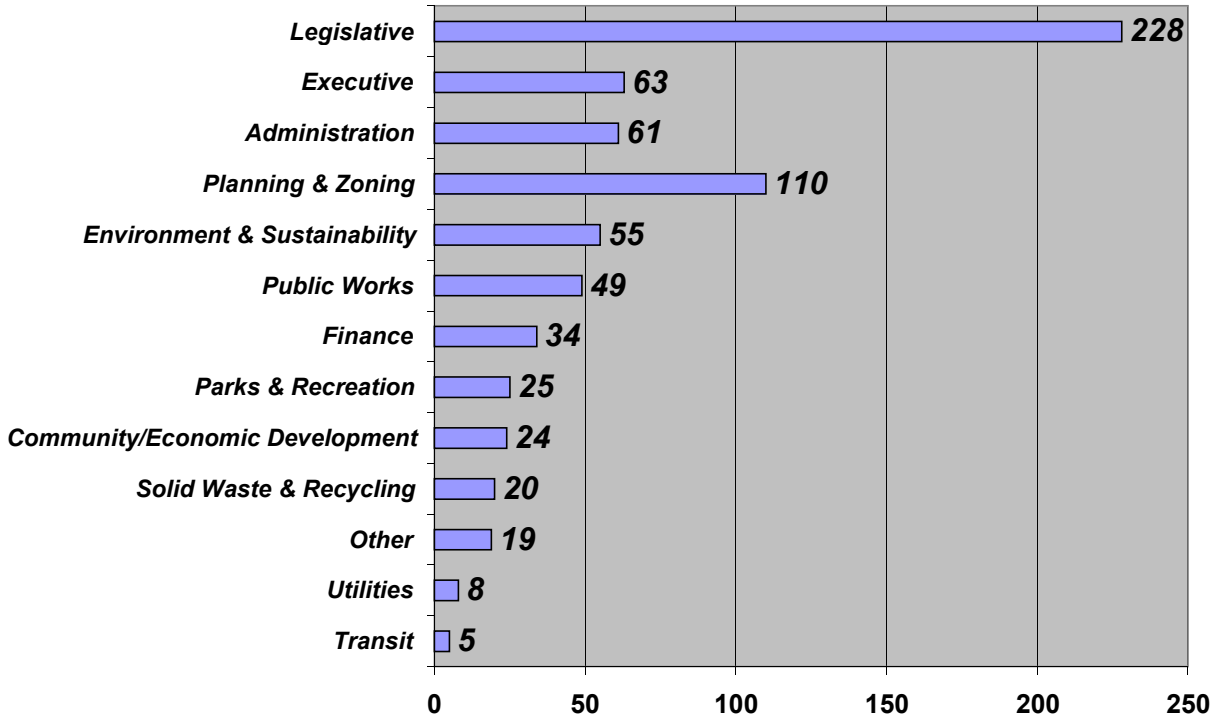

Figure 6: Respondents by Function (Incorporated Places)

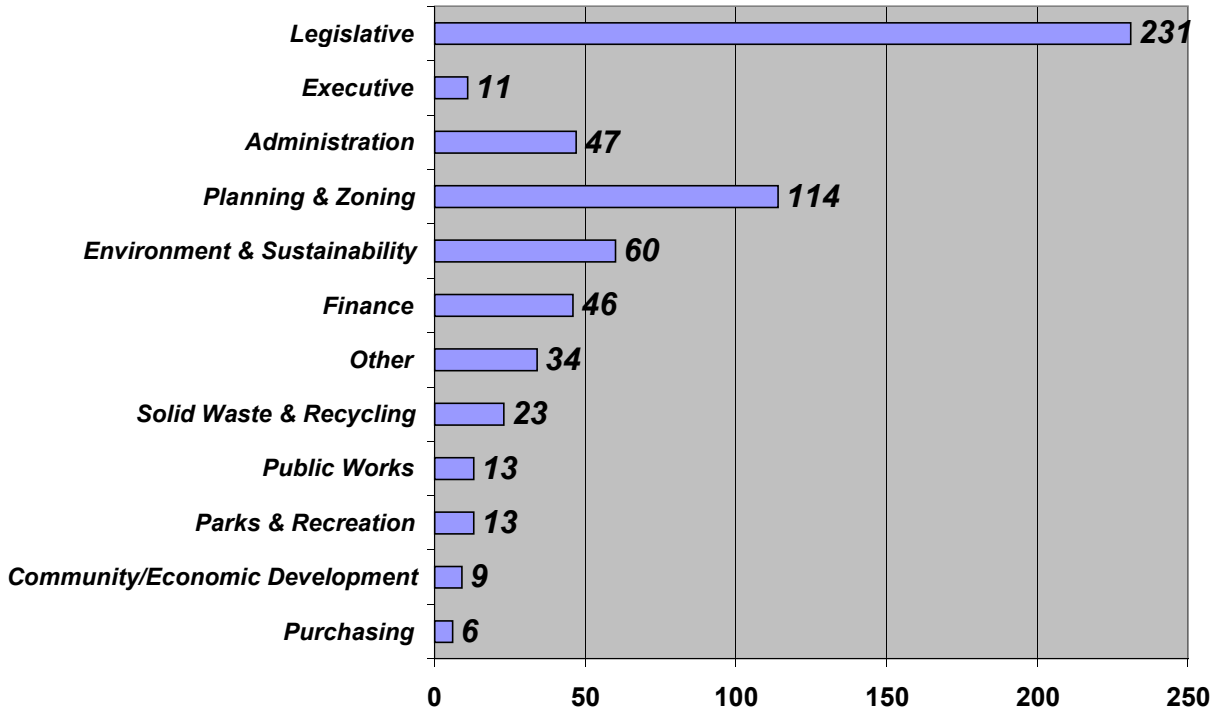

Figure 7: Respondents by Function (Counties)

information for 10,582 potential respondents, representing 992 of the local governments in my sample. So my units of observation are the individual survey respondents, while my units of analysis are the municipalities they represent.

I sent a personalized email (or, on rare occasions when email wasn't possible, made a phone call or sent a letter) to each of the potential respondents I identified. Two weeks later, I sent a follow-up email to anyone that hadn't yet responded, and I sent a final reminder in early July (examples of this outreach are available in Appendix 2). In all, I sent 28,910 emails asking for participation, and 257 emails responding to potential respondents.[19] [20] The survey was in the field for a total of seven weeks.

In all, I collected 1320 survey responses from the 10,582 potential respondents I contacted – an individual response rate of 12.47%. These respondents represented 607 of the 992 local governments I contacted, for a municipal response rate of 61.19%.

On average, I contacted 10.67 potential respondents from each local government. Multiple responses from the same municipality were averaged, on the assumption that consensus estimates are more likely to approximate "true" values than any individual estimate. I therefore expect the quality of a municipality's survey data to increase in proportion with the number of respondents from that municipality.

Both respondents and potential respondents were encouraged to forward the survey to colleagues within their local government. This simultaneously increased the likelihood of qualified respondents (assuming it was forwarded to those better able to complete it) and the likelihood of unqualified respondents (assuming – at least sometimes – the reverse). In cleaning the data, I therefore carefully examined the departments and titles of survey respondents. I deleted observations where the respondent did not represent a government in my random sample;[21] where the respondent recorded the names of two local governments;[22] and where the respondent specified their responses were specific to their department, rather than their government as a whole. Figures 3 through 6 show the titles of respondents from counties and incorporated places, as well as their governmental function.

SELF-SELECTION BIAS

Response rates below 100% entail the possibility of self-selection bias. To assess this bias I compared the observable characteristics of respondent and non-respondent municipalities (see Tables 3 and 4). Incorporated places that responded to my survey tended to be somewhat wealthier and more populous,

[19] I did not use mail merge for several reasons. First, I wanted the emails to originate from my official UW email account, and I knew the UW system would not allow me to send so many emails at once. Secondly, any mistake made with mail merge would be serious, given the sheer number of people I was contacting. Third, I was uncertain how mail merge would function with my plan to send two follow-up emails to potential respondents. Therefore I personalized each email by hand. I found I could send 200 personalized emails per hour, and 700 follow-up emails per hour (by sending the identical text attached to emails previously personalized).

[20] I also responded to about two dozen phone calls. Most of these potential respondents wanted more information about the survey; others wanted to verify the survey's authenticity, share their political opinions, provide more information, or decline to participate.

[21] For example, the Santa Monica Bay Restoration Commission, the Hood County Clean Air Coalition, and an NGO that works with communities in the Southeast United States about climate change.

[22] Often because they worked for both under a joint appointment. In such cases it's impossible to tell which government their survey data applies to.

Table 3: Comparison of Respondent and Non-Respondent Incorporated Places				
	Respondents (n=340)		Non-Respondents (n=168)	
	Mean	Standard Deviation	Mean	Standard Deviation
networkmem	.424	.495	.202	.403
coastvuln	.559	.497	.554	.499
hazardcost	714356.4	327	858890.3	3059544
libvoting	.544	.130	.524	.139
carbemploy*	.192	.062	.203	.076
medincome	58.89	22.78	60.02	23.46
munirevenue**	1708.01	1207.35	1196.11	1171.23
pop*	114454.6	288736.5	70154.33	118146.1
educ**	.329	.149	.301	.152
colltown	.068	.252	.024	.153
cleanair	.618	.487	.673	.471
transit	.307	.135	.321	.143
stmandate	.132	.339	.131	.338
dillons	.559	.497	.583	.494
stplan	.782	.413	.780	.416
sttarget	.594	.492	.595	.492
stpolicies	18.36	4.50	18.05	4.74
Difference in means test, assuming equal variances; not conducted on dichotomous variables: ***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed)				

Table 4: Comparison of Respondent and Non-Respondent Counties				
	Respondents (n=284)		Non-Respondents (n=218)	
	Mean	Standard Deviation	Mean	Standard Deviation
networkmem	.049	.217	.023	.150
coastvuln	.313	.465	.220	.415
hazardcost*	473089.8	3108777	76347.71	294101.9
libvoting***	.461	.129	.411	.123
carbemploy***	.242	.103	.302	.116
medincome***	51.32	11.72	45.93	11.92
munirevenue**	970.1	854.99	660.44	653.18
pop***	232333.1	702174.3	95838.03	146196.5
educ***	.249	.095	.189	.075
colltown	.035	.185	0.00	0.00
cleanair	.289	.454	.197	.399
transit	.309	.115	.323	.109
stmandate	.032	.175	.009	.096
dillons	.746	.436	.752	.433
stplan	.746	.436	.518	.501
sttarget	.398	.490	.220	.415
stpolicies***	16.56	4.04	14.41	4.50
Difference in means test, assuming equal variances; not conducted on dichotomous variables: ***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed)				

and were more likely to be college towns and climate network members. Counties that responded to my survey had the same characteristics, and also generally had worse air quality, better educated populations, and incurred more costly damage from hazardous weather events. Additionally, they were more likely to be located in coastal areas, and in states that took more aggressive action to address climate change. While noteworthy, these differences are rarely severe, and respondent and non-respondent municipalities are otherwise broadly similar. In any survey, self-selection bias is a potential problem, and conclusions based on such data must be qualified accordingly. However this comparison of observable characteristics indicates that – while a concern – such bias is unlikely to be serious.

Table 5: Reconciling Even Splits Between Multiple Respondents for Individual Policies

noauthority
no + noauthority
no
no + noauthority + workingconsideration + yes
no + notransit + workingconsideration + yes
no + noauthority + workingconsideration
no + notransit + workingconsideration
no + noauthority + yes
no + notransit + yes
no + noauthority + notransit
noauthority + notransit + yes
no + notransit
noauthority + workingconsideration
workingconsideration
workingconsideration + no + yes
workingconsideration + noauthority + yes
workingconsideration + no
workingconsideration + yes
workingconsideration + notransit
no + yes
notransit + yes
noauthority + yes

VARIABLES

My survey collected information about 27 local policies and activities, all of which mitigate greenhouse gas emissions from municipal operations or the community at large.[23] These policies reflect the range of activities being undertaken by members of the Cities for Climate Protection, Cool Cities, and US Mayors Climate Protection Agreement climate networks. They also reflect an extensive literature review.[24]

Survey respondents were given up to six choices when asked whether their government pursued one of these policies:

a) *Yes*
b) *We're working on it/it's under consideration*
c) *No*
d) *No, because our local government lacks that authority*
e) *Our local government does not participate in any mass transit service*

[23] This study does not distinguish between 'explicit' and 'implicit' mitigation: that is, between actions taken *to* reduce emissions and those taken *that* reduce emissions (Krause, 2013). Swapping incandescent bulbs for LEDs, for example, reduces energy usage and maintenance costs, so mitigation may be the primary or a secondary motivation. Krause finds that 'explicit' climate efforts are often more effective than 'implicit' efforts in yielding reductions of greenhouse gas emissions. However measuring the intent and efficacy of mitigative policies is beyond the scope of this study.

[24] However the participation rates and efficacy of these policies will vary from one local government to the next. Both incorporated places and counties can undertake all the policies included in this study.

f) I don't know

Categorical responses like these cannot be averaged. Instead, when multiple respondents from one municipality gave conflicting answers, I recorded their most common answer as the municipal response.[25] However multiple responses occasionally resulted in even splits between two or more selections, and Table 5 shows how these conflicts were resolved. These choices were guided by a general preference toward conservative assumptions.[26]

C. Results & Discussion

Table 6 presents the results from my survey. Only "yes" answers were tallied in the percentages shown here; numbers that include "workingconsideration" responses are not presented.[27]

> *"In the long term, global warming is not going to be a selling point. It boils down to dollars. …Money talks."*
> *(City Administrator, quoted in Slocum, 2004, p. 773)*

Researchers have been studying local mitigation in the United States for approximately 20 years. Yet the data presented here is among the only descriptive data to show how these local governments are pursuing mitigation on a large scale. Counties, till now almost entirely unstudied, are not a barren policyscape for mitigation efforts; instead they seem engaged in the very same things that incorporated places are doing – though with less frequency. Incorporated places with populations above 50,000 (Table 1), meanwhile, enact more policies than those with populations above 25,000 (Table 6).

> *"Energy efficiency is a double-edged sword: it's the reason for our progress, but it's also holding us back. Fundamentally, we're bleeding."*
> *(Portland activist Mark Cherniak, quoted in Rutland and Aylett, 2008, p. 643)*

More importantly, this data refutes the counter-intuitive preference for regulation indicated by the data from Krause (2011a) and Pitt (2009), and substantiates both **H1** and the small-n case studies that generated the hypothesis. Both cities and counties *are* more likely to adopt self-governing and 'enabling' mitigation policies than regulatory policies – though the difference is not as overwhelming as the case studies suggest.

These preferences have consequences. Enabling policies are only successful to the extent that relevant actors voluntarily participate – which means they rely on incentives, publicity, and coordination (Bulkeley and Kern, 2006). This need to "sell" participation

[25] There is one exception to this rule - a knowledgeable answer (such as "yes" or "no" or "workingconsideration" or etc) always outweighs a larger number of uncertain answers (i.e. "dontknow"). Also, on two occasions I deviated from the "majority rule" process I've laid out here. Once, when there was an even split between "no" and "workingconsideration" with an additional "noauthority", I summed these responses to "no." And once, when there were two "yes" responses, one "noauthority", one "no" and one "notransit", I summed these responses to "no."

[26] Again, with one exception: an even split between "workingconsideration" and "no" was recorded as "workingconsideration." This does not influence a count measure of the policies a government is *pursuing* – a count of "yes" responses remains conservative – but it does lead to an expansive measure of the policies a government is *considering*.

[27] Nor are the n values, which differ for nearly every policy and both forms of government.

Table 6: Survey Results

GHG-reducing activity	Percent of incorporated places where implemented	Percent of counties where implemented
Self-Governing	***Avg = 34.03%***	***Avg = 24.19%***
1. Completed a community-wide inventory of greenhouse gas emissions	*16.98%*	*9.59%*
2. Set formal goals or targets for the reduction of community-wide greenhouse gas emissions	*14.29%*	*7.38%*
3. Created a formal plan to reduce community-wide greenhouse gas emissions	*11.59%*	*5.51%*
4. Has a policy to install energy-efficient lighting (e.g. in government buildings or streetlights)	*65.57%*	*53.90%*
5. Has a policy to only purchase energy-efficient equipment and appliances, as certified by Energy Star	*42.95%*	*33.98%*
6. Has a policy to purchase and/or produce clean energy to power its operations	*18.83%*	*11.45%*
7. Has energy efficiency standards for the construction or renovation of government-owned buildings	*48.92%*	*41.64%*
8. Has an anti-idling policy for government-owned vehicles	*28.66%*	*14.29%*
9. Has, within the past year, acquired hybrid or electric vehicles, alternative-fueled vehicles, or otherwise acted to green its vehicle fleet	*51.94%*	*28.57%*
10. Explicitly considers how its decisions about mass transit service will affect sprawl or greenhouse gas emissions	*28.88%*	*17.45%*
11. Has adopted conservation easements, transfers of development rights, an urban growth boundary, and/or other growth management tools	*45.68%*	*42.34%*
Enabling	***Avg = 33.91%***	***Avg = 20.78%***
12. Provides information to residents about environmentally-friendly behavior	*72.29%*	*52.75%*
13. Offers other incentives to support energy efficiency (e.g. grants, tax rebates, fast-track permitting, free supplies, etc)	*14.89%*	*4.78%*
14. Offers other incentives for new, small-scale renewable energy systems (e.g. property tax exemptions/reductions; grants; rebates; technical assistance; streamlined or fast-track permitting processes, etc)	*14.55%*	*4.81%*
Provision	***Avg = 47.75%***	***Avg = 26.27%***
15. Offers curbside recycling to residents	*87.61%*	*39.36%*
16. Offers composting of residential yard waste to residents	*57.40%*	*33.57%*
17. Offers low-interest loans to offset the cost of new, small-scale renewable energy systems (e.g. with a fund set up or administered by your local government)	*6.04%*	*3.32%*
18. Offers low-interest loans to support energy efficiency (e.g. the construction of new, energy-efficient homes or buildings; energy-efficiency audits or upgrades to existing buildings; the purchase of energy-efficient appliances, etc)	*7.53%*	*2.96%*
19. Has built new bicycle lanes, multiuse paths, and/or other bicycle and pedestrian amenities within the last year	*80.18%*	*52.14%*
Regulation	***Avg = 19.58%***	***Avg = 8.98%***
20. Bans or regulates idling for private or commercial vehicles	*5.74%*	*1.80%*
21. Has regulations requiring private or commercial buildings to meet energy-efficiency construction or renovation standards	*23.91%*	*9.59%*
22. Has regulations requiring any new private or commercial buildings to incorporate passive heating, natural lighting, or photovoltaics	*4.35%*	*0.75%*
23. Requires contractors to comply with environmental requirements (e.g. green purchasing, anti-idling, energy efficiency, or etc)	*11.71%*	*3.77%*
24. Requires energy audits for residential and commercial buildings before they're sold	*0.31%*	*0.75%*
25. Requires new developments to plant trees, and/or regulates when existing trees can be cut down	*81.63%*	*34.55%*
26. Explicitly considers the effects its planning and zoning decisions have on sprawl or greenhouse gas emissions	*28.96%*	*20.59%*
27. Places a tax on carbon	*0.00%*	*0.00%*

incentivizes the use of "no regrets" messaging: even actors that don't care about the climate can switch to CFL or LED lighting without regret, for example, because doing so saves money. This "win/win" frame means that local governments don't have to sell the science of climate change[28] and can avoid political controversy, but the frame isn't compatible with policies that require sacrifice (Lindseth, 2004; Slocum, 2004; Yarnal, et al, 2003). [29]

Yet policies that require participation or sacrifice – like regulatory policies – are far more effective. Using the city of Denver as an example, Ramaswami (2013) writes that:

> "…About 1 percent of the total built area in Denver [is] added as new construction over 5 years. Voluntary adoption of green building codes in Denver is estimated to be among the highest in the nation at 5 percent of new construction (Simons, Choi, and Simons, 2009), which means only 0.005 percent of Denver's total building stock is likely to be impacted annually using a voluntary penetration model. In contrast, green building mandates that require all new construction (or large commercial projects) meet LEED or ENERGY STAR will impact almost all of the new building stock added to a city, at about 1 percent over 5 years. …Thus, orders of magnitude differences in participation rates are seen between voluntary city-scale programs (AI) versus city regulation (A2)." (p. 222)

Ramaswami finds similar participatory differences in other building and transportation sectors, and quantifies how they influence the efficacy of regulatory and voluntary mitigation policies. He finds that regulatory policies consistently achieve higher rates of participation and therefore yield significantly greater reductions in greenhouse gas emissions.

Aside from these questions of mitigative form and efficacy, there's a larger question: why bother? Climate change is a global problem; why are local governments doing anything at all? The next chapter examines several explanatory theories.

[28] Slocum (2004, p. 771) writes that an emphasis on science "proved dangerous when some administrators were stung in public fora by their own lack of scientific knowledge. A Fort Collins administrator had prepared a presentation for the local Chamber of Commerce, but could not answer the questions its members drew from a *Scientific American* article."

[29] Engel observes (2008) that the abstract nature of many local plans and policies suggest their use as symbolic statements, and the fact that many local mitigation plans and policies are nonbinding, and written such that government officials have significant flexibility in terms of timing, scope, and the aggressiveness of implementation, means that localities can back away should costs prove to be too high (Engel and Orbach, 2008). Existing plans may set ambitious goals, but often fail to specify the short-term targets (Wheeler, 2008) or provide the financial resources (Tang, 2010) required to meet them.

CHAPTER 2: WHY MITIGATE?

A. Literature Review & Hypotheses

The *Homo economicus* model lies at the heart of most rational choice theories of human behavior. It's a model in which actors have complete information and well-ordered preferences, and act accordingly to maximize the net value of their expected returns (Ostrom, 2007). With regards to municipal mitigation, such actors would understand two important facts: first, that no municipality – no matter how large – can stop or delay global climate change, because its emissions are such a vanishingly small percentage of the global total. And second, that mitigating local emissions won't protect the *local* area either, because the system of climate change is global. So from a classical political economy point of view, it just doesn't make sense for local governments to mitigate their emissions. [30]

And yet many have been – in some cases, for as long as 25 years. And for nearly as long, the rational choice literature has been trying to understand this seemingly irrational behavior. What explains the paradox? Four theories have emerged within the literature: *climate risk*, *internal determinants*, *excludable benefits*, and *influence from above*. I'll review them each in the sections that follow.

CLIMATE RISK

The idealized *homo economicus* may have complete information and well-ordered preferences, but real people don't – and neither do institutions that lack the selective pressure and information-generating capabilities of the competitive market (Ostrom, 2007).

> Information search is costly, and the information-processing capabilities of human beings are limited. Individuals, therefore, often must make choices based on incomplete knowledge of all possible alternatives and their likely outcomes. With incomplete information and imperfect information-processing capabilities, all individuals may make mistakes in choosing strategies designed to realize a set of goals (V. Ostrom 2007a). (Ostrom, 2007, p. 31)

So within this more realistic, boundedly-rational model of human behavior, mitigation results from our imperfect rationality: decision-makers and the public at large can misunderstand climate change and their ability to influence it (Krause, 2011b). This misunderstanding is most likely to result in mitigation when it's paired with a motive: vulnerability to the effects of climate change. [31] This leads to the following hypothesis:

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[30] Unless (a) their damages from climate change are very large; (b) their share of emissions are very large; AND (c) the costs of significant mitigation are appropriately low (Stewart, 2008).

[31] Urban municipalities are particularly vulnerable. On average, temperature increases projected for urban areas are greater than global-scale projections (Grimmond, 2007). Like the heat-island effect, this is a result of the land cover modifications that characterize urban areas (Krause, 2011a). The relative lack of wind and poorer air quality in urban areas also reduce the ability of local residents to cope with heat (Mills, 2007). And while other climate impacts are not specifically urban in nature – such as floods, draughts, hurricanes, fires, etc – the density and concentration of people, infrastructure, and economic activity in urban areas means they are at greater risk (Krause, 2011a). Industries vital to municipal economies – like tourism or agriculture – may also face legitimate threats from climate change.

[H2]: Climate risk predicts municipal mitigative action.

Zahran et al (2008a; 2008b) tested this hypothesis using participation in the Cities for Climate Protection (CCP) climate network as the dependent variable. Their regression models[32] found that being located in a coastal area, projected temperature changes, and prior deaths from natural hazards were all statistically-significant factors that increased the likelihood of CCP accession.[33] However Pitt (2010a) used a different dependent variable – a count of the number of mitigation policies adopted – and finds that coastal proximity is not a statistically-significant predictor.[34] Tang et al (2010) used yet another dependent variable – climate plan quality – and found that, on the contrary, property damages for all hazard events from 1995 to 2000 was a statistically-significant, *negative* predictor.

INTERNAL DETERMINANTS

According to the internal determinants theory, municipal mitigation is a product of the municipality's own political, economic, and social characteristics.

> *"Innovation is directly related to the motivation to innovate, inversely related to the strength of obstacles to innovation, and directly related to the availability of resources for overcoming such obstacles"*
> *(Mohr, 1969, p. 114)*

For instance, local politicians and citizens can derive utility from municipal mitigation in the form of preference satisfaction, regardless of whether or not that mitigation protects the climate. Or, they may value the "warm glow" feeling they get from behaving altruistically (Engel and Orbach, 2008). Their support may also reflect overestimated benefits, underestimated costs, and/or costs that have been discounted hyperbolically (Engel and Orbach, 2008).[35] Municipalities with these constituencies would be incentivized to mitigate, and politicians acting accordingly would be acting rationally – even if mitigation isn't rational from the municipal perspective.

[H3]: Political support predicts municipal mitigative action.

[32] Zahran et al didn't use cities as their unit of analysis, however; instead they analyzed the metropolitan statistical areas (2008a) and counties (2008b) *around* the cities in question.

[33] Other risk and vulnerability factors, such as precipitation levels and the percentage of land covered by forests and wetlands, were not significant, they found.

[34] Krause (2011b) uses a slightly different measure for climate risk – the number of times since 2000 that the surrounding county has been declared a weather-related, federal disaster area – but also finds that it doesn't significantly predict the number of municipal mitigation policies.

[35] Benefits may be overestimated because, while climate change plans frequently define emissions reduction goals, they often fail to specify the impact of those reductions on the global climate. This asymmetric presentation of information can create the impression that a linear relationship exists between emissions and climate change, when in fact the relationship is nonlinear and the impact of local mitigation is slight (Engel and Orbach, 2008). Costs may be underestimated because of the presumption that the efficiencies of capital and technological advance will reduce costs once mandatory reductions are in place (Engel and Orbach, 2008).

Furthermore, supply-side theories of the provision of public goods predict that local governments with more financial and institutional capacity are better able to respond to the demand for public goods (Ziblatt, 2008).

[H4]: Municipal financial capacity predicts mitigative action.
[H5]: Municipal institutional capacity predicts mitigative action.

Both qualitative and quantitative studies have found that the general public's support is a key predictor of municipal mitigation, supporting **H3** (Engel, 2006; Corbett and Hayden, 1981; Moore, 1994; Bulkeley and Betsill, 2003; Kousky and Schneider, 2003; Slocum, 2004; Schroeder and Bulkeley, 2009; Pitt 2010b; Gerber, 2013; Krause, 2013). Millard-Ball (2012) finds a strong causal role for environmental preferences. Zahran et al (2008a; 2008b) find that measures of political orientation and environmental awareness are statistically-significant predictors of CCP membership. And Krause (2011a) finds that political orientation has a strong association with the framing of mitigation policies as explicitly climate-protecting, and the institutionalization of climate protection as an explicit municipal aim.[36] The support of political leaders is also a necessary (if insufficient) condition for municipal mitigation action (Engel, 2006; Betsill and Bulkeley, 2007; Corbett and Hayden, 1981; Kron and Randolph, 1983; Holgate, 2007; Bulkeley and Betsill, 2003; Kousky and Schneider, 2003; Robinson and Gore, 2005; Tang et al 2012; Gerber, 2013).

Political opposition can also be influential (Bulkeley and Betsill, 2003; Schroeder and Bulkeley, 2009). Zahran et al (2008a; 2008b) find that the degree of automobile commuting and the percentage of workers employed in carbon-intensive industries significantly decreased the likelihood of accession to the CCP climate network. And Krause (2011c) finds that a higher reliance on manufacturing in the local economy significantly decreases the probability of network membership, although the magnitude of the effect is small. When the number of mitigation policies is used as the dependent variable, however, the influence of manufacturing on the local economy is no longer significant (Krause, 2011b).

There is clear qualitative support for **H4** (Pitt and Randolph, 2009; Robinson and Gore, 2005; Parker and Rowlands, 2007; Mathy, 2007; Collier, 1997; Granberg and Elander, 2007; Aall et al, 2007; Betsill and Bulkeley, 2007; ICLEI, 1997; Dierwechter and Wessells, 2013). Quantitative support has been found using such measures as per capita income (Krause, 2011c; Zahran et al 2008a, 2008b) and gross government expenditures (Vasi, 2006) – although in these cases, the dependent variable was climate network membership. Krause (2011b) finds that income is a statistically significant and *negative* predictor when the number of mitigation policies is used as the dependent variable.

[36] In contrast, Pitt (2010a) finds that voting history is not a statistically-significant predictor of the number of mitigative policies municipalities adopt.

Qualitative studies using staff as a measure of institutional capacity have found support for **H5**[37] (Pitt and Randolph, 2009; Pitt, 2010b; Corbett and Hayden, 1981; Collier, 1997; Betsill and Bulkeley, 2007; Betsill, 2001; Holgate, 2007; Robinson and Gore, 2005; Romero-Lankao, 2007). Quantitative studies using measures such as population (Krause, 2011a, 2011b, 2011c; Zahran et al 2008a, 2008b; Gerber, 2013), staff (Krause, 2012), and education (Krause, 2011a, 2011b, 2011c; Zahran et al 2008a, 2008b; Vasi, 2006; Gerber, 2013; Krause, 2013)[38] have also found support for **H5**.

EXCLUDABLE BENEFITS

Local governments bear the costs of their mitigation, but they don't capture the benefits to the global climate. Accordingly, Olson (1971) predicts that only a separate and selective incentive – that is, an excludable benefit that *is* captured locally – will stimulate mitigative action.

> *"Only a separate and 'selective' incentive will stimulate a rational individual in a latent group to act in group-oriented ways."*
> *(Olson, 1971, p. 51)*

[H6]: Excludable benefits predict municipal mitigative action.

Improvements in local air quality are an important excludable benefit, since reducing greenhouse gas emissions often has the effect of reducing ozone, nitrous oxide, sulfur dioxide, and other local air pollutants, as well (Betsill, 2001; Romero-Lankao, 2007). Using measures of carbon monoxide and particulate matter pollution, Vasi (2006) finds that local air quality is not a statistically-significant predictor – although in Vasi's qualitative interviews, the *perception* that mitigation policies might improve local air quality was influential with local decision-makers. Pitt's qualitative interviews found the same (2010b), but his quantitative assessment, like Vasi's, found that poor air quality was an insignificant predictor (2010a).[39]

INFLUENCE FROM ABOVE

Finally, the state or federal government can influence local mitigation efforts.[40] States can mandate municipal mitigation, for example – although California is the only state to do so thus far.[41]

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[37] Although NGOs, universities, and other institutions can sometimes assist municipalities with additional staff capacity and technical support (Holgate, 2007; Gore and Robinson, 2009; Knuth et al, 2007).

[38] Pitt, 2010a is a notable exception, finding that neither income nor education are statistically-significant predictors of the number of mitigation policies municipalities adopt.

[39] Pitt defines poor air quality as the failure to meet one of the EPA's National Ambient Air Quality Standards. The findings of Zahran et al (2008a; 2008b) are in line with Pitt and Vasi, but he uses an odd measure of local air pollution – HAP emissions per capita. HAP emissions are an odd choice because the local air pollutants most commonly associated with greenhouse gas emissions are not listed as hazardous air pollutants.

[40] Institutional studies often need to encompass multiple levels, because decisions about rules at any one level are made within the structure of rules existing at higher levels (Ostrom, 2007).

[41] The threat of mandates can also incentivize municipal mitigation, because municipalities then have an incentive to prepare – or follow through, and thereby relieve their uncertainty. But so far California is the only state with legally-binding emission caps (Krause, 2011c). Additionally, "The California Attorney General has taken legal action under the California Environmental Quality Act against cities such as Stockton, arguing that the impacts of greenhouse gas emissions were not adequately considered during

[H7]: State mandates predict municipal mitigative action.

State governments can also influence municipal mitigation indirectly, by passing and adopting their own climate policies. Shipan and Volden (2006) hypothesize a "snowball effect," such that state-level policies enable or encourage the adoption of local-level policies,[42] and a contrasting "pressure valve effect," whereby state-level policies reduce the likelihood of local-level initiatives by dispelling pressure for governmental action or creating the impression that action has already been taken.

Table 7: Chapter 2 Hypotheses and Degrees of Support

Hypothesis		Qualitative Support?	Quantitative Support?
Climate Risk	*[H2]: Climate risk predicts municipal mitigative action.*	Untested	Mixed
Internal Determinants	*[H3]: Political support predicts municipal mitigative action.*	Yes	Yes
	[H4]: Municipal financial capacity predicts mitigative action.	Yes	Mixed
	[H5]: Municipal institutional capacity predicts mitigative action.	Yes	Yes
Excludable Benefits	*[H6]: Excludable benefits predict municipal mitigative action.*	Yes	No
Influence from Above	*[H7]: State mandates predict municipal mitigative action.*	Yes	Untested
	[H8]: State mitigation policies predict municipal mitigative action.	Yes	Mixed

[H8]: State mitigation policies predict municipal mitigative action.

H8 is supported by multiple qualitative studies, which find that mitigation by municipalities is stimulated by policies at higher levels of government (Aall et al, 2007; Granberg and Elander, 2007; Bulkeley and Kern, 2006; Kern and Alber, 2008; Collier, 1997; Lindseth, 2004; Betsill, 2001). However quantitative studies are rare. Tang et al (2010) found that whether or not a state had passed climate legislation was a statistically-significant, strongly positive predictor of the climate plan quality of that state's localities. However Krause (2011c) uses multilevel modeling to test **H9**, finding that state-level characteristics – including the presence of state greenhouse gas reduction targets and climate plans – do not have a statistically-significant effect on the likelihood that municipalities will join the USMCPA climate network.

Table 7 summarizes the hypotheses from Chapter 2.

General Plan updates. As part of their settlement agreement, some cities committed to develop a Climate Action Plan. The Attorney General's Office has also encouraged cities to develop climate plans as a way to mitigate their greenhouse gas emissions (and, implicitly, avoid legal action)." (Millard-Ball, 2012, p. 290)

[42] State climate action may also incentivize local action by reducing "the political and information-gathering costs associated with policy passage" (Krause, 2012, p. 2406).

B. Methods & Results

SAMPLE

This chapter relies on the same sample I detail in Chapter 1.

DEPENDENT VARIABLES

Most existing research employs climate network membership as the dependent variable – a dichotomous measure that doesn't reflect financial or political cost.[43] Nor do the other dependent variables within the existing literature – namely, the existence of a local climate plan; its quality; the number of local mitigation policies; and the number of 'milestones' achieved by ICLEI members. Yet cost is the key to understanding mitigation within a rational choice framework. If the cost of mitigation is high, it's a challenge to explain – but if the cost is low (or even negative), the challenge dissipates. My research is the first to collect cost-related data, and to use it to explain municipal mitigation.

Net Mitigation Spending (`netspent`)

My primary dependent variable is net mitigation spending. Spending is a continuous variable that offers a clear-cut and defensible measure of municipal preferences, just as it does with individual preferences. Any municipality that spends $10 million on mitigation is arguably[44] twice as committed as the municipality that spends only $5 million.[45] As a measure of mitigative *effect*, municipal spending is crude; local policies and regulations may impose their costs on others, and some kinds of mitigation are more efficient than others (Ramaswami, 2013). But municipal spending is a strong, clear, and unambiguous measure of mitigative *preferences* – and therefore, well-suited explain municipal mitigation, and test the hypotheses listed above.

[43] Dierwechter and Wessells (2013, p. 1381) make the contrast explicit: "In our view, many MCPA communities have localised global climate action superficially, at little fiscal (or political) cost." And Portney (2009) finds that membership in climate networks (like the MCPA) often doesn't lead to further mitigative action (like policies and expenditures).

[44] One counterexample: the valuation of municipal assets according to GASB 34. The Governmental Accounting Standards Board sets accounting standards for local governments in the United States, and most governments use a market valuation when accounting for municipal trees (i.e. they add x value to property when sold). But a few governments have chosen to value trees according to the carbon they cleanse from the atmosphere, multiplied by the market price for carbon. Efforts like that won't show up in my `netspent` variable.

[45] Controlling for the other variables in the model (like population), of course.

However, what local mitigation costs is an open question: it's unaddressed by the existing literature,[46] and there is no published data about local government spending on mitigation. Therefore I collected estimates via the survey instrument I described in Chapter 1. After specifying which of the 27 mitigation policies their local government was engaged in, respondents were asked to estimate the expenditures, revenues, and cost-savings associated with these policies, in aggregate, for their local government. Multiple responses from the same municipality were then averaged, on the assumption that consensus estimates are more likely to approximate "true" values than any individual estimate. I therefore expect the quality of a municipality's survey data to increase as the number of respondents from that municipality increases.

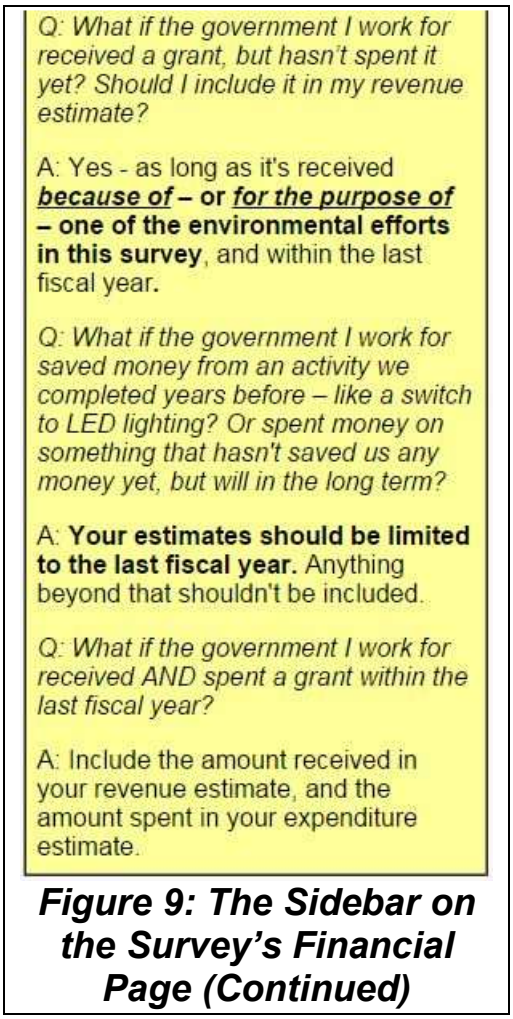
For each category I also asked the respondents themselves how sure they were that their own estimates fell within 10% of the "real" figure. This data is presented in Figures 10, 11, and 12. In every case, unsure respondents outnumber sure respondents. This isn't surprising: the environmental efforts in my survey often span several municipal departments, and it's natural for respondents to be cautious about the state of their own knowledge. Financial estimates are particularly daunting to give; Figures 8 and 9 illustrate a few of the complexities involved. That said, if our survey respondents don't know, no one does. Mitigation spending is not specified in municipal budgets, so the people who lead mitigation efforts and govern the municipality – mayors, councilmembers, city managers, department heads and staff – are the best possible source of information. And averaging multiple estimates from a single municipality should yield more accurate, collective estimates with less error than individual responses.

Figure 8: The Sidebar on the Survey's Financial Page

[46] Although a number of case studies describe, in qualitative terms, the importance of money in the decision-making process (e.g. Rutland and Aylett, 2008; Lindseth, 2004; Slocum, 2004; Yarnal, et al, 2003).

Time is another difficulty. It's impossible to fully capture the financial dynamics of local mitigation finance with data from a single year. Many mitigation activities – replacing city lights with LEDs, for example – yield cost savings that extend indefinitely. A single grant may also fund mitigation activities with costs that extend over several years, meaning that a survey capturing a single year of data fails to fully reflect the inflows and outflows of financial resources, and its validity is accordingly limited.[47]

However it would be impractical to expect survey respondents to report the fiscal details of municipal efforts in prior years. Staff change jobs and responsibilities, and even for those who remain, fiscal information from prior years is unlikely to be remembered. Response rates and the quality of the data would both decline if this survey's time period were expanded.[48] For the year's worth of data I collected, I offset the amount each municipality spent by the amount it saved and received in revenue, thereby creating estimates of net spending for each municipality. So `netspent` represents the net outflow of financial resources to fund local mitigation in the last fiscal year.


Q: What if the government I work for received a grant, but hasn't spent it yet? Should I include it in my revenue estimate?

A: Yes - as long as it's received ***because of*** **– or** ***for the purpose of*** **– one of the environmental efforts in this survey**, and within the last fiscal year.

Q: What if the government I work for saved money from an activity we completed years before – like a switch to LED lighting? Or spent money on something that hasn't saved us any money yet, but will in the long term?

A: **Your estimates should be limited to the last fiscal year.** Anything beyond that shouldn't be included.

Q: What if the government I work for received AND spent a grant within the last fiscal year?

A: Include the amount received in your revenue estimate, and the amount spent in your expenditure estimate.

Figure 9: The Sidebar on the Survey's Financial Page (Continued)

This presents another issue, because fiscal years are not consistent across local governments. Some local governments begin their fiscal year on July 1st; others on October 1st; still others on January 1st. This means there is not a calendar-year consistency between the estimates my survey respondents provided. I could have avoided this issue by specifying in my survey that estimates should conform to a calendar year (say, January 1st to December 31st of 2013), but this would have introduced error because the fiscal activities of local governments are organized according to their fiscal year. A calendar year estimate may include half of one fiscal year and half of

[47] That said, many mitigation activities do take place in the short term. Some are intended to – tax rebates expire; information campaigns are changed or dropped; weatherization efforts weatherize themselves out of work. Others are not – green purchasing policies, curbside recycling programs, and building codes are made to last, but that is no guarantee they will. Political decisions, once made, can always be unmade, and environmental activities that strain municipal budgets are often the first to be cut in an era of belt-tightening and economic downturn. So while the brief time period of this data does limit its validity, these limitations are not as grave as they may appear. Short-term activities should be valued over the short-term, and the short-term cycle of municipal politics makes even longer-term municipal efforts subject to short-term cancellation, restructuring, and reevaluation.

[48] This survey actually collected data for *two* years – the year presented here, and the year immediately prior. After providing their estimate of the amount their local government spent on the mitigation policies in my survey, respondents were asked whether this amount had increased or decreased from the prior year – and if so, by what percent. This data – and data from similar questions about revenues and cost savings – was used to create a second year of financial data for each municipality. The original intent had been to adjust for the multi-year nature of mitigation finance. But this isn't possible without more detail regarding the specific grants, expenditures, and cost savings for each municipality. That is, guessing that all of one year's cost savings are the result of some or all of a prior year's grants or expenditures (for example) would be a guessing game, introduce error, and have no merit. Accordingly, the earlier year of data is not used in this analysis.

another – or a quarter of one and three quarters of another. Asking respondents to mentally straddle two fiscal years would introduce error and degrade the quality of the data I received. And I felt the convenience of having the estimates cover the exact same time period was not worth this price. Given that the survey was in the field from early June through mid-July of 2014, the earliest possible fiscal year of any respondent government is July 1st, 2012 through June 30th of 2013, and the latest is July 1st, 2013 through June 30th of 2014.

Mitigation Costs (`estcost`)

I also measure the gross outflow of financial resources, unadjusted for revenue and cost savings. More specifically, `estcost` is a consensus estimate of the amount a local government spent, over the last fiscal year, to implement and administer the environmental efforts in my survey. Even if expenditures will be repaid in time, they may inflict short-term financial pain and opportunity costs; this measure may capture these costs more accurately than `netspent`.

CLIMATE RISK VARIABLES

Coastal Vulnerability (`coastvuln`)

Rising sea levels are one of the best-known impacts of climate change. Vulnerability to rising sea levels should therefore predict municipal mitigative action. Following the lead of Zahran et al (2008b) and Tang et al (2010) I measure coastal vulnerability dichotomously. A county received a score of 1 if it is designated a coastal county by the National Oceanic and Atmospheric Administration (NOAA) – meaning

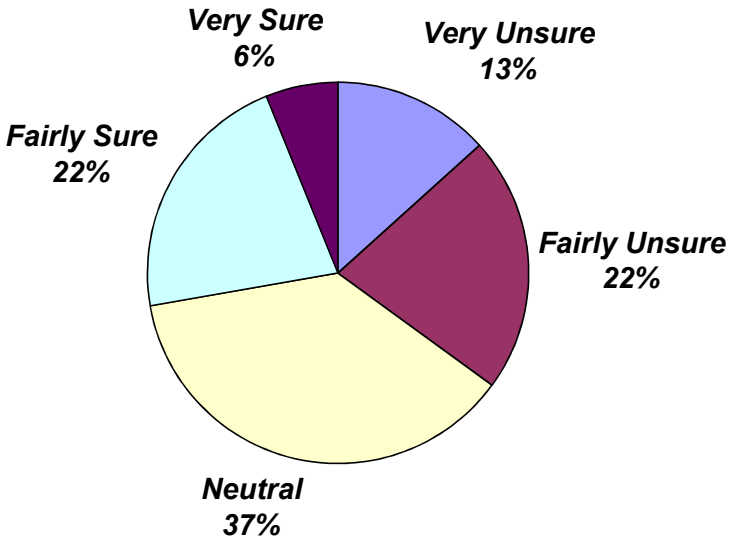


Figure 10: How Sure are Respondents of their Cost Estimates?

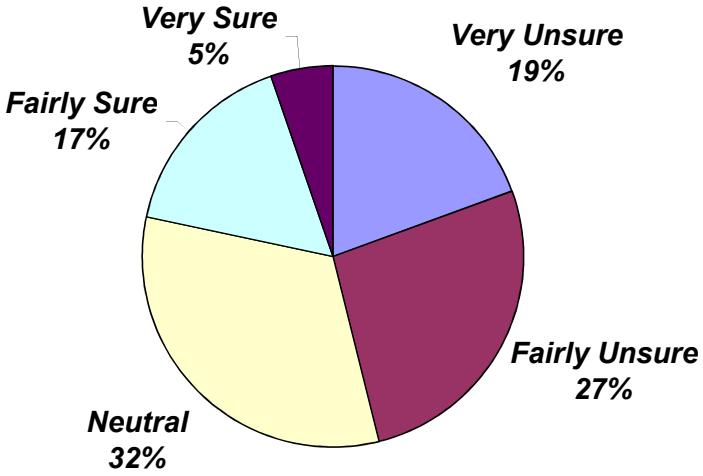


Figure 11: How Sure are Respondents of their Savings Estimates?

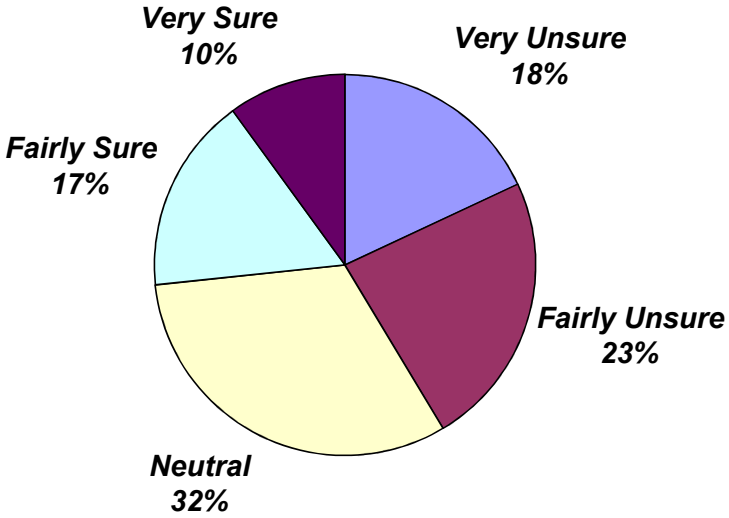


Figure 12: How Sure are Respondents of their Revenue Estimates?

that at least 15% of its area is in a coastal watershed – and a zero otherwise. Cities and other incorporated areas received the same score as the counties they inhabit.[49]

Damage from Natural Hazard Events (`hazardcost`)

Climate change also increases the likelihood and severity of hurricanes, flooding, forest fires, and other natural hazard events. Like Tang et al (2010), I use the damage caused by such events as a measure of climate risk. The data comes from the Storm Events Database, a project of the US National Oceanic and Atmospheric Administration's National Climatic Data Center. The value of both property and crop damages are totaled from 2000-2013 (in thousands), and cities and other incorporated areas are allocated the same total as the counties they inhabit.[50]

Casualties from Natural Hazard Events (`hazardcasualties`)

In a similar vein, I include a second set of data obtained from the Storm Events Database: the number of directly-caused deaths and injuries due to natural hazard events. These are both totaled from 2000-2013 and added together; cities and other incorporated areas are again allocated the same total as the counties they inhabit.[51]

INTERNAL DETERMINANTS VARIABLES

Democratic Voting (`libvoting`)

Popular support can influence political leaders and policy entrepreneurs (Gerber, 2013). Like Pitt (2010a), I assume that Democratic voters are more likely to support municipal mitigation efforts than Republican voters. I therefore measure popular political orientation as the average percentage of voters, at the county level, who voted for the Democratic presidential candidate in the 2008 and 2012 elections. Cities and other incorporated areas are allocated the same total as the counties they inhabit.[52]

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[49] A document entitled "NOAAs List of Coastal Counties for the Bureau of the Census Statistical Abstract Series" is available online at http://www.census.gov/geo/landview/lv6help/coastal_cty.pdf (accessed July 5th, 2014). It includes a state-by-state list of US counties that are "defined as coastal by the Strategic Environmental Assessments Division of the National Oceanic and Atmospheric Administration (NOAA). These are counties that meet one of the following criteria: 1) at least 15 percent of a county's total land area is located within the Nation's coastal watershed; or 2) a portion of or an entire county accounts for at least 15 percent of a coastal cataloging unit."

[50] I accessed the Storm Events Database (at http://www.ncdc.noaa.gov/stormevents/) from November 6th through 11th, 2014. I searched by state and then by county for each county in my sample. The "begin date" I selected was January 1, 2000; the end date was January 1, 2014. The event types included in the data are blizzard; coastal flood; cold/wind chill; drought; dust storm; excessive heat; extreme cold/wind chill; flash flood; flood, frost/freeze; funnel cloud; hail; heat; heavy rain; heavy snow; high surf; high wind; hurricane (typhoon); ice storm; lake-effect snow; lakeshore flood; landslide; lightning; sleet; storm surge/tide; strong wind; thunderstorm wind; tornado; tropical depression; tropical storm; wildfire; winter storm; and winter weather.

[51] I accessed the Storm Events Database (at http://www.ncdc.noaa.gov/stormevents/) from November 6th through 11th, 2014. I searched by state and then by county for each county in my sample. The "begin date" I selected was January 1, 2000; the end date was January 1, 2014. The event types included in the data are blizzard; coastal flood; cold/wind chill; drought; dust storm; excessive heat; extreme cold/wind chill; flash flood; flood, frost/freeze; funnel cloud; hail; heat; heavy rain; heavy snow; high surf; high wind; hurricane (typhoon); ice storm; lake-effect snow; lakeshore flood; landslide; lightning; sleet; storm surge/tide; strong wind; thunderstorm wind; tornado; tropical depression; tropical storm; wildfire; winter storm; and winter weather.

[52] Most of the data for this variable was obtained from the DailyKos Elections website, at https://docs.google.com/spreadsheet/pub?key=0Av8O-dN2giY6dEFCOFZ4ZnlKS0x3M3Y0WHd5aWFDWkE&single=true&gid=1&output=html. The supplementary sources were as follows. For Alaska, 2008: http://uselectionatlas.org/FORUM/index.php?topic=88046.0 (5th post); 2012:

Carbon Employment (`carbemploy`)

I use the percentage of local workers employed in carbon-intensive industries as a crude measure of the political opposition faced by mitigative efforts.[53] Like Zahran et al (2008a), I measure this as the total civilian population (older than 16) employed in agriculture, forestry, mining, construction, manufacturing, transportation, warehousing, and utilities, divided by the total employed population (older than 16) at the county level. Cities and other incorporated areas are allocated the same total as the counties they inhabit.[54]

Median Income (`medincome`)

I use the median household income of municipal residents as one measure of municipal financial capacity; I obtained this data for counties and incorporated places from the US Census.[55]

Local Government Revenue (`munirevenue`)

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http://uselectionatlas.org/FORUM/index.php?topic=164339.0 (18th post). For California, 2008: http://elections.nytimes.com/2008/results/states/president/california.html. For Connecticut, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Connecticut,_2008; 2012: http://www.politico.com/2012-election/results/president/connecticut/. For Delaware, 2008: http://elections.delaware.gov/archive/elect08/elect08_general_election/html/elect08_gen_county.shtml; 2012: http://elections.delaware.gov/archive/elect12/elect12_general/html/stwoff_kns.shtml. For Florida, 2008: http://content.usatoday.com/news/politics/election2008/PresidentialByCounty.aspx?sp=FL&oi=P&rti=G. For Maine, 2008: http://www.maine.gov/sos/cec/elec/2008/tabs-can-pr-cnty-11-08.html; 2012: http://www.maine.gov/sos/cec/elec/2012/tabs-can-pr-2012.html. For Massachusetts, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Massachusetts,_2008. For Montana, 2008: http://sos.mt.gov/elections/archives/2000s/2008/index.asp; 2012: http://electionresults.sos.mt.gov/resultsCountyList.aspx?eid=4. For Nebraska, 2012: http://www.sos.ne.gov/elec/prev_elec/. For North Carolina, 2008: http://www.ncsbe.gov/ncsbe/Elections/Election-Results-Display?ED1=11xx04xx2008&EL1=GENERAL&YR1=2008&CR1=A. For North Dakota, 2008: http://results.sos.nd.gov/resultsCTY.aspx?eid=1&text=Race&type=SW&rid=22&osn=100&map=CTY; 2012: http://results.sos.nd.gov/resultsCTY.aspx?eid=35&text=Race&type=SW&rid=4949&osn=100&map=CTY. For Rhode Island, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Rhode_Island,_2008; 2012: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=44&year=2012. For South Dakota, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=46&year=2008; 2012: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=46&year=2012. For Texas, 2008: http://uselectionatlas.org/RESULTS/state.php?fips=48&year=2008. For Vermont, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=50&year=2008; 2012: http://uselectionatlas.org/RESULTS/state.php?year=2012&fips=50&off=0&elect=0&f=0. For Wyoming, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&year=2008&fips=56; 2012: http://uselectionatlas.org/RESULTS/state.php?year=2012&fips=56&f=0&off=0&elect=0. With the exception of Alaska, I obtained the number of votes for the Democratic presidential candidate in 2008 and 2012 for each county in my sample; these were then turned into annual percentages for each county for both 2008 and 2012, and averaged to create the final libvoting variable. All websites accessed on July 30th and 31st, 2014. In general, allocating county data to the cities they contain is likely to slightly bias cities in a conservative direction, if we assume that democratic voters are more highly concentrated in urban areas.

[53] Sharp et al (2011) use a similar measure – "the number of manufacturing establishments in a city in 2002 relative to other professional establishments" – and write that "we agree with [the] argument that much better conceptualization and measurement are needed to identify the types of business interests that tend to mobilize against environmental initiatives, but that work has yet to be done" (p. 447).

[54] The data for this variable originated with the 2012 County Business Patterns (NAICS) database of the US Census (http://censtats.census.gov/cbpnaic/cbpnaic.shtml, accessed from June 20th to 25th, 2014).

[55] I chose median household income rather than per capita income because per capita income - an average - would be shifted by the "long tail" of the incomes of the very wealthy. The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census, and reflects median household income in the past 12 months (in 2012 inflation-adjusted dollars). I obtained most of this data from the relevant State & County QuickFacts pages - for example, http://quickfacts.census.gov/qfd/states/56/56001.html. However townships and some towns were not listed on this site, and on those occasions I obtained the data by looking up the governments via the "American Factfinder" tool provided by the US Census, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Websites accessed from July 21st through July 23rd, 2014.

I use own-source government revenue as a second measure of municipal financial capacity. Own-source revenue is funding that's generated locally, and does not originate with the state or federal government. Greater levels of own-source revenue indicate better financial health, and more flexibility to pursue local priorities (Krause, 2012). I obtained this data for counties and incorporated places from the US Census.[56]

Population (pop)

Municipal population, in thousands. Population is a standard measure of institutional capacity. I obtained 2012 estimates for counties and incorporated places from the US Census.

College Education (educ)

Percent of municipal residents, 25 years or older, who have a bachelor's degree or higher. This is my second measure of institutional capacity; I obtained this data for counties and incorporated places from the US Census.[57]

College Town (colltown)

Small and rural municipalities may benefit disproportionately from the labor, ideas, and expertise provided by the students, faculty, and administrative staff of local colleges and universities. Accordingly I include college town status as a dichotomous measure of the institutional capacity of municipalities. College towns are defined as municipalities in which at least a quarter of the residents are students. Undergraduate and graduate enrollment data for counties and incorporated places was obtained from the US Census.[58]

EXCLUDABLE BENEFITS

Clean Air (cleanair)

Poor air quality should predict municipal mitigation, since the policies to improve air quality and mitigate emissions are often the same. I define poor air quality dichotomously: counties receive a one if they were

[56] The latest publicly-available data is from 2007, and was obtained by emailing the Census. Matt Clarke, a Statistician there, directed me to download the "_IndFin_1967-2007.zip" file from the following link: http://www2.census.gov/pub/outgoing/govs/special60/. I imported the 2007 text file from that link into Excel. The column of primary interest is "Total Rev-Own Sources" because local government income from sources under the control of that local government – primarily different forms of taxation, but also, depending on the local government, fines or licensing fees – is one of the best measures of local financial capacity. Data was missing for two of the cities with survey responses – Menifee, CA and Dunwoody, GA – because they were incorporated as municipalities in 2008, after the 2007 data from the US Census. Following the lead of Krause (2012, p. 2415), I used mean values for each, in order to keep the observations. Website accessed on October 28th, 2014.

[57] The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census. I obtained most of this data from the relevant State & County QuickFacts pages - for example, http://quickfacts.census.gov/qfd/states/56/56001.html. However townships and some towns were not listed on this site, and on those occasions I obtained the data by looking up the governments via the "American Factfinder" tool provided by the US Census, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Websites accessed on July 22nd and 23rd, 2014.

[58] I used the "American Factfinder" tool (see http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml) to obtain 2008-2012 American Community Survey 5-Year Estimates for "school enrollment" for each of the local governments in my sample, and used Excel to determine if the ratio between the number of students and the population as a whole for each local government exceeded .25. Website accessed on July 23rd and 24th, 2014.

found in nonattainment for at least one of the EPA's National Ambient Air Quality Standards (NAAQS) criteria pollutants between 2010 and 2014, and a zero otherwise. This data is available from the EPA, and cities and other incorporated areas receive the same score as the counties they inhabit.[59]

Improved Transit (`transit`)

Many of the policies that municipalities adopt to reduce traffic congestion and automobile dependency – such as expanded mass transit services, or zoning for transit-oriented development – also mitigate emissions of greenhouse gases. Therefore measures of automobile dependency should predict municipal mitigation. According to 2011 data from the US Census,[60] only 35.8% of US workers have travel times to work that are 30 minutes or longer. Following the lead of Pitt (2010a), I define automobile dependence as the percentage of workers in a municipality that fall into this upper third – the percentage of workers who drive to work and have travel times of 30 minutes or longer.[61]

INFLUENCE FROM ABOVE

State Mitigation Mandates (stmandate)

California is the only state that currently has legally-binding limits on greenhouse gas emissions.[62] So mandates are coded dichotomously, with all California municipalities receiving a score of one, and all other municipalities a zero.

Municipal Authority (dillons)

The scope of municipal authority is not consistent across US states. In 'home rule' states, municipalities may assume any regulatory power not explicitly excluded by state law, while in 'Dillon's rule' states, municipalities can only utilize powers specifically granted to them by state law (Pitt and Randolph, 2009). Dillon's rule status may also vary by type of municipality (e.g. applying only to cities, townships, or

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[59] The EPA can designate a county as being in nonattainment for any one of six criteria air pollutants: Ozone, Particulate Matter (PM), Sulfur Dioxide, Lead, Carbon Monoxide, or Nitrogen Dioxide. Four of these six pollutants have more than one standard under which a county can be found in nonattainment (http://www.epa.gov/airquality/greenbk/). For each of the six criteria air pollutants, I coded a county as being in nonattainment if the EPA classified it as such, under any standard, at any time between 2010 and 2014. The final "cleanair" variable is dichotomous - if a county was found in nonattainment for any criteria air pollutant for any year between 2010 and 2014, that county is coded with a "1" and a "0" otherwise. Website accessed June 15th, 2014.

[60] American Community Survey: see http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_1YR_B08303&prodType=table, accessed November 25, 2014.

[61] The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census, and obtained via the "American Factfinder" tool, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. I did so by searching for "Means of Transportation to Work By Travel Time to Work," which documents the forms of transportation used and time required for workers (aged 16 years and older who did not work at home) to reach their place of work. My variable includes those who drove alone and those who carpooled, traveling by car, truck, or van, but does not include workers that reached work via public transportation, walking, taxi, bicycle, motorcycle, or "other means." Website accessed July 25th, 2014.

[62] Via the California Global Warming Solutions Act, AB 32 (see http://www.c2es.org/us-states-regions/key-legislation).

Table 8: Ch. 2 Variables, Expected Directions, and Data Sources

	Variable Operation	Sign	Data Year & Source
ding	Municipal spending data for 27 mitigation policies, aggregated per municipality. This data is offset by the revenue and cost-savings such policies generate in each municipality. In thousands.		2013-2014: Survey
	Costs incurred by the government because of its mitigation efforts in the last fiscal year. In thousands.		2013-2014: Survey
	Measured dichotomously. Counties designated "coastal" by the National Oceanic and Atmospheric Administration (NOAA) – meaning that at least 15% of their area is in a coastal watershed – receive a one; a zero otherwise. Cities and other incorporated areas receive the same score as the counties they inhabit.	+	2013: National Oceanographic and Atmospheric Administration (NOAA)
	Property and crop damage from natural hazard events over the years 2000-2013, in thousands; cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2000-2013: Storm Events Database, National Climatic Data Center, US National Oceanic and Atmospheric Administration (NOAA)
	Count of directly-caused deaths and injuries from natural hazard events over the years 2000-2013; cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2000-2013: Storm Events Database, National Climatic Data Center, US National Oceanic and Atmospheric Administration (NOAA)
	Average percentage of voters, at the county level, who voted for the Democratic candidate in the 2008 and 2012 presidential elections. Cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2008, 2012: DailyKos Elections
	Total civilian population (older than 16) employed in agriculture, forestry, mining, construction, manufacturing, transportation, warehousing, and utilities, divided by the total employed population (older than 16) at the county level. Cities and other incorporated areas allocated the same total as the counties they inhabit.	-	2012: US Census
	Median household income of municipal residents, in thousands.	+	2012: US Census
	Local government revenue, from own sources, in thousands.	+	2007: US Census
	Municipal population, in thousands.	+	2012: US Census
	Percent of municipal residents, 25 years or older, who have a bachelor's degree or higher.	+	2008-2012: US Census
	Measured dichotomously. Cities or counties in which at least a quarter of the residents are students enrolled in a college or university at an undergraduate or graduate level.	+	2008-2012: US Census
	Measured dichotomously. A county receives a one if it was found in nonattainment for at least		

Improved Transit (transit)	The percentage of workers in a municipality who drive to work and have travel times of 30 minutes or longer.	+	2008-2012: US Census
Influence from Above			
State Mitigation Mandates (stmandate)	Measured dichotomously. Whether or not a state has legally-binding mandates for mitigation.	+/-	2013: US Environmental Protection Agency
Municipal Authority (dillons)	Measured dichotomously. Whether or not a municipality is subject to Dillon's rule.	-	2004: National Association of Counties
State Climate Action Plans (stplan)	Measured dichotomously. Whether or not a state has adopted a climate action plan.	+/-	2013: US Environmental Protection Agency
State Mitigation Targets (sttarget)	Measured dichotomously. Whether or not a state has set mitigation targets.	+/-	2013: Center for Climate and Energy Solutions
State Energy and Climate Policies (stpolicies)	The number of specific climate change and energy conservation policies passed on the state level.	+/-	2013: Pew Center on Global Climate Change
Other Variables			
Regulatory Preference (regpref)	The number of regulatory mitigation policies in my survey a municipality has enacted, divided by those it *could* enact. Ranges from 0 to 1, with values closer to one representing a stronger preference for regulatory action.		2014: Survey
Mitigation Policies (tota)	A count measure of the number of mitigation policies in my survey a government has enacted.		2014: Survey
Climate Plan (muniplana)	Measured dichotomously. Whether or not the municipality has a climate plan.		2014: Survey
Climate Network Membership (networkmem)	Measured dichotomously. Whether or not the government is a member of a climate network.		2014: ICLEI – Local Governments for Sustainability; US Mayors Climate Protection Agreement; Cool Cities
Cost Savings (estsavings)	Cost savings realized by the government because of its mitigation efforts in the last fiscal year. In thousands.		2014: Survey
State and Federal Mitigation Funding (govfund)	Municipal revenue generated by mitigation policies, offset by the percentage of such funding generated from non-governmental sources.		2014: Survey
Revenue (revenue)	Funding received by municipalities for mitigation, not including cost savings, from government and non-government sources, in the last fiscal year. In thousands.		2014: Survey
Money (money)	Funding received by the government for its mitigation activities. Includes cost savings, external grants, and all other sources. Averaged by municipality; in thousands.		2014: Survey
Political Support from Municipal Leaders (polsupport)	Support of local elected officials for measures that address climate change, measured on a Likert scale (from a high of 5 to a low of 1); responses averaged by municipality.		2014: Survey
Municipal Electric Utility (muniutil)	Measured dichotomously. Municipalities which own or operate a local electric utility.		2014: Survey
Staff (staff)	Estimated number of municipal staff (in FTE - full-time equivalents) which work to protect the natural environment, not counting temporary or contract employees.		2014: Survey
Climate Plan (muniplanb)	Measured dichotomously. Whether or not the municipality has a climate plan, is working on one, or considering one. A more expansive measure than muniplana.		2014: Survey
Mitigation Policies (totb)	A count measure of the number of mitigation policies in my survey a government has enacted, or is considering. A more expansive measure than tota.		2014: Survey

counties) and year (e.g. governments incorporated prior to 1976). Accordingly each municipality was coded dichotomously to account for whether they are or are not subject to Dillon's rule.[63]

State Climate Action Plans (`stplan`)

States that adopt climate action plans – formal documents that identify strategies and policies to reduce greenhouse gas emissions – may signal to municipalities that climate change is a priority, and worth addressing on the municipal level. Alternately, state plans may signal that no local efforts are required, since the state has already taken action. I code states dichotomously to reflect whether or not they have adopted a climate action plan. I obtained this data from the US Environmental Protection Agency.[64]

State Mitigation Targets (`sttarget`)

Twenty US states have set mitigation targets – targets that, like climate action plans, may incentivize local climate action, or signal that no local action is needed. I obtained this data from the Center for Climate and Energy Solutions.[65]

State Energy and Climate Policies (`stpolicies`)

The number of climate change and energy conservation policies passed on the state level may similarly signal to municipalities that local climate action is – or is not – called for. I measure this variable as a count of the total number of these policies passed in each state, according to the Pew Center on Global Climate Change.[66]

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[63] In constructing this variable, I referred to "Dillon's Rule or Not?" – a 2004 Research Guide from the National Association of Counties (http://www.celdf.org/downloads/Home%20Rule%20State%20or%20Dillons%20Rule%20State.pdf). "Is Home Rule the Answer? Clarifying the Influence of Dillon's Rule on Growth Management" – a 2003 discussion paper from the Brookings Institution (http://www.brookings.edu/es/urban/publications/dillonsrule.pdf) – was also helpful. I obtained a list of charter cities in California from the League of California Cities, at http://www.cacities.org/Resources-Documents/Resources-Section/Charter-Cities/Charter_Cities-List. In Colorado, Dillon's Rule applies to statutory cities and towns, and all counties (see the Brookings paper). I determined the status of each city and town by referring to this wikipedia list: http://en.wikipedia.org/wiki/List_of_cities_and_towns_in_Colorado#Statutory_city. Whether or not local governments in Florida are subject to Dillon's Rule is unclear: "The only exception to the exclusive selection of home rule or Dillon's rule is the state of Florida, which employs home rule but reserves taxing authority for the state" (http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-powers/local-government-authority). The Brookings paper cites the two conflicting court rulings: Barry v. Garcia, 573 So.2d 932 (Fla.App. 3 Dist.,1991) determined that Dillon's Rule does apply; City of Boca Raton v. State, 595 So.2d 25, 17 Fla. L. Weekly S142 Fla., Feb 27, 1992 found that Article VIII, Section 2(b) of the Florida Constitution rejects Dillon's Rule. I coded local governments from Florida with zeroes, meaning that Dillon's Rule does not apply. This is because the "no" ruling is more recent – and more importantly, because Dillon's Rule represents a restriction of authority, and in the context of ambiguity, restrictions are unenforceable. In Illinois, Dillon's Rule does not apply to home rule municipalities – or to Cook County, which has also obtained Home Rule (see Brookings; for Cook County, see http://www.citizenadvocacycenter.org/uploads/8/8/4/0/8840743/homerulebrochure.pdf). A list of municipalities in Illinois with home rule is available at http://www.iml.org/page.cfm?key=2. In Louisiana, Dillon's Rule does apply to charter municipalities designated as such after 1974. I was able to determine from http://ballotpedia.org/Cities_in_Louisiana that all of the cities from my sample in Louisiana are charter municipalities. In Tennessee, Dillon's rule does not apply to Home Rule municipalities. A list of municipalities in Tennessee, which includes their form of government, is available at http://en.wikipedia.org/wiki/List_of_municipalities_in_Tennessee. Websites accessed on July 17th, 2014.

[64] The EPA lists the states that have completed a Climate Action Plan, at http://www.epa.gov/statelocalclimate/state/state-examples/action-plans.html. Website accessed July 17th, 2014.

[65] See http://www.c2es.org/us-states-regions/policy-maps/emissions-targets; accessed July 19th, 2014.

[66] As of February, 2014, the Pew Center on Global Climate Change tracks thirty-one such policies (http://www.c2es.org/docUploads/all-state-initiatives-feb-2014.pdf). Of these, I have excluded consideration of Hydraulic Fracking Chemical Disclosure (column 19) because this policy does not have the same hypothesized relationship as a signal for local climate action. Website accessed June 28th, 2014.

OTHER VARIABLES

Regulatory Preference (`regpref`)

This variable measures political cost as the propensity of a local government to mitigate via regulatory policies. There were eight regulatory policies in my survey (see Table 6), and a municipality could have the authority to pursue all eight, or some lesser number.[67] `Regpref` is the number of those mitigation policies a municipality enacted, divided by those it *could* enact. Accordingly it ranges from 0 to 1, with values closer to one representing a stronger preference for regulation.

This measure is admittedly crude. Crude because some regulatory policies (such as a tax on carbon) entail greater political costs than others (such as energy-efficient building codes). Yet this measure gives all of them equal weight. It also requires the assumption that regulatory efforts are always politically costly, when they may not always be (e.g. protections for trees in a tree-friendly city). However I argue that, in general, regulatory policies entail greater political costs, and that having more of them is more costly. And that attempting to more accurately weight the political costs of these policies would probably increase the measurement error, rather than decrease it.

Number of Mitigation Policies (`tota`)

Following the lead of Pitt (2010a) and Krause (2011b), I include a count measure of the number of mitigation policies in my survey a government has enacted.

Climate Plan (`muniplana`)

A local climate plan is typically a strategic document, filled with specific policies, regulations and spending recommendations to help a municipality achieve some targeted level of emissions reductions. Implementation usually requires further action by municipal staff or political authorities (Millard-Ball, 2012). I collected the data for this dichotomous measure with the survey instrument.

Climate Network Membership (`networkmem`)

This measures whether or not a government is a member of at least one of the following climate networks: ICLEI – Local Governments for Sustainability, the Cool Cities program, or the US Mayors' Climate Protection Agreement (USMCPA). Most studies of local mitigation use a measure like this one – most often membership in Cities for Climate Protection (CCP). However the CCP network is no more; it's been replaced by membership in ICLEI.[68] 2014 data was collected from each of these climate networks.[69]

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[67] Respondents specified in the survey whether their local government had the authority to pursue these policies, on a policy-by-policy basis. So the number a municipality *could* enact derives from this respondent data.

[68] In a personal email dated July 3rd, 2014, Eli Yewdall, Senior Program Officer, ICLEI-Local Governments for Sustainability USA, writes that "CCP has not been an active campaign for a number of years…ICLEI membership has replaced CCP." The CCP campaign was originally founded as an ICLEI project, and has always been managed by ICLEI.

[69] I obtained a 2014 list of US ICLEI member governments from Eli Yewdall, Senior Program Officer, ICLEI-Local Governments for Sustainability USA (in a personal email dated July 3rd, 2014). A list of signatories to the USMCPA is available at

Cost Savings (`estsavings`)

My survey collected data on the money local governments saved, over the last fiscal year, by implementing and administering the environmental efforts in my survey. Respondents' estimates were averaged by municipality to arrive at consensus estimates of these cost savings.

State and Federal Mitigation Funding (govfund)

States and the federal government may influence municipal mitigation through the funding they provide. My survey collected data on the funding municipalities receive for mitigation generally – which may include fines and in-kind donations, in as well as grants from nonprofits and foundations – rather than from governmental sources specifically. However respondents were also asked to specify what percentage of these funds came from non-governmental sources,[70] and for each municipality, the remainder is assumed to come from state and federal sources.[71]

Revenue (`revenue`)

My survey collected data on the money local governments earned, over the last fiscal year, by implementing and administering the environmental efforts in my survey. State and federal grants are the predominant source of this revenue, but non-governmental and in-kind donations are also included (though not cost-savings). The estimates from respondents were averaged, by municipality, to arrive at consensus estimates.

Money (`money`)

This is a measure of all the money received by governments because of their mitigation activities in the last fiscal year. So `money` is the sum of the consensus estimates of `estsavings` and `revenue` for each municipality.

Political Support from Municipal Leaders (`polsupport`)

I collected estimates of this support via the survey instrument; respondents were asked to state the interest of their government's elected leaders in addressing climate change (on a Likert scale from a low of 1 to a high of 5). These responses were then averaged by municipality.

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http://www.usmayors.org/climateprotection/list.asp (accessed on July 2nd, 2014). A list of Cool Cities member governments is available at www.coolcities.us (accessed on June 25th, 2014).

[70] The mean estimated by respondents is 10.5%

[71] This is admittedly a crude adjustment – the govfund variable may still contain some measure of funding that doesn't come from state and federal sources (such as fines levied by the municipality). However if these totals are small in comparison with state and federal grants, the error they introduce will be correspondingly minor.

Municipal Electric Utility (`muniutil`)

I include a dichotomous measure of municipalities which own or operate an electric utility, and I collect this data via the survey instrument.[72]

Staff (staff)

I ask survey respondents to estimate the number of municipal staff (in FTE - full-time equivalents) that "work to protect the natural environment," not counting temporary or contract employees.[73] This language is intentionally vague, so as not to exclude staff (like Drain Commissioners, planners, and sanitation staff) whose responsibilities – particularly in smaller governments – may include leading environmental initiatives. However this also leaves room for interpretation, which may hinder this variable's precision. Multiple estimates from a single municipality were averaged to arrive at a consensus estimate.[74]

Climate Plan (`muniplanb`)

This is a secondary, more expansive measure of `muniplana` which includes "workingconsideration" answers from the survey. So `muniplanb` is a measure of whether or not a government has a climate plan, is working on one, or considering one.

Number of Mitigation Policies (`totb`)

This is a secondary, more expansive measure of `tota` which includes "workingconsideration" answers from the survey. So `totb` measures the number of my survey's mitigation policies a government has enacted, or is considering.

DESCRIPTIVE STATISTICS: INCORPORATED PLACES

Tables 9 and 10 present the descriptive statistics for incorporated places.

[72] This variable is the answer to survey question #9 transformed such that "yes" becomes "1", "no" becomes "0", and "dontknow" becomes "." (a missing value). When there are multiple respondents from a single municipality with conflicting answers, the answer they give most often is adopted.

[73] This variable may reflect some degree of reverse causation – staff can help spend money and implement policies, but getting money and passing policies can also cause staff to be hired. The concern here would be greater if my data reflected a time period longer than a single year.

[74] Blank answers become "." (a missing value). Textual qualifiers were eliminated, such that the response "approx 75" became "75". Similarly, "2 FTE" and "two" became "2". Department-specific estimates (e.g. "2.5 in my bureau, many others in the Bureaus of Environmental Services and Parks and Recreation") were changed to "." (a missing value). Overly vague estimates (e.g. "unknown--dozens or hundreds as a guess") were also changed to "." (a missing value). Specific range-estimates (e.g. "10 to 20") were changed to the midpoint of the range (e.g. "15"). Infinite ranges (e.g. "100+") were converted to the number given. Finally, estimates that specified that everyone in the city worked on environmental issues (e.g. "All of them. We have 537 FTEs") were converted to "." (a missing value).

Table 9: Descriptive Statistics for Non-Dichotomous Variables					
	Observations	**Mean**	**Standard Deviation**	**Min**	**Max**
netspent	299	272.22	2595.06	-36700	10616.66
tota	340	8.48	4.36	0	23
totb	340	13.51	5.48	0	26
hazardcost	508	762155	3199073	768	35100000
hazardcasualties	508	103.07	290.33	0	5277
libvoting	508	.537	.134	.091	.894
polsupport	340	3.76	.843	1	5
carbemploy	508	.195	.067	.062	.554
medincome	508	59.26	22.99	19.28	181.12
munirevenue	506	212663.9	941657.9	195	16500000
pop	508	99.80	246.53	25.15	3857.80
educ	508	.319	.151	.042	.813
staff	330	25.36	74.85	0	832.5
transit	508	.312	.138	.050	.721
stpolicies	508	18.26	4.58	6	25
regpref	336	.232	.171	0	1
estcost	316	1078.77	3093.99	0	36430
estsavings	308	356.00	1829.52	0	25150
revenue	310	452.27	2517.30	0	36333.33
money	303	822.00	3760.98	0	43233.33
govfund	304	377.60	2115.54	0	31488.89

In Table 9, the most noteworthy variables display generalizable financial information on local mitigation. Incorporated places with populations greater than 25,000 appear to spend, on average, a little more than a million dollars on mitigation – of which $356,000 is recouped via cost savings and $452,000 via various forms of revenue, the largest of which is state and federal funding ($378,000). Income from mitigation ($822,000) covers the bulk of mitigation expenditures, leaving incorporated places out pocket, on average, $272,000 for their mitigation efforts annually. That's a small fraction of the average own-source municipal revenue ($212,664,000) – a little more than a tenth of one percent, on average (0.128%). And it's an even smaller fraction of the average costs each municipality incurred from natural hazards from 2000-2013 ($762 million).

These expenditures are spread across an average of 8.48 mitigation policies, per municipality, and overseen by an average of 25 municipal staff (a mean that's heavily influenced by a long-tailed distribution). When policies under active consideration are included, that number increases to 13.51, but that still doesn't match the average of 18.26 state-level mitigation policies. There's little appetite for regulatory policies on the local level, with the average ratio of regulatory policies enacted over those which could be enacted (`regpref`) at just under a quarter (.2322). However there is surprising support for mitigation from local elected leaders (an average of 3.76 on a 1-5 scale), despite a democratic voting

constituency that only slightly exceeds the national average in the 2008 and 2012 presidential elections (53.7%, vs. a national average of 52.0%).

Table 10: Descriptive Statistics for Dichotomous Variables					
	Observations	**Mean**	**Standard Deviation**	**% 0 (No)**	**% 1 (Yes)**
networkmem	508	.350	.478	65.0%	35.0%
muniplana	328	.116	.321	88.4%	11.6%
muniplanb	328	.357	.480	64.3%	35.7%
coastvuln	508	.557	.497	44.3%	55.7%
colltown	508	.053	.225	94.7%	5.3%
muniutil	340	.118	.323	88.2%	11.8%
cleanair	508	.636	.482	36.4%	63.6%
stmandate	508	.132	.339	86.8%	13.2%
dillons	508	.567	.496	43.3%	56.7%
stplan	508	.781	.414	21.9%	78.1%
sttarget	508	.594	.491	40.6%	59.4%

Table 10 reveals that a little more than a third of the incorporated places in my sample are members of the ICLEI, USMCPA, or Cool Cities climate networks. A common requirement of network membership is the formation of a plan to reduce local emissions, but this is less common: only 11.6% of the incorporated places have done so. Governments that are considering or in the process of doing so are captured in the more expansive `muniplanb` variable, which shows a percentage similar to climate network membership.

However most of the governments are located within states that have set emissions targets (59.4%) and created plans to reduce greenhouse gas emissions (78.1%). Only California mandates emission reductions, so the `stmandate` variable doubles as a measure of the incorporated places in California.[75]

Most of the incorporated places are located in low-lying, coastal areas that are vulnerable to flooding and hurricanes, and suffer from poor air quality. In contrast, municipally-owned utilities are rare (11.8%) while only 5.3% of incorporated places are small enough to disproportionately benefit from the labor, ideas, and expertise provided by local colleges and universities.

Tables 11-14 present the financial statistics for incorporated places in greater detail. Table 11 breaks out the financial data by population subset, allowing for a comparison between small, mid-sized, and larger municipalities. So we can see that gross expenditures (`estcost`) increase for larger municipalities, as do the savings yielded by those expenditures (`estsavings`). However smaller governments are more effective at bringing in revenue from their mitigation – particularly government funding – than are mid-size governments. And partly as a consequence, the average net spending on mitigation is (surprisingly) highest among the mid-sized local governments.

[75] This percentage is roughly equivalent to the percentage of the US population from California (12.17%).

Table 11: Descriptive Financial Statistics for Incorporated Places						
	Population Subset	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
estcost	None	316	1078.77	3093.99	0	36430
	25K – 50K	155	454.01	871.48	0	5317.17
	50K – 100K	95	691.49	1175.80	0	7650
	100K+	66	3103.46	6105.73	0	36430
estsavings	None	308	356.00	1829.52	0	25150
	25K – 50K	150	79.04	239.04	0	2500
	50K – 100K	95	201.50	604.96	0	5000
	100K+	63	1248.42	3853.59	0	25150
revenue	None	310	452.27	2517.30	0	36333.33
	25K – 50K	150	200.70	653.47	0	5398.2
	50K – 100K	96	107.53	216.02	0	1500
	100K+	64	1559.00	5331.42	0	36333.33
money	None	303	822.00	3760.98	0	43233.33
	25K – 50K	145	284.13	792.52	0	5776.95
	50K – 100K	95	310.16	703.95	0	5500
	100K+	63	2831.76	7842.65	0	43233.33
govfund	None	304	377.60	2115.54	0	31488.89
	25K – 50K	147	173.94	599.86	0	5344.22
	50K – 100K	94	91.61	193.26	0	1500
	100K+	63	1279.52	4463.18	0	31488.89
netspent	None	299	272.22	2595.06	-36700	10616.66
	25K – 50K	143	169.86	829.69	-2570	4812.5
	50K – 100K	95	381.33	1232.62	-4500	7262.5
	100K+	61	342.25	5421.15	-36700	10616.66
Financial data in thousands of dollars, from the last fiscal year.						

These average statistics generalize to the 1913 incorporated places with populations greater than 25,000 in 2012. So the gross mitigation spending by these incorporated places is about $2.06 billion annually,[76] of which a little less than $521 million is net spending.

Table 12 puts this data into per capita terms, again breaking out subsections by population bracket. On a per-person basis, smaller governments spend the most on mitigation: an average of $12.13 per person. They also earn the most revenue from their mitigation, an average of $5.32 per person – of which the vast majority ($4.63) comes from state and federal government funding. Larger governments also benefit from significant government funding for mitigation (28.4% of per-person mitigation spending), but they simultaneously direct their mitigation dollars towards activities that earn a significant return via cost savings (40.9% of per-person mitigation spending). Mid-size governments recapture the least of their

[76] That is, $1,078,771 per municipality, on average, times 1913 municipalities.

gross spending via cost-savings and revenue (41.3%, compared with 61.8% for smaller governments and a whopping 79.2% for the largest governments), which means these mid-sized governments end up spending more on mitigation, on a per-person basis, than either smaller or larger governments.

Table 12: Per Capita Financial Statistics for Incorporated Places						
	Population Subset	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
estcost	None	316	11.71	22.95	0	213.98
	25K – 50K	155	12.13	22.19	0	135.25
	50K – 100K	95	10.92	20.46	0	139.10
	100K+	66	11.83	27.94	0	213.98
estsavings	None	308	2.91	11.51	0	169.23
	25K – 50K	150	2.07	5.99	0	63.38
	50K – 100K	95	2.87	8.38	0	61.07
	100K+	63	4.96	21.39	0	169.23
revenue	None	310	3.98	13.59	0	137.31
	25K – 50K	150	5.32	17.05	0	137.31
	50K – 100K	96	1.62	3.35	0	22.73
	100K+	64	4.34	13.71	0	103.88
money	None	303	6.95	19.79	0	186.56
	25K – 50K	145	7.50	20.49	0	146.95
	50K – 100K	95	4.51	9.94	0	67.18
	100K+	63	9.37	27.68	0	186.56
govfund	None	304	3.37	11.88	0	135.94
	25K – 50K	147	4.63	15.62	0	135.94
	50K – 100K	94	1.39	3.01	0	22.73
	100K+	63	3.36	9.57	0	70.38
netspent	None	299	4.79	19.73	-76.44	132.05
	25K – 50K	143	4.47	21.48	-70.22	116.25
	50K – 100K	95	6.41	20.59	-54.96	132.05
	100K+	61	2.99	13.08	-76.44	37.10
Financial data in dollars per capita, from the last fiscal year.						

Table 13 again breaks out subsections by population bracket, but this time does so in per-policy terms (with policies being actively implemented – `tota` – as the denominator). This table doesn't control for population, so the ranked order we see for `estcost` and `estsavings` (small to large) is what we might expect. However smaller governments continue to earn significantly more revenue from government funding than mid-sized governments, and their overall average income from mitigation (`money`) is larger. So while net spending by governments with more than 100,000 residents is more than three times the per-policy net spending by governments with 25-50,000 residents, it's the mid-sided governments that – by a small margin – have the largest net expenditures per policy, on average.

Table 13: Per Policy Financial Statistics for Incorporated Places						
	Population Subset	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
estcost	None	311	114.17	247.87	0	2500
	25K – 50K	152	63.17	123.07	0	750
	50K – 100K	93	104.31	284.33	0	2500
	100K+	66	245.50	345.95	0	1590
estsavings	None	303	31.08	107.32	0	1257.5
	25K – 50K	147	12.87	54.25	0	625
	50K – 100K	93	24.55	78.29	0	625
	100K+	63	83.19	190.98	0	1257.5
revenue	None	305	39.83	145.68	0	1730.16
	25K – 50K	147	31.35	103.00	0	762.5
	50K – 100K	94	11.32	18.56	0	80.21
	100K+	64	101.17	268.54	0	1730.16
money	None	298	72.02	219.26	0	2058.73
	25K – 50K	142	45.09	147.20	0	1387.5
	50K – 100K	93	35.99	86.91	0	687.5
	100K+	63	185.90	391.19	0	2058.73
govfund	None	299	33.70	124.51	0	1499.47
	25K – 50K	144	27.04	89.18	0	620.31
	50K – 100K	92	9.65	16.04	0	78.95
	100K+	63	84.04	228.60	0	1499.47
netspent	None	294	44.60	234.54	-1747.62	2475
	25K – 50K	140	19.52	124.09	-637.5	687.5
	50K – 100K	93	68.31	289.61	-562.5	2475
	100K+	61	66.00	318.67	-1747.62	1061.67
Financial data in thousands of dollars per policy, from the last fiscal year.						

Finally, Table 14 shows the per-capita, per-policy financial statistics for incorporated places in different population brackets. So we can see that gross mitigation spending by small and mid-sized governments is nearly equal in per-capita, per-policy terms (though larger governments spend less), and that governments of all three sizes save money from their mitigation at roughly the same rate. However mid-sized governments bring in roughly half the state and federal funding (and revenue generally) that larger governments do, and only about a fifth that of smaller governments. Consequently, their per-capita, per-policy net expenditures are roughly twice that of smaller governments, and nearly four times those of the largest incorporated places. Overall gross expenditures are, on average, $1.57 per person, per policy, and overall net expenditures are an average of 71 cents per person, per policy.

Clearly local mitigation is not a money-making endeavor for incorporated places, on average – even taking cost-savings and state and federal funding into account. So why mitigate?

Table 14: Per Capita, Per Policy Financial Statistics for Incorporated Places						
	Population Subset	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
estcost	None	311	1.57	3.80	0	47.33
	25K – 50K	152	1.71	3.34	0	23.45
	50K – 100K	93	1.72	5.29	0	47.33
	100K+	66	1.02	1.70	0	10.70
estsavings	None	303	0.34	1.23	0	15.84
	25K – 50K	147	0.33	1.37	0	15.84
	50K – 100K	93	0.35	1.11	0	7.63
	100K+	63	0.35	1.09	0	8.46
revenue	None	305	0.53	1.92	0	19.33
	25K – 50K	147	0.83	2.67	0	19.33
	50K – 100K	94	0.17	0.29	0	1.33
	100K+	64	0.35	0.89	0	5.77
money	None	298	0.88	2.80	0	35.17
	25K – 50K	142	1.19	3.77	0	35.17
	50K – 100K	93	0.53	1.24	0	8.40
	100K+	63	0.71	1.58	0	9.33
govfund	None	299	0.45	1.65	0	15.80
	25K – 50K	144	0.72	2.31	0	15.80
	50K – 100K	92	0.15	0.26	0	1.20
	100K+	63	0.28	0.67	0	3.91
netspent	None	294	0.71	3.83	-16.16	46.86
	25K – 50K	140	0.54	3.41	-16.16	21.13
	50K – 100K	93	1.20	5.30	-6.87	46.86
	100K+	61	0.36	1.01	-4.25	3.23
Financial data in dollars per capita, per policy, from the last fiscal year.						

STATISTICAL MODELS: INCORPORATED PLACES

Table 15 presents two models of municipal mitigation, of which the first – with net spending as the dependent variable – is the primary model of explanatory interest. The reason is simple: `netspent` best captures the financial costs incurred as local governments pursue mitigation, and measures of cost are the key to understanding local mitigation within a rational choice framework.

While the OLS results for Model 1 are presented here, similar results were found using multilevel analysis, and these can be found in Appendix 3. Model 2 also uses OLS.

I transform the `pop` variable in Models 1-2 to reflect a nonlinear relationship with the dependent variables. Assuming a linear relationship means that a 2 million increase in population (for example) has the same impact on mitigation policies and spending, regardless of the existing population (the difference

between a city with 25,000 people and 2,025,000 is the same as the difference between 6,025,000 people and 8,025,000). I assume differently: I hypothesize a quadratic relationship between population and the two dependent variables (in Models 1 and 2) to capture the effect of fiscal economies of scale.

The White test didn't indicate heteroskedasticity in any of the models, but in Model 2, the Breusch-Pagan and Cook-Weisberg test did. I therefore use robust standard errors for Model 2.[77] The variance inflation factor test didn't indicate problematic multicollinearity in any of the models; sensitivity analyses for the primary model – Model 1 – are presented in Appendix 3. Models which test each motivation individually for each of the dependent variables are presented in Appendix 5.

REGRESSION & CAUSATION

Before we examine these regression results, it's worth reviewing what they can say – and what they can't – with regard to causation.

In the text *Using Econometrics: A Practical Guide*, Studenmund writes that:

> …Propositions such as these pose an if-then, or causal, relationship that logically postulates that a dependent variable's movements are determined by movements in a number of specific independent variables. Don't be deceived by the words "dependent" and "independent," however. Although many economic relationships are causal by their very nature, a regression result, no matter how statistically significant, **cannot prove causality**. All regression analysis can do is test whether a significant quantitative relationship exists. Judgments as to causality must also include a healthy dose of economic theory and common sense. For example, the fact that the bell on the door of a flower shop rings just before a customer enters and purchases some flowers by no means implies that the bell causes purchases! If events A and B are related statistically, it may be that A causes B, that B causes A, that some omitted factor causes both, or that a chance correlation exists between the two. (Studenmund 2011, p. 6, emphasis added)
>
> While regression analysis specifies that a dependent variable is a function of one or more independent variables, **regression analysis alone cannot prove or even imply causality**. (Studenmund 2011, p. 24, emphasis added)

If regression cannot prove causality, what purpose does it serve?

> The general purpose of multiple regression (the term was first used by Pearson, 1908) is to learn more about the relationship between several independent or predictor variables and a dependent or criterion variable. For example, a real estate agent might record for each listing the size of the house (in square feet), the number of bedrooms, the average income in the respective neighborhood according to census data, and a subjective rating of appeal of the house. Once this information has been compiled for various houses it would be interesting to see whether and how these measures relate to the price for which a house is sold. For example, one might learn that the number of bedrooms is a better predictor of the price for which a house sells in a particular neighborhood than how "pretty" the house is (subjective rating). (Hill and Lewicki, 2006, p. 248)

In this example, it's not possible to say that a larger number of bedrooms "causes" a house to sell for a higher price, any more than it is to say that the ring of a doorbell in Studenmund's example causes flower sales. Regression can only describe the relationship that exists – the level of statistical significance; the direction; the magnitude – within the context of a specific set of data and statistical specification.

> In their excellent book on the design of social science research, Shadish, Campbell, and Cook (2002, p. 6) cite 19th-century philosopher John Stuart Mill's description of three critical conditions that must be met in order to claim that one thing *causes* another. The first condition is that the hypothesized *cause* must *precede* its anticipated *effect* in time. For example, in investigating whether student achievement depends upon the number of students in the class, it is important to ensure that students had been taught in class settings of a particular size *before* their achievement was measured.
>
> The second of Mill's conditions is that if the levels of the cause differ in some systematic way, then there must be corresponding variation in the effect. For example, if our theory suggests that children taught in classes with fewer students achieved at higher levels, we would anticipate that as the number of students in classes got smaller, the students' achievement would be higher, on average.

[77] Although the GLM method I employ in Model 3 also uses robust standard errors.

> The third of Mill's conditions is by far the most important and the most difficult to satisfy in practice. It stipulates that the researcher must be able to discount all other plausible explanations – other than the anticipated causal one – for the link observed between the hypothetical cause and effect. In the case of an investigation of the impact of class size on student achievement, we must be able to argue compellingly that any observed association between class sizes and subsequent student achievement is not a consequence, for example, of choices that parents may have made about where to send their children to school or decisions by school administrators to assign students with particular characteristics to classes of particular sizes. (Murnane and Willett, p. 29-30, authors' emphasis)

Since the results I present are not based on experimental data, and municipal decisions regarding mitigation are endogenous, my results cannot satisfy this third causal condition – even if they could satisfy the other two. Therefore I do not and cannot make causal claims in this dissertation. So when I say that variable X "predicts" variable Y, that common statistical language should not be read as making an explicitly causal claim.

It's unlikely there ever will be an experiment which examines why local governments pursue mitigation, and therefore the causal question will remain perpetually open. If so, then why have researchers bothered to develop theoretical explanations within the literature – explanations which can never be proven? Because even if causation can't be definitively resolved, more and better evidence can be accumulated. I believe my regression results improve significantly on the existing literature – and even though they cannot prove causation, represent the best existing evidence. Evidence which, while not conclusive, is nevertheless indicative.

The question of why local governments are mitigating has both theoretical and practical import – and the interested reader may choose to use these regression results, in concert with their own judgment and other sources of knowledge, to reflect on this question. But to do so, it may help to reflect further on the first causal condition specified by John Stuart Mill, and the degree to which my data complies.

Mill specifies that a cause must precede its effect in time. To expand on Studenmund's flower shop example, an advertisement that appears *after* a purchase is made cannot possibly have caused the prior purchase. Instead, it must precede the purchase in time – but by how much time? A billboard erected 10 seconds prior may technically precede the purchase, but that length of time is insufficient basis for a convincing causal argument. Similarly, a billboard erected a decade ago may live on in a customer's memory, and therefore cause a purchase – but this is similarly unlikely. So: what amount of time is the right amount of time? This quantity will likely vary from one variable to the next, and from one observation to the next.

For example, consider `medincome` – median household income – and own-source municipal revenue, or `munirevenue`. Both variables reflect a government's financial capacity, and therefore its ability to invest in mitigation spending. But their influence on a government's financial capacity often differs in terms of time. Increases in median household income may gradually result in higher assessed property values and therefore more property tax, and in more local commerce and therefore more sales tax. But these impacts on a government's tax receipts take longer to realize than a direct increase in `munirevenue`, which may occur through a short-term increase in the rate of sales or property tax.

Similarly, consider City A and City B. City A may have an efficient administration and budgeting process, which quickly allocates increases in municipal revenue to spending priorities like mitigation. City B may have an antiquated budgeting process and inefficient administration, which takes longer to do so.

Which brings us back to Mill's causal condition. There is a line in time, before which causation is possible, and after which it is not. But that line is likely to differ – both between variables and between observations. Nor are events before that line equally likely to have a causal effect, even if such causation is equally possible. Yesterday's television advertisement might cause someone to buy flowers, just as a fifty-year-old magazine advertisement may. In each case, a causal effect is possible, but not equally likely.

Finally, consider the causal effects my variables miss because of their limited duration in time. `Cleanair` measures whether a government is located in a county that was found in nonattainment for one or more of the EPA's criteria air pollutants, at any point between 2010 and 2014. Yet a prior state of nonattainment – say, in 2009 – might easily have a causal impact on the mitigation efforts underway in that jurisdiction today. But if so, it won't be observed in my regression results, because the `cleanair` variable only extends so far back in time.

How can we wade through these causal weeds? With extreme caution and careful judgment. But for judgment to be informed, we have to know the timeframe for my data. This is reported in the right-hand column of Table 8.

Let's look at the dependent variables. Both `netspent` and `estcost` reflect a government's mitigation spending over the last fiscal year; as I write on pages 24-25:

> Time is another difficulty. It's impossible to fully capture the financial dynamics of local mitigation finance with data from a single year. Many mitigation activities – replacing city lights with LEDs, for example – yield cost savings that extend indefinitely. A single grant may also fund mitigation activities with costs that extend over several years, meaning that a survey capturing a single year of data fails to fully reflect the inflows and outflows of financial resources, and its validity is accordingly limited.
>
> However it would be impractical to expect survey respondents to report the fiscal details of municipal efforts in prior years. Staff change jobs and responsibilities, and even for those who remain, fiscal information from prior years is unlikely to be remembered. Response rates and the quality of the data would both decline if this survey's time period were expanded. For the year's worth of data I collected, I offset the amount each municipality spent by the amount it saved and received in revenue, thereby creating estimates of net spending for each municipality. So `netspent` represents the net outflow of financial resources to fund local mitigation in the last fiscal year.
>
> This presents another issue, because fiscal years are not consistent across local governments. Some local governments begin their fiscal year on July 1st; others on October 1st; still others on January 1st. This means there is not a calendar-year consistency between the estimates my survey respondents provided. I could have avoided this issue by specifying in my survey that estimates should conform to a calendar year (say, January 1st to December 31st of 2013), but this would have introduced error because the fiscal activities of local governments are organized according to their fiscal year. A calendar year estimate may include half of one fiscal year and half of another – or a quarter of one and three quarters of another. Asking respondents to mentally straddle two fiscal years would introduce error and degrade the quality of the data I received. And I felt the convenience of having the estimates cover the exact same time period was not worth this price. Given that the survey was in the field from early June through mid-July of 2014, the earliest possible fiscal year of any respondent government is July 1st, 2012 through June 30th of 2013, and the latest is July 1st, 2013 through June 30th of 2014.

So strictly-speaking, the earliest time-period either variable could cover is mid-2012 to mid-2013. However both variables may reflect financial events that took place years before – a multiyear government grant issued in 2010; a switch to compact fluorescent lighting in 2005.

We could determine the extent of this temporal contamination by collecting data on the date when each municipal utility was founded; the date when each mitigation policy was passed; the date when each municipal staff person who works to protect the natural environment was hired. However:

a) Causation still could not be proven, because the third condition of Mill's remains unfulfilled. An experiment with exogenous, random assignment would fulfill this condition, and therefore enable causal claims to be made, but this is not possible for a regression analysis.
b) Detailed temporal data would enable a very different form of statistical analysis – an event history analysis. This study is based on data which does not enable such an analysis.
c) Judgment remains necessary. An experiment might prove causation, but its credibility depends on the reader's judgment of its data, methodology, and execution. A regression may not be able to prove causality, but the need for the reader's careful judgment – and on the same criteria – remains the same.

Therefore the inability of this regression analysis to prove causality isn't fatal; no regression analysis can. But the results I present do represent a significant step forward in a decades-long literature.

STATISTICAL RESULTS: INCORPORATED PLACES

Climate Risk

One thing all the models seem to agree on: climate risk does not predict mitigative action, refuting **H2**. None of the climate risk variables I include in my model – vulnerability to rising sea levels, and the actual damages caused by natural hazard events – are statistically-significant, and only one (`hazardcasualties`) is weakly significant in any model. This contradicts the results found by Zahran et al (2008a; 2008b) for climate network membership, though with a different sampling population and procedure. No other study has found that climate risk predicts local mitigation.

That said, all the existing studies (including this one) use measures of actual risk, but climate risk has to be perceived – by elected officials, municipal staff, and the population at large – to have any influence. If actual risk is a poor proxy for risk perception – which seems possible, if unlikely – then *perceived* risk may indeed have an influence on municipal mitigation. This is a potential area for future research.

Internal Determinants

If **H3** is correct, the variables which measure the support and opposition to municipal mitigation should be significant: namely, `libvoting` and `carbemploy`. The first is a broad measure of potential support; the other a measure of potential opposition. However neither variable is significant in either model.

H4 posits that a government's financial capacity – measured here by median household income and own-source municipal revenue – predicts municipal mitigative action. Yet neither variable predicts net mitigation spending – and the wealth of an area (as measured by median household income) is a significant negative predictor of gross mitigation spending.

Table 15: Explanatory Models for Mitigation By Incorporated Places			
		Model 1	**Model 2**
About the Model	**Dependent Variable**	netspent	estcost
	Statistical Method	OLS	OLS
	Adjusted R^2	.6896	.1851
	Observations	299	316
	Units	$ (in 1000s)	$ (in 1000s)
	Constant	-1121.03	-956.92
Climate Risk	**coastvuln**	-258.80 *(232.05)*	-23.63 *(424.52)*
	hazardcost	0.00 *(0.00)*	-0.00 *(0.00)*
	hazardcasualties	-0.31 *(0.27)*	-0.54 *(0.52)*
Internal Determinants	**libvoting**	118.60 *(836.13)*	-683.78 *(1559.80)*
	carbemploy	-160.51 *(1525.24)*	2691.13 *(2781.95)*
	medincome	-4.55 *(8.12)*	-30.91** *(15.10)*
	munirevenue	0.00 *(0.00)*	0.00 *(0.00)*
	pop	9.62*** *(1.29)*	9.39*** *(1.79)*
	pop (squared)	-0.01*** *(0.00)*	-0.00*** *(0.00)*
	educ	-177.33 *(1124.73)*	6232.27*** *(2111.97)*
	colltown	463.21 *(473.12)*	-1545.27* *(866.17)*
Exclud-able Benefits	**cleanair**	70.52 *(209.84)*	39.99 *(392.48)*
	transit	807.50 *(951.82)*	-572.61 *(1741.82)*
Influence From Above	**stmandate**	-828.00*** *(301.42)*	-275.41* *(567.86)*
	dillons	192.47 *(180.67)*	-4.13 *(340.26)*
	stplan	226.16 *(287.97)*	-2.56 *(533.02)*
	sttarget	-386.90 *(279.40)*	496.03 *(522.41)*
	stpolicies	53.49* *(31.73)*	41.83* *(57.79)*
***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses			

H5 says that a government's institutional capacity – measured by `pop`, `educ`, and `colltown` – should predict municipal mitigative action. Neither college town status nor the percentage of residents with a bachelor's degree or greater significantly predict net mitigation spending, although the former is weakly predictive of gross spending, and the latter strongly predictive. Population, however, is predictive across both models, and strongly so.

Excludable Benefits

Two excludable benefits are represented in Table 15, neither one of which is statistically significant.

Influence from Above

It makes sense to assume that mandates (like those in California) predict mitigation spending by municipalities. However the opposite appears to be true. The state mandate in California is significantly predictive of net mitigation spending, and weakly predictive of gross spending.

However most of the existing research on state influence investigates **H8**: whether or not subtler signals – like state climate plans, targets, and policies – have an effect on municipal mitigation. The answer appears to be that mostly, they do not. The number of state mitigation policies are weakly significant in both models, but the other forms of state-level influence – the development of a state climate plan and state target – are insignificant in both models.

Table 16 summarizes the findings thus far.

Table 16: Hypotheses and Degrees of Support for Incorporated Places

Hypothesis		Supported by Model?	
		#1	#2
Climate Risk	*[H2]: Climate risk predicts municipal mitigative action.*	No	No
Internal Determinants	*[H3]: Political support predicts municipal mitigative action.*	No	No
	[H4]: Municipal financial capacity predicts mitigative action.	No	No
	[H5]: Municipal institutional capacity predicts mitigative action.	Yes	Yes
Excludable Benefits	*[H6]: Excludable benefits predict municipal mitigative action.*	No	No
Influence from Above	*[H7]: State mandates predict municipal mitigative action.*	No	No
	[H8]: State mitigation policies predict municipal mitigative action.	No	No

DESCRIPTIVE STATISTICS: COUNTIES

My study also examines mitigation by US counties – an important (and almost entirely unstudied) form of local government. Tables 17 and 18 present generalizable descriptive statistics for the 1607 counties with populations greater than 25,000 in 2012.

Table 17: Descriptive Statistics for Dichotomous Variables

	Observations	Mean	Standard Deviation	% 0 (No)	% 1 (Yes)
networkmem	502	.038	.191	96.2%	3.8%
muniplana	271	.055	.229	94.5%	5.5%
muniplanb	271	.196	.397	80.4%	19.6%
coastvuln	502	.273	.446	72.7%	27.3%
colltown	502	.020	.140	98.0%	2.0%
muniutil	282	.018	.132	98.2%	1.8%
cleanair	502	.249	.433	75.1%	24.9%
stmandate	502	.022	.147	97.8%	2.2%
dillons	502	.749	.434	25.1%	74.9%
stplan	502	.647	.478	35.3%	64.7%
sttarget	502	.321	.467	67.9%	32.1%

Table 18: Descriptive Statistics for Non-Dichotomous Variables

	Observations	Mean	Standard Deviation	Min	Max
netspent	262	482.14	1479.83	-3250	11029.17
tota	284	5.09	4.02	0	19
totb	284	9.08	5.34	0	24
hazardcost	502	300799.4	2352743	38	35100000
hazardcasualties	502	39.41	253.85	0	5277
libvoting	502	.439	.129	.115	.873
polsupport	284	3.36	1.01	1	5
carbemploy	502	.268	.113	.063	.766
medincome	502	48.98	12.09	24.19	101.11
munirevenue	501	173893.3	782828.1	337	15800000
pop	502	173.06	540.70	25.08	9962.79
educ	502	.223	.092	.082	.605
staff	281	28.89	100.99	0	906
transit	502	.315	.113	.062	.609
stpolicies	502	15.62	4.38	6	25
regpref	275	.118	.160	0	.667
estcost	273	847.28	2166.35	0	20000
estsavings	266	180.20	553.96	0	5000
revenue	270	206.80	1024.07	0	15000
money	266	389.31	1312.90	0	17000
govfund	266	188.94	1010.46	0	15000

Climate network membership is much less common among counties than it is among incorporated places. Only 3.8% of the counties in my sample – that is, 19 – are network members, whereas 35% of incorporated places have joined the ICLEI, USMCPA, or Cool Cities climate networks. Counties with climate plans are just as rare – only 5.5% (or 15 of the counties I surveyed) reported they had one. Only a few counties are considered college towns, and still fewer report having municipal electric utilities. 2.2% of the counties in my sample are located in California, and therefore covered by its mitigation mandate.

Table 18 shows that counties spend, on average, $847,000 per year on mitigation – a little less than the average of $1,078,000 spent by incorporated places. However their net expenditures are nearly double: $482,000, as compared with $272,000 for incorporated places. Partly it's because what they spend returns less in savings: 21 cents on the dollar, whereas incorporated places save 33 cents on the dollar from their mitigation spending. And partly it's because counties earn less revenue from their

Table 19: Descriptive Financial Statistics for Counties

	Population Subset	Observations	Mean	Standard Deviation	Min	Max
estcost	None	273	847.28	2166.35	0	20000
	25K – 50K	79	196.40	618.19	0	5000
	50K – 100K	68	637.85	1609.39	0	10000
	100K+	126	1368.40	2831.96	0	20000
estsavings	None	266	180.20	553.96	0	5000
	25K – 50K	77	41.00	183.03	0	1500
	50K – 100K	67	68.05	248.98	0	2000
	100K+	122	329.65	758.56	0	5000
revenue	None	270	206.80	1024.07	0	15000
	25K – 50K	78	29.69	90.21	0	500
	50K – 100K	68	81.87	187.99	0	1000
	100K+	124	386.72	1485.95	0	15000
money	None	266	389.31	1312.90	0	17000
	25K – 50K	76	69.58	247.86	0	2000
	50K – 100K	67	150.70	400.17	0	3000
	100K+	123	716.84	1848.41	0	17000
govfund	None	266	188.94	1010.46	0	15000
	25K – 50K	76	28.75	88.57	0	500
	50K – 100K	67	69.91	157.42	0	750
	100K+	123	352.75	1465.87	0	15000
netspent	None	262	482.14	1479.83	-3250	11029.17
	25K – 50K	75	118.50	606.83	-1750	4475
	50K – 100K	66	505.33	1446.02	-278.7	9953
	100K+	121	694.89	1809.63	-3250	11029.17

Financial data in thousands of dollars, from the last fiscal year.

mitigation: an average of $207,000, instead of the $452,000 that incorporated places receive. Gross spending on mitigation by counties is about half a percent of their annual own-source revenue (0.487%), while net spending is, again, about double that of incorporated places (0.277% for counties, versus 0.128%).

This money is being spent on fewer policies (an average of 5.09, instead of 8.48) administered by more staff (28.89 on average – though again, there's a long-tailed distribution). And there's even less appetite for *regulatory* policies among counties: whereas the average ratio for incorporated places was .2322, it's .1176 for counties – less than half. This may reflect the differing authorities and responsibilities of cities and counties, but it may also reflect the political landscape faced by the counties in my sample. Instead of the primarily Democratic territory represented by incorporated places (53.7% Obama voters, on average), the counties in my sample are primarily Republican territory (43.92% Obama voters, on average). Support for mitigation among elected leaders is weaker (3.36 on a 1-5 scale) and carbon

Table 20: Per Capita Financial Statistics for Counties

	Population Subset	Observations	Mean	Standard Deviation	Min	Max
estcost	None	273	5.64	13.81	0	116.21
	25K – 50K	79	5.03	14.77	0	116.21
	50K – 100K	68	9.00	20.86	0	116.00
	100K+	126	4.20	6.07	0	30.97
estsavings	None	266	1.10	3.90	0	35.57
	25K – 50K	77	1.00	4.23	0	33.17
	50K – 100K	67	.96	3.59	0	29.00
	100K+	122	1.25	3.87	0	35.57
revenue	None	270	.90	2.18	0	14.50
	25K – 50K	78	.75	2.19	0	11.62
	50K – 100K	68	1.19	2.84	0	14.50
	100K+	124	.83	1.70	0	10.39
money	None	266	2.00	5.29	0	44.23
	25K – 50K	76	1.73	5.68	0	44.23
	50K – 100K	67	2.17	5.86	0	43.50
	100K+	123	2.08	4.71	0	42.68
govfund	None	266	.81	1.96	0	11.62
	25K – 50K	76	.73	2.15	0	11.62
	50K – 100K	67	1.02	2.36	0	10.87
	100K+	123	.74	1.56	0	8.66
netspent	None	262	3.73	12.60	-38.70	104.74
	25K – 50K	75	3.11	14.39	-38.70	104.01
	50K – 100K	66	7.10	17.99	-4.43	104.74
	100K+	121	2.28	5.81	-23.12	29.29

Financial data in dollars per capita, from the last fiscal year.

employment is higher (26.8%). So to whatever extent mitigation is influenced by politics, we should expect less of it among US counties.

Tables 19-22 break out the financial statistics for counties in greater depth. In Table 19 we see that there is a consistent ranked order for each financial variable, on the basis of population: as population increases, the average for each variable does as well. Since these averages generalize to the 1607 counties with populations greater than 25,000, we can calculate that gross mitigation spending by these counties is $1.36 billion annually, of which about $775 million is net spending. This is nearly 50% more than the $521 million in net mitigation spending by incorporated places.

However counties spend less per person than do incorporated places. Table 20 reveals that the average per-person spending on mitigation is $5.64 – less than half what incorporated places spend on a per capita basis. However the spending by counties with populations between 50,000 and 100,000 is notably higher, which leads to levels of net spending that are twice as high as smaller and larger counties. This propensity for mid-size counties to have higher net mitigation spending resembles that found in Table 12 for cities and incorporated places within the same population bracket. The reason appears to differ – excessive mitigation spending by these counties, instead of the relative lack of revenue for comparable incorporated places – but the net spending by this population bracket may be worth further investigation.

Mid-size counties can narrow this disparity by focusing their mitigation spending in areas that yield greater financial savings. The largest counties save an average of 29.8 cents from every dollar they spend on mitigation, and the smallest save 19.9 cents from every dollar. Mid-size counties save much less: a mere 10.7 cents for every dollar spent on mitigation.

Now that we have spending data for both counties and incorporated places, let's put it in context. A brief by the Climate Policy Initiative calculates that in fiscal year 2010, federal government "spending to reduce emissions which contribute to climate change was $38 billion, less than 2% of federal spending, including $21 billion in public investments and $17 billion in incentives. Almost $13 billion of this is temporary spending associated with the Recovery Act" (Varadarajan and Zuckerman, 2012, p. ii).

Federal spending on mitigation is likely to be inconsistent, given its political contentiousness and the nature of federal appropriations. However if we take the non-American Recovery and Reinvestment Act spending of $25 billion as a crude baseline, and divide it by the US population in 2010 (309.33 million) that yields average federal mitigation spending of $80.82 per person. In 2010, US local governments spent, in aggregate, 47.84 cents for every dollar spent on the federal level.[78] So if spending by counties and incorporated places were proportional to these federal and local spending levels, we'd expect to see per-person average spending of $38.66 on mitigation. We don't – the combined mean for counties and incorporated places is $17.35, which is a little less than 45%. But why should we expect local spending on a global challenge to approximate federal spending? The surprise is that local mitigation spending is

[78] Data from http://www.usgovernmentspending.com/year2010_0.html.

as high as it is – an estimated $3.42 billion per year for counties and incorporated places with populations greater than 25,000.

Table 21 presents county mitigation spending in per-policy terms. This reveals that the average mitigation policy costs $132,000 annually to administer, of which only 36.8% is recouped via savings and state and federal funding, on average. The majority of this spending – $86,000 per policy – is net, out-of-pocket spending by county governments. Again, gross and net spending by counties in the middle bracket, with populations between 50,000 and 100,000, exceeds the spending by larger and smaller-sized counties.

Finally, in Table 22, we can see that the money counties receive from their mitigation – from cost-savings and revenue combined – is nearly equal on a per-person, per-policy basis. But because mid-size counties spend so much more on mitigation, their net expenditures are 87.3% of their gross expenditures,

Table 21: Per Policy Financial Statistics for Counties

	Population Subset	Observations	Mean	Standard Deviation	Min	Max
estcost	None	246	132.19	271.87	0	2500
	25K – 50K	72	55.47	160.74	0	1250
	50K – 100K	57	168.77	404.95	0	2500
	100K+	117	161.57	236.55	0	1450
estsavings	None	242	25.14	69.31	0	625
	25K – 50K	71	9.46	37.76	0	300
	50K – 100K	56	11.92	26.63	0	181.82
	100K+	115	41.26	91.86	0	625
revenue	None	246	23.16	65.80	0	789.47
	25K – 50K	72	7.66	21.63	0	125
	50K – 100K	57	18.15	38.02	0	191.67
	100K+	117	35.14	88.62	0	789.47
money	None	242	48.61	107.38	0	894.74
	25K – 50K	70	17.32	52.36	0	400
	50K – 100K	56	30.26	56.97	0	272.73
	100K+	116	76.34	139.39	0	894.74
govfund	None	242	20.76	63.97	0	789.47
	25K – 50K	70	7.46	21.47	0	125
	50K – 100K	56	15.58	33.16	0	142.31
	100K+	116	31.29	86.84	0	789.47
netspent	None	238	85.91	252.81	-406.25	2485
	25K – 50K	69	38.13	157.80	-350	1118.75
	50K – 100K	55	144.06	407.41	-50	2485
	100K+	114	86.77	191.59	-406.25	1102.92

Financial data in thousands of dollars per policy, from the last fiscal year.

Table 22: Per Capita, Per Policy Financial Statistics for Counties						
	Population Subset	**Observations**	**Mean**	**Standard Deviation**	**Min**	**Max**
estcost	None	246	1.32	4.16	0	47.21
	25K – 50K	72	1.41	3.82	0	29.05
	50K – 100K	57	2.67	7.25	0	47.21
	100K+	117	.61	.92	0	6.51
estsavings	None	242	.19	.61	0	6.63
	25K – 50K	71	.23	.87	0	6.63
	50K – 100K	56	.17	.38	0	2.64
	100K+	115	.17	.50	0	4.45
revenue	None	246	.17	.42	0	3.17
	25K – 50K	72	.19	.53	0	2.91
	50K – 100K	57	.26	.56	0	3.17
	100K+	117	.10	.17	0	.89
money	None	242	.35	.86	0	8.85
	25K – 50K	70	.43	1.20	0	8.85
	50K – 100K	56	.43	.83	0	3.95
	100K+	116	.27	.60	0	5.34
govfund	None	242	.15	.38	0	2.91
	25K – 50K	70	.19	.53	0	2.91
	50K – 100K	56	.22	.47	0	2.35
	100K+	116	.09	.15	0	.87
netspent	None	238	.99	4.15	-7.74	46.93
	25K – 50K	69	.98	3.74	-7.74	26.00
	50K – 100K	55	2.33	7.32	-0.77	46.93
	100K+	114	.35	.92	-2.89	5.90
Financial data in dollars per capita, per policy, from the last fiscal year.						

controlling for population and the number of policies they have. This compares with 69.5% for smaller counties, and an average of 57.4% for the largest. Overall, counties spend $1.32 per person, per policy, on their mitigation activities – nearly as much as incorporated places do ($1.57). And they spend more out of pocket – 99 cents instead of the 71 cents of per person, per policy net expenditures by incorporated places.

These expenditures again beg the important question: why bother? Why are counties spending anything to address the global problem of climate change?

STATISTICAL MODELS: COUNTIES

As with incorporated places, Table 23 presents two models of municipal mitigation; again, the `netspent` model is the primary model of explanatory interest. However two variables are shaded, to remind the reader that their estimates are based on a very small number of observations, and therefore likely

unreliable. I employ the same variable transformations for counties, because I again assume that population – that is, size – yields fiscal economies of scale. Both models are reported using robust standard errors, as the Breusch-Pagan and Cook-Weisberg test indicated heteroskedasticity in these models. The variance inflation factor test did report numbers in Models 7 and 8 for `pop`, pop^2, and `munirevenue` that exceed the recommended threshold. None of these variables are dropped because they remain of theoretical interest, but their findings should be qualified accordingly. Sensitivity analyses for the primary model – Model 7 – are presented in Appendix 4. Models which test each motivation individually for each of the dependent variables are presented in Appendix 6.

STATISTICAL RESULTS: COUNTIES

Since there's so little research on mitigation by counties (Bedworth and Hanak, 2013, and Tang, et al, 2012, are the notable exceptions) everything in Table 23 is new – not just the first three models, as with incorporated places. Even qualitative research is lacking – which means it wasn't there to guide quantitative model development. As a result, I applied the same quantitative models to counties that I applied to cities – even though some variables are an awkward fit. Given all this, it's not surprising to find lower values for adjusted r-squared: models designed for cities aren't designed for counties. The important question is: what variables *should* be in these models, but aren't?[79]

Climate Risk

Climate risk was broadly insignificant for incorporated places; that remains true for counties, although casualties from hazard events are weakly (and negatively) significant for both of the models.

Internal Determinants

According to **H3**, mitigation is a function of the political environment. The two variables that capture this environment – democratic voting and employment levels in carbon-intensive industries – are largely insignificant (though `libvoting` is weakly predictive of net mitigation expenditures).

Financial capacity predicts mitigation, according to **H4**, but neither median household income nor own-source revenue supported this hypothesis for incorporated places. However, counties differ: own-source revenue *is* statistically significant – and strongly so – for both models. This may reflect the fact that counties pay a higher percentage of their mitigation expenditures from their own pockets, as the descriptive data indicates, and receive a lower percentage of their expenditures from government funding. Since counties are paying more of their own mitigation expenditures, their financial capacity is more relevant and influential.

[79] For instance: the geographic size of a county likely hinders its ability to engage in certain environmental programs (like curbside recycling) to a greater degree than for a city, because city boundaries more closely follow densely-populated areas.

Table 23: Explanatory Models for Mitigation By Counties			
		Model 3	**Model 4**
About the Model	**Dependent Variable**	netspent	estcost
	Statistical Method	OLS	OLS
	Adjusted R^2	.1729	.5005
	Observations	262	273
	Units	$ (in 1000s)	$ (in 1000s)
	Constant	-292.57	-442.82
Climate Risk	**coastvuln**	112.89 *(197.32)*	108.80 *(227.14)*
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*
	hazardcasualties	-0.25* *(0.14)*	-0.40* *(0.21)*
Internal Determinants	**libvoting**	-859.19* *(834.87)*	-802.54 *(868.30)*
	carbemploy	574.87 *(798.75)*	300.55 *(846.38)*
	medincome	15.94 *(13.08)*	28.81* *(15.07)*
	munirevenue	0.00*** *(0.00)*	0.00*** *(0.00)*
	pop	0.48 *(0.49)*	0.07 *(0.65)*
	pop (squared)	-0.00** *(0.00)*	-0.00* *(0.00)*
	educ	112.77 *(1394.17)*	19.60 *(1688.78)*
	colltown	134.81 *(277.63)*	-44.75 *(371.41)*
Exclud-able Benefits	**cleanair**	333.81 *(249.95)*	193.77 *(290.78)*
	transit	-1055.50 *(781.95)*	-1559.31* *(857.34)*
Influence From Above	**stmandate**	2213.40 *(1582.41)*	3144.60* *(1641.70)*
	dillons	-10.23 *(162.15)*	-27.23 *(182.24)*
	stplan	533.29** *(258.51)*	639.24** *(295.44)*
	sttarget	-94.19 *(179.81)*	2.42 *(209.62)*
	stpolicies	-19.47 *(23.22)*	-33.20 *(27.54)*
***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*			

H5 suggests that institutional capacity predicts mitigation, and this hypothesis was supported for incorporated places. Again, however, counties differ, as the institutional capacity variables are broadly insignificant.

Excludable Benefits

As in Table 15, two excludable benefits are tested – cleanair and transit – neither one of which is statistically significant. However transit – the proportion of workers in a municipality who drive to work and have travel times of 30 minutes or longer – is weakly significant, and negative. This may suggest that congestion and long commutes actually serve to dissuade counties from pursuing mitigation.

Influence from Above

Although state mitigation targets and policies are insignificant in both models, the existence of a state climate plan is statistically significant in both. And this influence is positive, supporting the "snowball effect" hypothesized by Shipan and Volden (2006).

Table 24 summarizes these findings.

Table 24: Hypotheses and Degrees of Support for Counties

Hypothesis		Supported by Model?	
		#3	#4
Climate Risk	*[H2]: Climate risk predicts municipal mitigative action.*	No	No
Internal Determinants	*[H3]: Political support predicts municipal mitigative action.*	No	No
	[H4]: Municipal financial capacity predicts mitigative action.	Yes	Yes
	[H5]: Municipal institutional capacity predicts mitigative action.	No	No
Excludable Benefits	*[H6]: Excludable benefits predict municipal mitigative action.*	No	No
Influence from Above	*[H7]: State mandates predict municipal mitigative action.*	N/A	N/A
	[H8]: State mitigation policies predict municipal mitigative action.	Yes	Yes

C. Conclusion

Increasing numbers of local governments have been mitigating their greenhouse gas emissions since the early 1990s. And for nearly as long, researchers have tried to understand why. Because it's a paradox: it makes no sense, within a rational choice framework, for local governments to do so. Even massive cities like New York and Los Angeles emit a vanishingly small percentage of global emissions, so their mitigation won't impede climate change globally – or even locally. And even if it did, cities that mitigate

would bear all the costs of their mitigation, while reaping only a tiny fraction of the global benefits. So why bother?

Four theories have emerged within the rational choice literature to explain all this seemingly-irrational behavior: *climate risk*, *internal determinants*, *excludable benefits*, and *influence from above*. In this chapter, I've added to the existing literature in the following ways:

- **The sample**: My study is the first to use a randomized sampling procedure. This avoids the bias of selecting on the dependent variable, and the cost of sampling an entire population – as most existing studies do. It's also the first detailed study of mitigation by US counties – an important form of local government. Finally, it samples cities with populations as low as 25,000. Little is known about this population, because cities with populations below 50,000 are virtually unstudied. In all, my findings generalize to the 1607 counties and 1913 "incorporated places" with populations greater than 25,000 in 2012.
- **The measures**: Nearly every existing study uses a single measure to explain municipal mitigation. I present results from two entirely new measures: the first to reflect the key element in any effort to understand mitigation within a rational choice framework – *cost*.
- **The methods**: Nearly all the existing studies test a single potential motive. I test all four simultaneously, which reduces omitted variable bias and yields models that better fit the data. More importantly, this allows for the possibility that multiple motivations are at work.

Moving forward, the results from this chapter suggest the following:

- **Counties deserve further research**. This study indicates they're a major source of local mitigation: collectively they spend $1.36 billion on it annually, and they spend more than incorporated places do, on a net basis. Future research should better identify the factors that influence this mitigation, enabling better model development, and a deeper understanding of how the distinctive authorities and responsibilities of counties influence their mitigation.
- **The distribution of local mitigation and its costs deserve further research**. Bulkeley (2010, p. 245) foresees "a divide opening up between those cities that can deploy resources to act on climate change ahead of the pack, creating a positive spiral of reward and (economic) gain, and those who can not." Dierwechter and Wessells (2013, p. 1382) find "the uneven localisation of climate action across metropolitan regions can be as much about ability to pay, as willingness to pay" and stress "the troubling equity implications of disbursing state and federally funded climate-related grants to those municipalities which are best poised and resourced to compete for them." A similar concern may arise within cities,[80] depending on how the responsibilities, benefits, and consequences of mitigation are distributed across existing patterns of uneven social and economic development (Bulkeley,

[80] Since the communities most at risk from climate change are often those least empowered to translate their concerns into policy (Burch and Robinson, 2007).

2010). Better understanding these distributional consequences would better allow policymakers to mitigate emissions without exacerbating financial and resource inequity.

- **Net spending is the greatest for governments with populations between 50,000 and 100,000**. Both cities and counties within this bracket spend more than smaller and larger governments, a pattern that also deserves further research.
- **Regulation is rare**. On average, cities and incorporated places adopt only 23.2% of the regulatory policies within their authority, and counties adopt even less: 11.8%. Yet Ramaswami (2013, p. 222) finds that regulatory policies are vastly more effective in yielding mitigation: "orders of magnitude differences." This means the untapped potential of local mitigation is massive, and future research should better identify local regulations and their specific barriers and drivers.
- **Mitigation isn't always costly.** Governments report costs that vary widely – some spend a great deal, but others generate income. In his study of local governments in California, Wang (2013, p. 603) finds evidence for a cost-based hierarchy of mitigative action: "The fact that cities adopting less commonly taken actions were more prone to adopt the ones more commonly adopted suggests that the variation in local choice of climate policies is not just because of randomness or heterogeneous preference. Instead, it suggests the incremental levels of effort or cost-benefit ratios associated with different actions." [81] Better understanding the cost of local mitigation is the key to understanding it within a rational choice framework.

[81] He continues: "For instance, mitigating climate impact of individual projects is perhaps easier to adopt than establishing formal mitigation policies/programs because the former can easily fit into the existing regulatory framework (CEQA). Individual mitigation policies/programs may in general be less resource demanding than conducting a systematic inventory and setting a formal emission target. Similarly, at the project level, the incremental adoption of different CEQA mitigation measures also seems to reflect the net costs of mitigation measures/strategies. For example, while reducing GHG emissions, the efficiency measures also save energy and resource consumption, which provides a direct financial incentive, termed as "win-win measures" by Bulkeley and Betsill (2003) and "(measures) producing immediate results" by Bassett and Shandas (2010). In fact, such measures may even be implemented simply for the cost-saving purpose, independent of the motivation to mitigate climate change. On the other hand, sequestration measures are less attractive because they require direct expenses, although there may be environmental and social co-benefits from planting trees. Purchasing offsets is understandably the least favorable because it increases costs without any tangible local benefits" (Wang 2013, p. 603).

CHAPTER 3: CLIMATE NETWORKS

A. Literature Review & Hypotheses

In this final chapter, I examine whether membership in one of three US municipal climate networks predicts the mitigation funding municipalities receive from the state or federal government. Before deriving this hypothesis, however, I first examine three US climate networks in detail – the Cities for Climate Protection campaign (now a part of ICLEI – Local Governments for Sustainability); the US Mayors Climate Protection Agreement (USMCPA); and the Sierra Club's Cool Cities Campaign. I then examine the extent to which these networks embody the characteristics of a network, as defined within the academic literature.

Table 25: US Climate Networks

Climate Network	Geographic Reach	Membership	Members
ICLEI/Cities for Climate Protection	International	Cities and Counties	600+
US Mayors Climate Protection Agreement (USMCPA)	USA	Cities	1060+
Cool Cities	USA & Canada	Cities and Counties	1000+

CITIES FOR CLIMATE PROTECTION / ICLEI

In 1990, the International Council for Local Environmental Initiatives (ICLEI) – now known as "ICLEI – Local Governments for Sustainability" – was founded by the International Union of Local Authorities and the United Nations Environment Programme. Its goal was to "establish an active and committed municipal membership ... that promotes environmental and sustainable development initiatives within the framework of decentralised cooperation" (Betsill and Bulkeley, 2004, p. 477). Following a successful pilot with fourteen local authorities from Europe and North America, ICLEI established the Cities for Climate Protection (CCP) Campaign in 1993 (Betsill and Bulkeley, 2004). CCP's original aim was to induce a large number of local governments – enough to account for 10% of global greenhouse gas emissions – to formally declare their intention to "address" the threat of climate change (Betsill and Bulkeley, 2004, p. 477). However its aims became more specific and detailed as the campaign matured. By 2001, joining the CCP campaign meant formally agreeing to pass through five milestones: conducting a baseline emissions inventory and forecast; choosing a reductions target; developing a 'local action plan' to achieve that target; implementing the plan; and monitoring and verifying the results (Betsill, 2001).

Its organizational structure also changed over time. Initially the CCP campaign was coordinated centrally – from ICLEI's international headquarters in Toronto – but by 2002 ICLEI had decentralized CCP's campaign operations. National efforts were established in Australia, Canada, Finland, India, Italy, Mexico, the Philippines, South Africa, the UK, and the US; regional campaigns were established in Europe, Asia, and Latin America (Betsill and Bulkeley, 2004). Many of these – particularly the successful

European campaign – remain as decentralized efforts, but the US CCP campaign has now been merged with ICLEI USA.[82]

US MAYORS' CLIMATE PROTECTION AGREEMENT (USMCPA)

The US Mayors Climate Protection Agreement (USMCPA) was unveiled in mid-February, 2005, by former Seattle Mayor Greg Nichols and the city's sustainability department. This was symbolic timing: the Kyoto Protocol, an agreement to limit greenhouse gas emissions which the United States had failed to ratify, entered into force on February 16 of 2005. But Nichols announced the support of nine mayors in February, and by the annual meeting of the US Conference of Mayors in June, "141 mayors had signed the Agreement – the same number of nations that ratified the Kyoto Protocol" (US Conference of Mayors, n.d.). The network is coordinated by the US Conference of Mayors.

By signing the USMCPA, mayors pledge to (a) "strive to meet or beat the Kyoto Protocol targets in their own communities;" (b) "urge their state governments, and the federal government…to meet or beat" the 7% emissions reduction target from the Kyoto Protocol; and (c) "Urge the US Congress to…establish a national emission trading system" (US Conference of Mayors, n.d.).

COOL CITIES

The Cool Cities Campaign, a project of the Sierra Club, also began in 2005; in fact it was partly inspired by the USMCPA (Brand and Bell, 2006). Signing the USMCPA is the first step in its four-step program for cities – either that, or joining the CCP instead. The steps themselves are modeled explicitly on the five-step benchmarking process employed by the CCP[83] - taking the pledge,[84] conducting an emissions inventory; creating a solutions plan, and implementing and monitoring progress (Brand and Bell, 2006).

Unlike both the USMCPA and the CCP, however, teams of Cool Cities volunteers and advocates organize to build political pressure, and to urge cities to make and keep climate-related commitments. These advocates are often Sierra Club members and volunteers, but they don't have to be.[85] The Sierra Club, however, provides support and loose coordination for their advocacy efforts via a central website (www.coolcities.us, which is not currently operational) and several regional staff. It describes the strategy for the campaign this way:

> The Cool Cities strategy is to use the U.S. Mayors Climate Protection Agreement to achieve two important goals: 1). Get cities (and eventually states and the federal government) to take action with smart energy solutions that reduce global

[82] In a personal email dated July 3rd, 2014, Eli Yewdall, Senior Program Officer, ICLEI-Local Governments for Sustainability USA, writes that "CCP has not been an active campaign for a number of years…ICLEI membership has replaced CCP." The CCP campaign was originally founded as an ICLEI project, and has always been managed by ICLEI.

[83] "Getting your city to become part of the fight against global warming is as simple as the four steps outlined below. These steps are modeled on the Cities for Climate Protection program, a successful initiative run by the International Council for Local Environmental Initiatives (ICLEI) to help cities reduce global warming pollution" (Brand and Bell, 2006).

[84] The pledge need not require joining the USMCPA or the CCP, though these are preferred (Brand and Bell, 2006).

[85] "The members of Cool Cities teams do not have to be Sierra Club members. The relationships between the Sierra Club and the Cool Cities teams evolved over time since the Sierra Club initially started forming them in 2005 to urge cities to combat climate change. Some teams and groups of volunteers no longer exist and some new ones have formed." See http://lomaprieta.sierraclub.org/cool_cities/teams (accessed May 15, 2015).

warming emissions, and 2) Energize, support and build local volunteer activism and influence, both inside and outside the Sierra Club.

Accordingly, each local Cool Cities campaign has two major overlapping goals, one environmental and the other organizational.

On the environmental side, your primary goal is to have your city implement meaningful smart energy solutions (cleaner vehicles, energy efficiency and renewables) which result in measurable reductions of global warming pollution.

Successful local Cool City campaigns build public demand for clean energy solutions and turn mayors and other local officials into clean energy advocates. As more cities in your state sign the Mayors' agreement, public support for statewide action (e.g. climate protection plan, renewable portfolio, clean car, and appliance efficiency standards, etc…) will increase. And as more states move forward, the federal government will be forced to act more responsibly to curb global warming.

The organizational goal for your local Cool City campaign is as important as conservation victories: Attract, engage and empower more local long-term volunteer activists and form stronger partnerships across your community.

By establishing and deepening a positive working relationship with your mayor and local government, and through coalition work with traditional and non-traditional partner organizations (environmental, labor, faith, business), your local Cool Cities campaign will build power and influence for your group. In this way, you will increase your capacity to tackle larger conservation and organizational goals in the future. (Sierra Club, 2006, p.5)

US CLIMATE NETWORKS

These three climate networks are the subject of this chapter's analysis (see Table 25). As of December 2010, more than 600 US municipalities were members of the CCP and more than 1000 mayors had signed the USMCPA – or approximately 5% of all US municipalities, covering nearly 30% of the population (Krause, 2011a). Other climate networks exist internationally – like the Climate Alliance and Energie-Cités – but they lack US members (Kern and Bulkeley, 2009).

NETWORKS? OR GREEN CLUBS?

Throughout this dissertation, I've referred to the CCP, ICLEI, the USMCPA and Cool Cities as 'climate networks.' In so doing, I've followed the lead of the literature,[86] but these "networks" fit academic definitions of a network to varying degrees. In this section I re-examine the extent to which the 'network' label is applicable, and consider an alternate terminology: "green clubs."

In the policy literature, the "network" term can refer to a policy network: a new governing structure that's often contrasted with, "on the one hand, vertically organized hierarchical forms and, on the other hand, horizontally organized market structures" (Adam and Kriesi, 2007, p. 130). Policy networks are characterized by "horizontal, self-organizing coordination between private and public actors who are involved in joint negotiating and problem solving" around particular policy areas (Adam and Kriesi, 2007, p. 130). This is considered a reflection of the "increasing scope, sectoralization, decentralization, fragmentation, informatization (increasing importance of information), and transnationalization of policy making" and the "blurring of boundaries between the public and the private spheres," meaning that "the actors who are formally responsible for political decisions, in fact, are not the only or even the most

[86] See, e.g., Betsill and Bulkeley, 2006; Bulkeley, 2010; Bulkeley and Kern, 2006; Davies, 2005; Dierwechter and Wessells, 2013; Kern and Alber, 2008; Kern and Bulkeley, 2009; Krause, 2011a; Krause, 2011b; Krause, 2011c; Krause, 2012; Krause, et al, 2015; Lindseth, 2004; Osofsky and Levit, 2008; Pitt and Randolph, 2009; Pitt, 2010a; Reams, et al, 2012; and Toly, 2008. Betsill and Bulkeley (2004) present a detailed argument in favor of the term.

influential decision makers in the process of policy formation and implementation" (Adam and Kriesi, 2007, p. 131-132).

However Kern and Bulkeley (2009) define the CCP, Climate Alliance and Energie-Cités as "transnational municipal networks," or TMNs:

> TMNs have three defining characteristics. First, member cities are autonomous and free to join or leave. Second, because they appear to be non-hierarchical, horizontal and polycentric, such networks are often characterized as a form of self-governance. Third, decisions taken within the network are directly implemented by its members. In this respect TMNs differ considerably from traditional associations or transnational NGOs which concentrate on lobbying and mobilization. (Kern and Bulkeley, 2009, p. 309-310)

In so doing, they argue that a policy network approach "provides an inadequate framework for analysing the nature, role and impact of TMNs" for three reasons:

> First, whereas TMNs are comprised of municipalities and a secretariat, policy networks usually consist of a heterogeneous mix of actors (Pattberg, 2007; Khagram and Ali, 2008). Second, in the main, policy networks are considered to be linked by resource interdependencies; while resources certainly provide some of the glue which holds TMNs together, network relations are characterized more by cognitive than bargaining processes (Börzel, 1998). Finally, in the literature on policy networks there is some confusion as to what networks actually do, with emphasis usually placed on trying to influence the behaviour of a (single) central state actor, whereas TMNs undertake a variety of governing activities, including forms of self-governing and external influence. (Kern and Bulkeley, 2009, p. 313-314)

The "heterogeneous mix of actors" in a policy network related to local climate change might include chambers of commerce, university faculty, advocacy organizations, and others. But even a policy network limited strictly to municipalities would be different from the CCP, USMCPA, and other networks, because many governments are working to mitigate their emissions without formally joining one of these networks.

This formal delineation – between those governments inside a climate network and those outside – is another important difference. There is no such objective delineation for a policy network, nor is there any process to join and become a "member." Policy networks are described as "self-organizing" yet, within the US, ICLEI has merged the CCP into the rest of its national operations. In contrast, ICLEI has not merged the actual policy network – the climate-related relationships between and within local governments – into its operations. This illustrates that the CCP – and other "climate networks" – cannot accurately be defined as policy networks.

Kern and Bulkeley add that:

> Other network concepts, which have been employed in the analysis of the governance of global environmental issues, also seem inadequate for the task of assessing TMNs (Betsill and Bulkeley, 2004) because the latter cannot be labeled as transnational advocacy coalitions (Keck and Sikkink, 1998) or expert epistemic communities (Haas et al., 1993). (Kern and Bulkeley, 2009, p. 313-314)

For both epistemic communities and transnational advocacy coalitions, "the focus remains on the nation-state as the location of governance, and the significance of non-state actors is measured in terms of the extent to which they shape, facilitate, and change the behavior of nation-states within international regimes" (Betsill and Bulkeley, 2004, p. 475-476). TMNs often do act in ways that influence their nation-state; the USMCPA, for example, was instrumental in getting the US Government to develop the Energy Efficiency and Conservation Block Grant program, which supports energy-efficiency projects at the city, county, and state level with federal funding (US Conference of Mayors, n.d.). However TMNs operate primarily as a vehicle of self-governance; municipal members act mainly to reduce their own greenhouse gas emissions.

But referring to climate networks as TMNs has problems as well. As with the "climate network" term, it's unclear how the TMN terminology relates back to the existing network literature. And while the CCP, Climate Alliance, and Energie-Cités are all "transnational," the term imperfectly fits networks – like the USMCPA, and the US branch of CCP/ICLEI – within a single national context.

Alternately, a "network" can refer to a form of organization:

> We define a network form of organization as any collection of actors (N> 2) that pursue repeated, enduring exchange relations with one another and, at the same time, lack a legitimate organizational authority to arbitrate and resolve disputes that may arise during the exchange. (Podolny and Page, 1998, p. 59)

In this context, networks are again contrasted with horizontal markets – where exchange relations are episodic – and vertical hierarchies, where relationships last longer but a legitimate authority exists to arbitrate disputes (Podolny and Page, 1998, p. 59). Organizational networks provide many of the same benefits as policy networks: they "foster learning, represent a mechanism for the attainment of status or legitimacy, provide a variety of economic benefits, facilitate the management of resource dependencies, and provide considerable autonomy for employees" (Podolny and Page, 1998, p. 57). Climate networks can also be thought of as networks of individuals – and the role and placement of these individuals within their local government can have important ramifications for the success of climate networks (Betsill and Bulkeley, 2004). But climate networks are defined – both internally, and within the existing literature – as networks of municipalities and governments, rather than individuals. Moreover, it's unclear that "a legitimate organizational authority" *is* lacking. While each network is considerably less hierarchical than the operations of any one of its local governments, they are not truly decentralized: the terms of membership and network operations are coordinated, in each case, by a central authority.[87]

"Green clubs" offer another alternative terminology. According to Potoski and Prakash (2005):

> Clubs promulgate standards of conduct targeted to produce public benefits by changing members' behaviors. In return, club members receive excludable and nonrivalrous (club) benefits, such as affiliation with the club's positive "brand name." Successful clubs induce members to voluntarily undertake progressive environmental action beyond what they would have taken unilaterally. This is because the costs of joining the club and adhering to its standards are offset by the tangible and/or intangible benefits accruing to firms via the clubs' positive brand reputation. (Potoski and Prakash, 2005, p. 235)

The example they cite – ISO 14001 – certifies the environmental management systems of industrial and commercial businesses. However the concept isn't limited to a market context, and the reputational benefits Potoski and Prakash describe are similar to those provided by climate networks.

> Credible clubs provide valuable information about members' progressive environmental activities because so much of firms' environmental activities are unobservable to most external audiences (though different audiences may have different information about firms' performance). Affiliation with the club reputation is thus akin to building organizational reputations: their value is in how they shape external actors' interactions with the organization (Carpenter 2001). We use the term "external audiences" to refer to individuals and groups that might reward the firm for taking pro-environmental action. Audiences may thus include consumers, stockholders, residents of neighborhood surrounding the firm, and environmental groups. Rewards may be monetary, such as buying products because they were produced in an environmentally progressive way, or nonmonetary, or not directly monetary, such as avoiding negative publicity from an environmental group protesting a firm's environmental practices (Gunningham, Kagan, and Thornton2003; Hoffman 1997; Prakash 2000b). The key conceptual distinction for our purposes is that clubs' excludable benefits are not the rewards members receive from external audiences for taking specific environmental action. Rather, excludable benefits stem from membership in ISO 14001, which provides a credible signal of a firm's overall approach to environmental governance. (Potoski and Prakash, 2005, p. 237)

[87] For CCP: ICLEI; for the USMCPA: the US Conference of Mayors; for Cool Cities: the Sierra Club.

Climate networks also provide a credible signal of a government's approach to environmental governance – to advocates like environmental groups; to the public they represent; and to the state and federal government. Potoski and Prakash stress that this signal – the club's reputation – "is the key benefit that induces program participation" (p. 236). However this isn't clear for climate networks. For instance, whereas ISO 14001-certified businesses may have little to no ongoing relationship with other certified businesses, relationships between climate network members are both more prevalent and considered more vital. Secondly, green clubs impose "nontrivial costs" on their members. These costs may be direct – such as a fee or dues for membership – or indirect (such as the costs of adopting a stringent environmental management system) (Potoski and Prakash, 2005).

> In monetary terms, the initial cost of establishing an EMS and having it audited by a third party can range from $25,000 to over $100,000 per facility (Kolk 2000). For a moderate-sized firm with 10 facilities, initial monetary costs could range from $250,000 to $1,000,000. The ongoing costs of maintaining ISO 14001 certification are also important, including the time, money, and expertise for day-to-day operations and preparing for future annual recertification audits. Managers at three ISO 14001 certified facilities (see below) we interviewed all noted that the "bureaucratic" or "paper work" costs of ISO 14001 were substantial. William Glasser of the U.S. EPA notes that "large facilities spend on average about $1M in sunk transaction costs to pursue certification."5 In his analysis of firms' "beyond compliance" environmental decisions, Prakash (2000b) reports that both Baxter and Eli Lily hired additional staff to cope with the paper work and managerial requirements of their ISO 14001 certified EMS. (Potoski and Prakash, 2005, p. 237-238)

However both the USMCPA and the Cool Cities networks are free to join, and the cost to join the CCP/ICLEI is nominal, ranging from $600 to $8000, depending on the municipality's population.[88] And while climate mitigation may impose non-trivial costs on network members, those costs are not imposed *by* network membership, as they are with the pursuit of certification through ISO 14001.

Kern and Bulkeley (2009) may be right – an entirely new term, like "transnational municipal network," may be needed to describe climate networks. However in this dissertation, I'll simply use "climate network," in keeping with the existing literature.

HYPOTHESIS

The literature indicates that climate networks provide their members with four important resources. The first is information – best-practice case studies; advice and guidance; technical expertise. Secondly, climate networks provide an organized voice, and representation in important fora such as UN climate treaty negotiations and international decision-making bodies (Kern and Bulkeley, 2009). Network membership also provides stature – for the governments that join (Granberg and Elander, 2007) and for those administrators and politicians who may be striving, within the municipality, to push for mitigation (Betsill and Bulkeley, 2004). Finally, networks provide local governments with access to financial resources – information regarding grants and the opportunity to apply with other governments in the network for those grants (Davies, 2005).

The financial data I've collected allows me to test the following hypothesis:

[H9]: Climate network membership predicts the receipt of government funding.

[88] See http://www.icleiusa.org/join/process-of-joining/iclei-usa-membersip-dues, accessed March 23, 2015.

Multiple qualitative studies have found support for **H10**. For example, Denver's participation in the CCP helped it attract funding from the U.S. Environmental Protection Agency and Department of Energy (Betsill and Bulkeley, 2004). Kern and Bulkeley (2009) cite several examples, such as how CCP-Europe involved Stuttgart, Bremen and Dresden in a study funded by the European Commission. Davies (2005, p. 33) writes that Local Energy Agencies "in Ireland recognise their need to hook up with other areas to maximize eligibility for funding. One LEA noted that while 'one application to the Fifth Framework, [that] we spent three months on, was not funded because the project was deemed too small (€2 million when €10 million needed), through *Energie-Cités* we found five islands whose applications together make 10 million—a critical mass.'"

Yet the picture is not so simple. Many grants are competitive, and the governments that join networks to obtain more funding may drop their membership if they fail (Betsill and Bulkeley, 2004). Municipalities can also game the system: Davies (2005, p. 35) reports that the cost of network membership led a Local Energy Agency in Ireland to propose that "one LEA become a member…[and] then disseminate their experiences to other Irish LEAs." Betsill and Bulkeley (2004, p. 482) write that particularly successful governments develop experience which gives climate networks "reason to recruit and retain these members." All of these factors complicate theory – and may also complicate efforts to find a statistically significant result.

B. Methods & Results

SAMPLE

I exclude counties from consideration in this chapter, because only 19 of the counties in my sample are climate network members – and that's too few to generate reliable statistical findings. Therefore this analysis is focused on 'incorporated places' – the term the US Census uses to refer to cities, towns, villages, and townships. More information about the sampling procedure and response rate is available in Chapter 1, and Table 4 compares respondent and non-respondent incorporated places.

DEPENDENT VARIABLES

Revenue (`revenue`)

My first dependent variable measures the money local governments earned, over the last fiscal year, by implementing and administering the environmental efforts in my survey. This includes state and federal grants, as well as non-governmental sources (but not cost savings). Respondents' survey estimates were averaged by municipality to arrive at consensus estimates.

State and Federal Grants (`govfund`)

My second dependent variable is more specific – it's a measure of the governmental funding municipalities receive for their mitigation. I created this measure by adjusting respondents' estimates of revenue by their estimates of the percentage of these funds that came from non-governmental sources.[89] Their mean estimate of non-governmental funding was 10.5%, which means that `govfund` should be closely related to `revenue`. They are – the correlation between the two is over .99 – which means we should expect similar results from the models built around these two variables. But I include them both because the significance of network membership will be diluted in the `revenue` model if networks are ineffective in the non-governmental realm.

Neither variable fully measures the financial assistance that networks provide. Networks can offer technical assistance that improves funding bids; experiential and process knowledge that does the same; the opportunity to bid collaboratively with other network members; and knowledge about the funding opportunities in the first place. But networks can't guarantee winning bids, because funding decisions are often competitive, and made by other parties. That said, results matter, and both networks and their members have an interest in evaluating whether this assistance is effective.

CLIMATE NETWORK VARIABLES

Climate Network Membership (`networkmem`)

My first measure of network membership is a collective one – a measure of whether or not a government is a member of one or more of the following climate networks: ICLEI – Local Governments for Sustainability, the Cool Cities program, or the US Mayors' Climate Protection Agreement (USMCPA). I obtained 2014 data for each of these climate networks; if a government is a member of any of them, this variable is equal to one; zero otherwise.[90]

US Mayors Climate Protection Agreement (`usmcpa`)

However I also test the climate networks individually, because some of them – like the USMCPA – don't try to help their members obtain funding. If a government is a member of the USMCPA, it receives a score of one, and a zero otherwise.

Cool Cities (`coolcities`)

If a government is a member of the Sierra Club's Cool Cities program, it receives a score of one, and a zero otherwise.

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[89] This is admittedly a crude adjustment – the govfund variable may still contain some measure of funding that doesn't come from state and federal sources (such as fines levied by the municipality). However if these totals are small in comparison with state and federal grants, the error they introduce will be correspondingly minor.

[90] I obtained a 2014 list of US ICLEI member governments from Eli Yewdall, Senior Program Officer, ICLEI-Local Governments for Sustainability USA (in a personal email dated July 3rd, 2014). A list of signatories to the USMCPA is available at http://www.usmayors.org/climateprotection/list.asp (accessed on July 2nd, 2014). A list of Cool Cities member governments is available at www.coolcities.us (accessed on June 25th, 2014).

Table 26: Ch. 3 Variables, Expected Directions, and Data Sources			
Variable Name	**Variable Operation**	**Sign**	**Data Year & Source**
Dependent Variables			
Revenue (revenue)	Funding received by municipalities for mitigation, not including cost savings, from government and non-government sources, in the last fiscal year. In thousands.		2014: Survey
State and Federal Mitigation Funding (govfund)	Municipal revenue generated by mitigation policies, offset by the percentage of such funding generated from non-governmental sources.		2014: Survey
Climate Network Variables			
Climate Network Membership (networkmem)	Measured dichotomously. Whether or not the government is a member of a climate network.	+	2014: ICLEI – Local Governments for Sustainability; US Mayors Climate Protection Agreement; Cool Cities
US Mayors Climate Protection Agreement (usmcpa)	Measured dichotomously. Whether or not the government is a member of the US Mayors Climate Protection Agreement.	+	2014: US Mayors Climate Protection Agreement
Cool Cities (coolcities)	Measured dichotomously. Whether or not the government is a member of the Sierra Club's Cool Cities network.	+	2014: Cool Cities
ICLEI – Local Governments for Sustainability (iclei)	Measured dichotomously. Whether or not the government is a member of a ICLEI – Local Governments for Sustainability.	+	2014: ICLEI – Local Governments for Sustainability
Cities for Climate Protection Membership (ccp)	Measured dichotomously. Whether or not the government was a member of ICLEI's Cities for Climate Protection campaign.	+	2007: ICLEI – Local Governments for Sustainability
Control Variables			
Median Income (medincome)	Median household income of municipal residents, in thousands.	+	2012: US Census
Local Government Revenue (munirevenue)	Local government revenue, from own sources, in thousands.	+	2007: US Census
Cost Savings (estsavings)	Cost savings realized by the government because of its mitigation efforts in the last fiscal year. In thousands.	+	2014: Survey
Political Support from Municipal Leaders (polsupport)	Support of local elected officials for measures that address climate change, measured on a Likert scale (from a high of 5 to a low of 1); responses averaged by municipality.	+	2014: Survey
Democratic Voting (libvoting)	Average percentage of voters, at the county level, who voted for the Democratic candidate in the 2008 and 2012 presidential elections. Cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2008, 2012: DailyKos Elections
Carbon Employment (carbemploy)	Total civilian population (older than 16) employed in agriculture, forestry, mining, construction, manufacturing, transportation, warehousing, and utilities, divided by the total	-	2012: US Census

	employed population (older than 16) at the county level. Cities and other incorporated areas allocated the same total as the counties they inhabit.		
Coastal Vulnerability (coastvuln)	Measured dichotomously. Counties designated "coastal" by the National Oceanic and Atmospheric Administration (NOAA) – meaning that at least 15% of their area is in a coastal watershed – receive a one; a zero otherwise. Cities and other incorporated areas receive the same score as the counties they inhabit.	+	2014: National Oceanographic and Atmospheric Administration (NOAA)
Damage from Natural Hazard Events (hazardcost)	Property and crop damage from natural hazard events over the years 2000-2013, in thousands; cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2000-2013: Storm Events Database, National Climatic Data Center, US National Oceanic and Atmospheric Administration (NOAA)
Casualties from Natural Hazard Events (hazardcasualties)	Count of directly-caused deaths and injuries from natural hazard events over the years 2000-2013; cities and other incorporated areas allocated the same total as the counties they inhabit.	+	2000-2013: Storm Events Database, National Climatic Data Center, US National Oceanic and Atmospheric Administration (NOAA)
Staff (staff)	Estimated number of municipal staff (in FTE - full-time equivalents) which work to protect the natural environment, not counting temporary or contract employees.	+	2014: Survey
Municipal Electric Utility (muniutil)	Measured dichotomously. Municipalities which own or operate a local electric utility.	+	2014: Survey
College Town (colltown)	Measured dichotomously. Cities or counties in which at least a quarter of the residents are students enrolled in a college or university at an undergraduate or graduate level.	+	2008-2012: US Census
Population (pop)	Municipal population, in thousands.	+	2012: US Census
College Education (educ)	Percent of municipal residents, 25 years or older, who have a bachelor's degree or higher.	+	2008-2012: US Census
State Climate Action Plans (stplan)	Measured dichotomously. Whether or not a state has adopted a climate action plan.	+	2014: US Environmental Protection Agency
State Mitigation Targets (sttarget)	Measured dichotomously. Whether or not a state has set mitigation targets.	+	2014: Center for Climate and Energy Solutions
State Energy and Climate Policies (stpolicies)	The number of specific climate change and energy conservation policies passed on the state level.	+	2014: Pew Center on Global Climate Change
State Mitigation Mandates (stmandate)	Measured dichotomously. Whether or not a state has legally-binding mandates for mitigation.	+	2014: US Environmental Protection Agency
Clean Air (cleanair)	Measured dichotomously. A county receives a one if it was found in nonattainment for at least one of the EPA's National Ambient Air Quality Standards (NAAQS) criteria pollutants between 2010 and 2014; zero otherwise. Cities and other incorporated areas receive the same score as the counties they inhabit.	+	2010-2014: Environmental Protection Agency
Improved Transit (transit)	The percentage of workers in a municipality who drive to work and have travel times of 30 minutes or longer.	+	2008-2012: US Census
Municipal Authority (dillons)	Measured dichotomously. Whether or not a municipality is subject to Dillon's rule.	-	2004: National Association of Counties

ICLEI – Local Governments for Sustainability (`iclei`)

If a government is a member of ICLEI, it receives a score of one, and a zero otherwise.

Cities for Climate Protection Campaign (`ccp`)

The CCP campaign, a former project of ICLEI, is no longer a stand-alone program. However I include this measure because the CCP campaign focused solely on climate protection, while ICLEI membership addresses climate change within a broader focus on sustainability. I obtained a list of the CCP member governments as of April 2007;[91] if a government appears on the list, it receives a score of one, and a zero otherwise.

CONTROL VARIABLES

Financial Capacity (`medincome`, `munirevenue`, `estsavings`)

I include measures of the government's financial capacity because some grants require the recipient to put up matching funds, and because the process of applying can itself consume staff time and existing resources. **`Medincome`** is the median household income of local residents, and therefore measures the wealth available in the local community. I obtained this data from the US Census.[92] **`Munirevenue`** is a measure of own-source government revenue;[93] greater levels of own-source revenue indicate better financial health, and more flexibility to pursue local priorities (Krause, 2012). I also obtained this data from the US Census.[94] Finally, **`estsavings`** measures the money saved via mitigation over the last fiscal year; many governments reinvest these savings in further mitigation efforts. I collected this data via my survey; respondents' estimates were averaged by municipality to arrive at consensus estimates of these cost savings.

The Political Environment (`polsupport`, `libvoting`, `carbemploy`)

The local support for mitigation may influence whether governments apply for funding, and the quality of any proposals they submit. If the local elected leaders don't support mitigation, for example, staff are less

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[91] The data comes from a pdf file I downloaded from http://wakefieldcap.org/archivewakefieldcap.org/Proposal/ICLEI_Local%20Governments_Apr07.pdf on November 11, 2014.

[92] The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census, and reflects median household income in the past 12 months (in 2012 inflation-adjusted dollars). I obtained most of this data from the relevant State & County QuickFacts pages - for example, http://quickfacts.census.gov/qfd/states/56/56001.html. However townships and some towns were not listed on this site, and on those occasions I obtained the data by looking up the governments via the "American Factfinder" tool provided by the US Census, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Websites accessed from July 21st through July 23rd, 2014.

[93] Own-source revenue is funding that's generated locally, and does not originate with the state or federal government.

[94] The latest publicly-available data is from 2007, and was obtained by emailing the Census. Matt Clarke, a Statistician there, directed me to download the "_IndFin_1967-2007.zip" file from the following link: http://www2.census.gov/pub/outgoing/govs/special60/. I imported the 2007 text file from that link into Excel. The column of primary interest to me is "Total Rev-Own Sources" because local government income from sources under the control of that local government – primarily different forms of taxation, but also, depending on the local government, fines or licensing fees – is one of the best measures of local financial capacity. Data was missing for two of the cities with survey responses – Menifee, CA and Dunwoody, GA – because they were incorporated as municipalities in 2008, after the 2007 data from the US Census. Following the lead of Krause (2012, p. 2415), mean values were used for each, in order to keep the observations. Website accessed on October 28th, 2014.

likely to put together funding proposals, and less able to do so. I collected estimates of this support via the survey instrument; respondents were asked to state the interest of their government's elected leaders in addressing climate change (on a Likert scale from a low of 1 to a high of 5). These responses – `polsupport` - were then averaged by municipality.

Both politicians and municipal staff are also responsive to the local political environment. Like Pitt (2010a), I assume that Democratic voters are more likely to support municipal mitigation efforts than Republican voters. I therefore measure popular political orientation as the average percentage of voters, at the county level, who voted for the Democratic presidential candidate in the 2008 and 2012 elections (`libvoting`). Cities and other incorporated areas are allocated the same total as the counties they inhabit.[95]

I also use the percentage of local workers employed in carbon-intensive industries – `carbemploy` – as a crude measure of the political opposition faced by mitigative efforts.[96] Like Zahran et al (2008a), I measure this as the total civilian population (older than 16) employed in agriculture, forestry, mining, construction, manufacturing, transportation, warehousing, and utilities, divided by the total employed population (older than 16) at the county level. Cities and other incorporated areas are allocated the same total as the counties they inhabit.[97]

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[95] Most of the data for this variable was obtained from the DailyKos Elections website, at https://docs.google.com/spreadsheet/pub?key=0Av8O-dN2giY6dEFCOFZ4ZnlKS0x3M3Y0WHd5aWFDWkE&single=true&gid=1&output=html. The supplementary sources were as follows. For Alaska, 2008: http://uselectionatlas.org/FORUM/index.php?topic=88046.0 (5th post); 2012: http://uselectionatlas.org/FORUM/index.php?topic=164339.0 (18th post). For California, 2008: http://elections.nytimes.com/2008/results/states/president/california.html. For Connecticut, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Connecticut,_2008; 2012: http://www.politico.com/2012-election/results/president/connecticut/. For Delaware, 2008: http://elections.delaware.gov/archive/elect08/elect08_general_election/html/elect08_gen_county.shtml; 2012: http://elections.delaware.gov/archive/elect12/elect12_general/html/stwoff_kns.shtml. For Florida, 2008: http://content.usatoday.com/news/politics/election2008/PresidentialByCounty.aspx?sp=FL&oi=P&rti=G. For Maine, 2008: http://www.maine.gov/sos/cec/elec/2008/tabs-can-pr-cnty-11-08.html; 2012: http://www.maine.gov/sos/cec/elec/2012/tabs-can-pr-2012.html. For Massachusetts, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Massachusetts,_2008. For Montana, 2008: http://sos.mt.gov/elections/archives/2000s/2008/index.asp; 2012: http://electionresults.sos.mt.gov/resultsCountyList.aspx?eid=4. For Nebraska, 2012: http://www.sos.ne.gov/elec/prev_elec/. For North Carolina, 2008: http://www.ncsbe.gov/ncsbe/Elections/Election-Results-Display?ED1=11xx04xx2008&EL1=GENERAL&YR1=2008&CR1=A. For North Dakota, 2008: http://results.sos.nd.gov/resultsCTY.aspx?eid=1&text=Race&type=SW&rid=22&osn=100&map=CTY; 2012: http://results.sos.nd.gov/resultsCTY.aspx?eid=35&text=Race&type=SW&rid=4949&osn=100&map=CTY. For Rhode Island, 2008: http://en.wikipedia.org/wiki/United_States_presidential_election_in_Rhode_Island,_2008; 2012: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=44&year=2012. For South Dakota, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=46&year=2008; 2012: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=46&year=2012. For Texas, 2008: http://uselectionatlas.org/RESULTS/state.php?fips=48&year=2008. For Vermont, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&fips=50&year=2008; 2012: http://uselectionatlas.org/RESULTS/state.php?year=2012&fips=50&off=0&elect=0&f=0. For Wyoming, 2008: http://uselectionatlas.org/RESULTS/state.php?f=0&year=2008&fips=56; 2012: http://uselectionatlas.org/RESULTS/state.php?year=2012&fips=56&f=0&off=0&elect=0. With the exception of Alaska, I obtained the number of votes for the Democratic presidential candidate in 2008 and 2012 for each county in my sample; these were then turned into annual percentages for each county for both 2008 and 2012, and averaged to create the final libvoting variable. All websites accessed on July 30th and 31st, 2014. In general, allocating county data to the cities they contain is likely to slightly bias cities in a conservative direction, if we assume that democratic voters are more highly concentrated in urban areas.

[96] Sharp et al (2011) use a similar measure – "the number of manufacturing establishments in a city in 2002 relative to other professional establishments" – and write that "we agree with [the] argument that much better conceptualization and measurement are needed to identify the types of business interests that tend to mobilize against environmental initiatives, but that work has yet to be done" (p. 447).

[97] The data for this variable originated with the 2012 County Business Patterns (NAICS) database of the US Census (http://censtats.census.gov/cbpnaic/cbpnaic.shtml, accessed from June 20th to 25th, 2014).

Climate Risk (`coastvuln`, `hazardcost`, `hazardcasualties`)

Vulnerability to climate hazards may also influence the propensity of local governments to apply for mitigation funding. I therefore include three measures of this vulnerability. Following the lead of Zahran et al (2008b) and Tang et al (2010) I measure vulnerability to rising sea levels (`coastvuln`) dichotomously. A county receives a score of 1 if it is designated a coastal county by the National Oceanic and Atmospheric Administration (NOAA) – meaning that at least 15% of its area is in a coastal watershed – and a zero otherwise. Cities and other incorporated areas receive the same score as the counties they inhabit.[98] Climate change also increases the likelihood and severity of hurricanes, flooding, forest fires, and other natural hazard events. Like Tang et al (2010), I use the damage caused by such events (`hazardcost`) as a measure of climate risk. The data comes from the Storm Events Database, a project of the US National Oceanic and Atmospheric Administration's National Climatic Data Center. The value of both property and crop damages are totaled from 2000-2013 (in thousands), and cities and other incorporated areas are allocated the same total as the counties they inhabit.[99] Finally, I include a second set of data obtained from the Storm Events Database: the number of directly-caused deaths and injuries due to natural hazard events (`hazardcasualties`). These are both totaled from 2000-2013 and added together; cities and other incorporated areas are again allocated the same total as the counties they inhabit.[100]

Institutional Capacity (`staff`, `muniutil`, `colltown`, `pop`, `educ`)

Finally, a government's institutional capacity may influence its ability to apply for funding. Bids consume `staff` time and expertise, for example; I therefore asked survey respondents to estimate the number of municipal staff (in FTE - full-time equivalents) that "work to protect the natural environment," not counting temporary or contract employees.[101] Multiple estimates from a single municipality were averaged to arrive

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[98] A document entitled "NOAAs List of Coastal Counties for the Bureau of the Census Statistical Abstract Series" is available online at http://www.census.gov/geo/landview/lv6help/coastal_cty.pdf (accessed July 5th, 2014). It includes a state-by-state list of US counties that are "defined as coastal by the Strategic Environmental Assessments Division of the National Oceanic and Atmospheric Administration (NOAA). These are counties that meet one of the following criteria: 1) at least 15 percent of a county's total land area is located within the Nation's coastal watershed; or 2) a portion of or an entire county accounts for at least 15 percent of a coastal cataloging unit."

[99] I accessed the Storm Events Database (at http://www.ncdc.noaa.gov/stormevents/) from November 6th through 11th, 2014. I searched by state and then by county for each county in my sample. The "begin date" I selected was January 1, 2000; the end date was January 1, 2014. The event types included in the data are blizzard; coastal flood; cold/wind chill; drought; dust storm; excessive heat; extreme cold/wind chill; flash flood; flood, frost/freeze; funnel cloud; hail; heat; heavy rain; heavy snow; high surf; high wind; hurricane (typhoon); ice storm; lake-effect snow; lakeshore flood; landslide; lightning; sleet; storm surge/tide; strong wind; thunderstorm wind; tornado; tropical depression; tropical storm; wildfire; winter storm; and winter weather.

[100] I accessed the Storm Events Database (at http://www.ncdc.noaa.gov/stormevents/) from November 6th through 11th, 2014. I searched by state and then by county for each county in my sample. The "begin date" I selected was January 1, 2000; the end date was January 1, 2014. The event types included in the data are blizzard; coastal flood; cold/wind chill; drought; dust storm; excessive heat; extreme cold/wind chill; flash flood; flood, frost/freeze; funnel cloud; hail; heat; heavy rain; heavy snow; high surf; high wind; hurricane (typhoon); ice storm; lake-effect snow; lakeshore flood; landslide; lightning; sleet; storm surge/tide; strong wind; thunderstorm wind; tornado; tropical depression; tropical storm; wildfire; winter storm; and winter weather.

[101] This language is intentionally vague, so as not to exclude staff (like Drain Commissioners, planners, and sanitation staff) whose responsibilities – particularly in smaller governments – may include leading environmental initiatives. However this also leaves room for interpretation, which may hinder this variable's precision.

at a consensus estimate.[102] Electric utilities that are owned or operated by a local government can sometimes supply (or supplement) the staff and expertise needed to put together a funding bid, so I include `muniutil` – a dichotomous measure for municipalities which own or operate an electric utility. I collected this data via the survey instrument.[103] In a similar vein, small and rural municipalities may benefit disproportionately from the labor, ideas, and expertise provided by the students, faculty, and administrative staff of local colleges and universities. Accordingly I include college town status (`colltown`) as a dichotomous measure, defined as municipalities in which at least a quarter of the residents are students. Undergraduate and graduate enrollment data was obtained from the US Census.[104] Population (`pop`) and education levels (`educ`) are two final, standard measures of institutional capacity; I obtained this data from the US Census.[105]

State Climate Efforts (`stplan`, `sttarget`, `stpolicies`, `stmandate`)

The grants a government receives partly depends on funding availability – and states that make climate change a priority are more likely to make funding opportunities available. I measure this state interest in climate change with four variables. Firstly, I code states dichotomously to reflect whether or not they have adopted a climate action plan (`stplan`). I obtained this data from the US Environmental Protection Agency.[106] I also create a dichotomous variable to represent the 20 states that have set mitigation targets (`sttarget`); I obtained this data from the Center for Climate and Energy Solutions.[107] The third variable is a count of the number of climate change and energy conservation policies passed on the state level (`stpolicies`), according to the Pew Center on Global Climate Change.[108] Finally, California is the only state that currently has legally-binding limits on greenhouse gas emissions.[109] So I code `stmandate`

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[102] Blank answers become "." (a missing value). Textual qualifiers were eliminated, such that the response "approx 75" became "75". Similarly, "2 FTE" and "two" became "2". Department-specific estimates (e.g. "2.5 in my bureau, many others in the Bureaus of Environmental Services and Parks and Recreation") were changed to "." (a missing value). Overly vague estimates (e.g. "unknown--dozens or hundreds as a guess") were also changed to "." (a missing value). Specific range-estimates (e.g. "10 to 20") were changed to the midpoint of the range (e.g. "15"). Infinite ranges (e.g. "100+") were converted to the number given. Finally, estimates that specified that everyone in the city worked on environmental issues (e.g. "All of them. We have 537 FTEs") were converted to "." (a missing value).

[103] This variable is the answer to survey question #9 transformed such that "yes" becomes "1", "no" becomes "0", and "dontknow" becomes "." (a missing value). When there are multiple respondents from a single municipality with conflicting answers, the answer they give most often is adopted.

[104] I used the "American Factfinder" tool (see http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml) to obtain 2008-2012 American Community Survey 5-Year Estimates for "school enrollment" for each of the local governments in my sample, and used Excel to determine if the ratio between the number of students and the population as a whole for each local government exceeded .25. Website accessed on July 23rd and 24th, 2014.

[105] The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census. I obtained most of this data from the relevant State & County QuickFacts pages - for example, http://quickfacts.census.gov/qfd/states/56/56001.html. However townships and some towns were not listed on this site, and on those occasions I obtained the data by looking up the governments via the "American Factfinder" tool provided by the US Census, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. Websites accessed on July 22nd and 23rd, 2014.

[106] The EPA lists the states that have completed a Climate Action Plan, at http://www.epa.gov/statelocalclimate/state/state-examples/action-plans.html. Website accessed July 17th, 2014.

[107] See http://www.c2es.org/us-states-regions/policy-maps/emissions-targets; accessed July 19th, 2014.

[108] As of February, 2014, the Pew Center on Global Climate Change tracks thirty-one such policies (http://www.c2es.org/docUploads/all-state-initiatives-feb-2014.pdf). Of these, I have excluded consideration of Hydraulic Fracking Chemical Disclosure (column 19) because this policy does not have the same hypothesized relationship as a signal for local climate action. Website accessed June 28th, 2014.

[109] Via the California Global Warming Solutions Act, AB 32 (see http://www.c2es.org/us-states-regions/key-legislation).

dichotomously, with all California municipalities receiving a score of one, and all other municipalities a zero.

Other Factors (`cleanair`, `transit`, `dillons`)

I include three other factors that may influence the propensity of local governments to apply for funding, or their likelihood of receiving it. The first is poor air quality, because many of the same policies that reduce airborne particulate matter, sulfur dioxide, ozone and other local pollutants also reduce greenhouse gas emissions. So efforts to reduce local air pollution – by the state and federal government, or locally – may lead to increased mitigation funding. I define poor air quality (`cleanair`) dichotomously on the county level: counties receive a one if they were found in nonattainment for at least one of the EPA's National Ambient Air Quality Standards (NAAQS) criteria pollutants between 2010 and 2014, and a zero otherwise. This data is available from the EPA, and cities and other incorporated areas receive the same score as the counties they inhabit.[110]

Secondly, many of the policies that municipalities adopt to reduce traffic congestion and automobile dependency – such as expanded mass transit services, or zoning for transit-oriented development – also mitigate emissions of greenhouse gases. Since I include policies like these in my survey, grants that support these activities should also influence respondents' `revenue` estimates. According to 2011 data from the US Census,[111] only 35.8% of US workers have travel times to work that are 30 minutes or longer. Following the lead of Pitt (2010a), I define automobile dependence as the percentage of workers in a municipality that fall into this upper third – the percentage of workers who drive to work and have travel times of 30 minutes or longer.[112]

Finally, what local governments have the jurisdiction to do can influence the mitigation funding they obtain. In 'home rule' states, municipalities may assume any regulatory power not explicitly excluded by state law, while in 'Dillon's rule' states, municipalities can only utilize powers specifically granted to them by state law (Pitt and Randolph, 2009). Dillon's rule status may also vary by type of municipality (e.g. applying only to cities, townships, or counties). Accordingly each municipality was coded dichotomously to account for whether they are or are not subject to Dillon's rule (`dillons`).[113]

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[110] The EPA can designate a county as being in nonattainment for any one of six criteria air pollutants: Ozone, Particulate Matter (PM), Sulfur Dioxide, Lead, Carbon Monoxide, or Nitrogen Dioxide. Four of these six pollutants have more than one standard under which a county can be found in nonattainment (http://www.epa.gov/airquality/greenbk/). For each of the six criteria air pollutants, I coded a county as being in nonattainment if the EPA classified it as such, under any standard, at any time between 2010 and 2014. The final "cleanair" variable is dichotomous - if a county was found in nonattainment for any criteria air pollutant for any year between 2010 and 2014, that county is coded with a "1" and a "0" otherwise. Website accessed June 15th, 2014.

[111] American Community Survey: see http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_1YR_B08303&prodType=table, accessed November 25, 2014.

[112] The data comes from the 2008-2012 American Community Survey 5-Year Estimates provided by the US Census, and obtained via the "American Factfinder" tool, at http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml. I did so by searching for "Means of Transportation to Work By Travel Time to Work," which documents the forms of transportation used and time required for workers (aged 16 years and older who did not work at home) to reach their place of work. My variable includes those who drove alone and those who carpooled, traveling by car, truck, or van, but does not include workers that reached work via public transportation, walking, taxi, bicycle, motorcycle, or "other means." Website accessed July 25th, 2014.

[113] In constructing this variable, I referred to "Dillon's Rule or Not?" – a 2004 Research Guide from the National Association of Counties (http://www.celdf.org/downloads/Home%20Rule%20State%20or%20Dillons%20Rule%20State.pdf). "Is Home Rule the

STATISTICAL MODELS

In Table 27, I examine the influence of climate network membership – collectively and individually – on mitigation revenue and governmental funding. The statistical method I use is OLS, and again I use a quadratic transformation for population. The variance inflation factor test didn't indicate troublesome multicollinearity in any of the models, but the Breusch-Pagan and Cook-Weisberg test did reveal heteroskedasticity; accordingly all the results are reported using robust standard errors.

C. Results & Discussion

All the models exhibit a relatively good fit, and their results are fairly consistent. Which shouldn't surprise us, given the high correlation between the two dependent variables. Population, support from elected officials, state mandates, and coastal vulnerability are all significant to some degree – but the variables relevant to our hypotheses are not. Table 28 presents the results: membership in a climate network doesn't predict the receipt of mitigation funding.

It's likely this is accurate. Networks like the USMCPA are free to join partly because they provide so little service; they solicit commitments but don't help their members comply.[114] ICLEI does – it charges membership dues to offset service it provides. But ICLEI is a sustainability organization – many of its members work on mitigation, but ICLEI membership is an inaccurate measure of those members. CCP membership is, but the CCP program no longer exists, and the data I have is from 2007.

Future research can improve on this study by focusing on those ICLEI members actively engaged in climate change work. Sharp et al (2011) found that the length of ICLEI membership strongly predicted the achievement of ICLEI program milestones; including this measure may also predict the receipt of

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Answer? Clarifying the Influence of Dillon's Rule on Growth Management" – a 2003 discussion paper from the Brookings Institution (http://www.brookings.edu/es/urban/publications/dillonsrule.pdf) – was also helpful. I obtained a list of charter cities in California from the League of California Cities, at http://www.cacities.org/Resources-Documents/Resources-Section/Charter-Cities/Charter_Cities-List. In Colorado, Dillon's Rule applies to statutory cities and towns, and all counties (see the Brookings paper). I determined the status of each city and town by referring to this wikipedia list: http://en.wikipedia.org/wiki/List_of_cities_and_towns_in_Colorado#Statutory_city. Whether or not local governments in Florida are subject to Dillon's Rule is unclear: "The only exception to the exclusive selection of home rule or Dillon's rule is the state of Florida, which employs home rule but reserves taxing authority for the state" (http://www.nlc.org/build-skills-and-networks/resources/cities-101/city-powers/local-government-authority). The Brookings paper cites the two conflicting court rulings: Barry v. Garcia, 573 So.2d 932 (Fla.App. 3 Dist.,1991) determined that Dillon's Rule does apply; City of Boca Raton v. State, 595 So.2d 25, 17 Fla. L. Weekly S142 Fla., Feb 27, 1992 found that Article VIII, Section 2(b) of the Florida Constitution rejects Dillon's Rule. I coded local governments from Florida with zeroes, meaning that Dillon's Rule does not apply. This is because the "no" ruling is more recent – and more importantly, because Dillon's Rule represents a restriction of authority, and in the context of ambiguity, restrictions are unenforceable. In Illinois, Dillon's Rule does not apply to home rule municipalities – or to Cook County, which has also obtained Home Rule (see Brookings; for Cook County, see http://www.citizenadvocacycenter.org/uploads/8/8/4/0/8840743/homerulebrochure.pdf). A list of municipalities in Illinois with home rule is available at http://www.iml.org/page.cfm?key=2. In Louisiana, Dillon's Rule does apply to charter municipalities designated as such after 1974. I was able to determine from http://ballotpedia.org/Cities_in_Louisiana that all of the cities from my sample in Louisiana are charter municipalities. In Tennessee, Dillon's rule does not apply to Home Rule municipalities. A list of municipalities in Tennessee, which includes their form of government, is available at http://en.wikipedia.org/wiki/List_of_municipalities_in_Tennessee. Websites accessed on July 17th, 2014.

[114] Also, the U.S. Mayors Conference (the organization behind the USMCPA) is limited to cities with populations of 30,000 or more (Wang 2013, p. 606). The sample for my study includes cities with populations between 25,000 and 30,000, so this may introduce some error.

Table 27: Funding Received by Incorporated Places: Network Membership Influence

		Model 5: networkmem		**Model 6: usmcpa**		**Model 7: coolcities**	
About the Model	**Dependent Variable**	revenue	govfund	revenue	govfund	revenue	govfund
	Statistical Method	OLS	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.7231	.7591	.7240	.7598	.7229	.7588
	Observations	299	297	299	297	299	297
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-52.00	-10.76	-51.28	-13.16	-65.32	-31.58
Climate Network Variables	**networkmem**	93.09 *(91.90)*	81.80 *(75.28)*	–	–		
	usmcpa	–	–	191.06 *(131.57)*	148.42 *102.85)*		
	coolcities	–	–	–	–	41.41 *(127.56)*	15.13 *(98.96)*
	iclei	–	–	–	–	–	–
	ccp	–	–	–	–	–	–
Control Variables	**medincome**	3.92 *(6.59)*	1.47 *(4.90)*	4.38 *(6.80)*	1.76 *(5.01)*	3.55 *(6.54)*	1.15 *(4.91)*
	munirevenue	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	estsavings	0.35 *(0.24)*	0.28 *(0.18)*	0.35 *(0.23)*	0.28 *(0.18)*	0.35 *(0.24)*	0.28 *(0.18)*
	polsupport	151.07** *(76.18)*	116.07* *(60.79)*	144.85* *(74.40)*	111.89* *(59.80)*	153.10** *(74.40)*	119.07** *(60.47)*
	libvoting	-410.05 *(391.72)*	-372.01 *(309.72)*	-455.06 *(399.00)*	-401.86 *(316.67)*	-376.56 *(375.34)*	-329.37 *(299.83)*
	carbemploy	398.10 *(782.43)*	412.61 *(628.66)*	463.32 *(790.25)*	470.75 *(640.45)*	457.94 *(786.15)*	476.08 *(636.64)*
	coastvuln	207.84* *(114.66)*	182.85** *(90.97)*	204.85* *(115.08)*	181.84** *(91.68)*	209.90* *(113.95)*	184.47** *(90.64)*
	hazardcost	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	hazardcasualties	0.06 *(0.10)*	0.08 *(0.08)*	0.06 *(0.10)*	0.08 *(0.08)*	0.06 *(0.10)*	0.08 *(0.08)*
	staff	4.66 *(4.63)*	3.18 *(3.63)*	4.60 *(4.60)*	3.13 *(3.61)*	4.63 *(4.63)*	3.15 *(3.63)*
	muniutil	138.96 *(172.41)*	93.82 *(145.03)*	135.68 *(172.31)*	92.67 *(145.04)*	135.28 *(171.82)*	89.38 *(144.59)*
	colltown	-203.35 *(262.24)*	-187.58 *(224.81)*	-196.06 *(265.05)*	-184.60 *(226.71)*	-221.65 *(268.57)*	-199.64 *(227.12)*
	pop	-4.08*** *(1.32)*	-3.59*** *(1.04)*	-4.18*** *(1.31)*	-3.66*** *(1.04)*	-4.00*** *(1.29)*	-3.50*** *(1.01)*
	pop (squared)	0.01*** *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*
	educ	444.32 *(602.20)*	483.69 *(548.01)*	406.56 *(603.27)*	465.26 *(549.30)*	507.11 *(618.87)*	539.48 *(567.98)*
	stplan	-275.00 *(242.79)*	-214.37 *(191.02)*	-281.54 *(245.24)*	-218.36 *(192.48)*	-273.98 *(242.76)*	-214.11 *(190.65)*
	sttarget	224.39 *(202.76)*	161.16 *(170.91)*	212.98 *(201.07)*	151.71 *(169.37)*	224.88 *(202.28)*	162.41 *(170.31)*
	stpolicies	-13.06 *(16.43)*	-8.41 *(13.44)*	-12.71 *(16.38)*	-8.13 *(13.44)*	-12.83 *(16.58)*	-8.03 *(13.54)*
	stmandate	843.01** *(411.79)*	636.13** *(305.18)*	837.99** *(408.41)*	632.72** *(302.72)*	846.67** *(412.78)*	640.30** *(307.35)*
	cleanair	-99.76 *(123.50)*	-106.06 *(97.62)*	-94.87 *(123.42)*	-103.25 *(97.66)*	-105.17 *(122.41)*	-111.14 *(96.51)*
	transit	-687.21 *(1154.86)*	-353.12 *(823.11)*	-686.95 *(1154.41)*	-352.35 *(822.36)*	-689.30 *(1126.70)*	-365.61 *(802.66)*
	dillons	-164.27 *(210.67)*	-126.64 *(158.24)*	-156.26 *(208.67)*	-121.26 *(156.91)*	-171.36 *(210.97)*	-134.08 *(158.95)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 27 (continued)					
		Model 8: iclei		**Model 9: ccp**	
About the Model	**Dependent Variable**	revenue	govfund	revenue	govfund
	Statistical Method	OLS	OLS	OLS	OLS
	Adjusted R^2	.7257	.7604	.7244	.7601
	Observations	299	297	299	297
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-237.88	-135.69	-184.16	-116.32
Climate Network Variables	**networkmem**	–	–	–	–
	usmcpa	–	–	–	–
	coolcities	–	–	–	–
	iclei	-419.14 *(371.51)*	-264.20 *(271.70)*	–	–
	ccp	–	–	-367.34 *(296.93)*	-283.72 *(222.54)*
Control Variables	**medincome**	3.92 *(6.76)*	1.38 *(5.07)*	2.46 *(5.91)*	0.33 *(4.57)*
	munirevenue	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	estsavings	0.35 *(0.23)*	0.28 *(0.18)*	0.36 *(0.24)*	0.29 *(0.18)*
	polsupport	185.88* *(96.81)*	139.06* *(73.09)*	166.92** *(83.83)*	128.61* *(65.65)*
	libvoting	-142.38 *(485.18)*	-186.83 *(360.94)*	-244.23 *(434.44)*	-235.12 *(334.67)*
	carbemploy	352.16 *(782.26)*	404.19 *(630.47)*	392.79 *(778.08)*	418.07 *(624.82)*
	coastvuln	193.44* *(109.16)*	174.23** *(87.00)*	193.51* *(109.16)*	171.29** *(87.15)*
	hazardcost	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	hazardcasualties	0.03 *(0.11)*	0.06 *(0.08)*	0.03 *(0.12)*	0.05 *(0.09)*
	staff	4.85 *(4.62)*	3.29 *(3.62)*	4.56 *(4.64)*	3.10 *(3.64)*
	muniutil	134.30 *(177.88)*	88.74 *(147.83)*	114.85 *(167.06)*	72.57 *(140.43)*
	colltown	-157.30 *(261.57)*	-161.02 *(229.18)*	-225.56 *(263.09)*	-204.68 *(225.90)*
	pop	-3.67** *(1.46)*	-3.30*** *(1.13)*	-3.74*** *(1.42)*	-3.31*** *(1.10)*
	pop (squared)	0.01*** *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*	0.00*** *(0.00)*
	educ	594.90 *(644.09)*	594.83 *(576.69)*	681.77 *(657.02)*	671.51 *(595.00)*
	stplan	-243.66 *(225.96)*	-195.19 *(180.78)*	-272.53 *(241.44)*	-213.77 *(190.53)*
	sttarget	237.22 *(206.16)*	170.40 *(173.41)*	223.46 *(200.63)*	161.87 *(169.27)*
	stpolicies	-13.81 *(16.85)*	-8.78 *(13.79)*	-9.17 *(15.48)*	-5.35 *(12.75)*
	stmandate	949.58** *(478.82)*	704.43** *(344.76)*	866.07** *(424.13)*	654.30** *(313.88)*
	cleanair	-141.64 *(120.41)*	-133.60 *(96.77)*	-100.27 *(122.98)*	-106.46 *(97.37)*
	transit	-865.54 *(1267.62)*	-471.60 *(901.44)*	-757.81 *(1191.83)*	-412.35 *(848.20)*
	dillons	-170.48 *(211.21)*	-133.29 *(159.18)*	-174.31 *(214.34)*	-135.91 *(160.90)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

mitigation funding. And more funding is available in Europe, partly because a supranational funding source (the European Union) exists, and partly because both the EU and many national governments are more aggressive in addressing climate change than the US. Consequently helping their members obtain access to this funding is a much larger part of the *raison d'être* of climate networks in Europe, which may lead a study of European networks to find different results.

Table 28: Hypotheses and Degrees of Support

Hypothesis	Supported by Model?	
	`revenue`	`govfund`
[H9]: Climate network membership predicts the receipt of government funding.	No	No
[H9a]: USMCPA membership predicts the receipt of government funding.	No	No
[H9b]: Cool Cities membership predicts the receipt of government funding.	No	No
[H9c]: ICLEI membership predicts the receipt of government funding.	No	No
[H9d]: Cities for Climate Protection membership predicts the receipt of government funding.	No	No

Studies in the US, Europe, and elsewhere have identified a lack of funding as an important barrier to local mitigation (e.g. Pitt and Randolph, 2009; Granberg and Elander, 2007; Aall et al, 2007; Mathy, 2007; Romero Lankao, 2007). This study is the first to evaluate whether climate networks help their members obtain funding for mitigation, as multiple qualitative studies suggest. However this quantitative study, using measures of mitigation revenue generally and government funding specifically, finds that they do not.

CONCLUSION

The potential for local mitigation within the United States is vast. Zoning regulations, building codes, transit systems, and other forms of local governance can control between a third and a half of total US emissions (Lindseth, 2004). If the mitigation goals that local governments have already set for themselves are achieved, Lutsey (2008) finds that US emissions would decline 7% from the 2020 "business-as-usual" baseline. Yet Stewart (2008, p. 690) argues these goals could merely be symbolic: "pushed by local political entrepreneurs for short-term political gain," and dropped "once their significant costs become apparent."

In this dissertation I have advanced the state of knowledge about what local governments are doing to mitigate their emissions, and why. Chapter 1 presents the results of a nationwide survey of mitigation by local governments, including – for the first time – US counties. Its use of a randomized sampling process – another first – means the results generalize to local governments representing 94.3% of the 2012 US population. They indicate that mitigation is widespread among local governments, though counties are less aggressive than incorporated places. They also indicate this mitigation is predominantly non-regulatory, which severely limits its scope and likely efficacy.

Chapter 2 gets to the heart of the local mitigation literature: the question of motivation. It does so using superior measures of local mitigation – superior because they reflect cost, and cost is pivotal within a rational choice framework. It presents a unique series of analyses, examining multiple forms of mitigation by multiple types of municipalities. Allowing this variation allows a much more complex picture of local mitigation to emerge: all four motivations are influential, but situationally dependent.

The final chapter is the first study to evaluate the efficacy of climate networks. It finds that network membership doesn't significantly predict the mitigation funding that municipalities receive.

Opinions differ about the implications of local mitigation. Rabe, et al (2005) theorize that subnational climate policies may reduce emissions by facilitating technological and policy innovation; by building political feasibility for national regulations; and creating self-reinforcing cycles that lead to deeper, broader, and more meaningful mitigation policies. However Wiener (2007) argues that subglobal regulation can undermine and reverse the benefits of mitigation policies,[115] increase their costs,[116] dissuade initial participation, and discourage future participation by non-actors.

Regardless, even global mitigation treaties require some degree of local implementation. This is certainly true in the United States, given the extent of local jurisdiction over emission sources. The research I present significantly improves our understanding of local mitigation. And better understanding the efforts already underway – who is doing what and why – should allow state and federal actors to

[115] Differing regulatory requirements in different jurisdictions may, for example, restrict the flexibility that greenhouse gas trading markets are designed to provide, thereby undermining their environmental and economic benefits (Stewart, 2008).
[116] For example, transaction costs and complexity for regulated firms (Stewart, 2008).

better incentivize that mitigation, learn from local innovation, and design large-scale systems that capitalize on local efforts.

BIBLIOGRAPHY

Aall, Carlo, Kyrre Groven and Gard Lindseth, 2007: "The Scope of Action for Local Climate Policy: The Case of Norway", *Global Environmental Politics*, Vol. 7, No. 2, pp.83-101.

Adam, Silke and Hanspeter Kriesi, 2007: "The Network Approach," in Paul A. Sabatier (ed.), *Theories of the Policy Process*. Boulder CO: Westview Press, pp. 129–54.

Allman, Lee, Paul Fleming and Andrew Wallace, 2004: "The Progress of English and Welsh Local Authorities in Addressing Climate Change" *Local Environment* 9(3): 271–283.

Anderson, Jason, 2005: "Counties, Cities, Villages, Towns: Forms of Local Government and Their Functions." Wisconsin Legislative Reference Bureau. Available at: legis.wisconsin.gov/lrb/gw/gw_6.pdf.

Bai, Xuemei, 2007: "Integrating Global Environmental Concerns into Urban Management: the Scale and Readiness Arguments" *Journal of Industrial Ecology* 11 (2), 15–29.

Bailey, John, 2007: *Lessons from the Pioneers: Tackling Global Warming at the Local Level*. Minneapolis: Institute for Local Self Reliance. See: http://www.newrules.org/energy/publications/lessons-pioneers-tackling-global-warming-local-level [Accessed 21 February 2011].

Bartholomew, Keith, 2009: "Cities and Accessibility: The Potential for Carbon Reductions and the Need for National Leadership" *Fordham Urban Law Journal*, Vol. 36 Issue 2, p159-209

Bedsworth, Louise W. and Ellen Hanak, 2013: "Climate Policy at the Local Level: Insights from California" *Global Environmental Change*, Volume 23, Issue 3, June 2013, pp. 664–677.

Betsill, Michele M., 2000: *Localizing Global Climate Change: Greenhouse Gas Emissions in US Cities* (Harvard University, Belfer Center for Science & International Affairs).

Betsill, Michele M., 2001: "Mitigating Climate Change in US Cities: Opportunities and Obstacles" *Local Environment* 6(4): 393–406.

Betsill, Michele, and Harriet Bulkeley, 2004: "Transnational Networks and Global Environmental Governance: the Cities for Climate Protection Program" *International Studies Quarterly* 48 (2): 471-493.

Betsill, Michele M. and Harriet Bulkeley, 2006: "Cities and the Multilevel Governance of Global Climate Change" *Global Governance*, 12 (2): 141–159.

Betsill, Michele and Harriet Bulkeley, 2007: "Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research" *Local Environment* 12 (5): 447-456.

Brand, Glen and Brendan Bell, 2006: "Cool Cities: Solving Global Warming One City At A Time." Sierra Club, San Francisco, CA

Brown, Marilyn A. and Frank Southworth, 2008: "Mitigating Climate Change Through Green Buildings and Smart Growth" *Environment and Planning A* 40 653 - 675

Bulkeley, Harriet, 2010: "Cities and the Governing of Climate Change" *Annual Review of Environment and Resources* Vol. 35: 229-253

Bulkeley, Harriet and Kristine Kern, 2006: “Local Government and the Governing of Climate Change in Germany and the UK” *Urban Studies*, Vol. 43, No 12, 2237-2259.

Bulkeley, Harriet, Heike Schroeder, Katy Janda, Jimin Zhao, Andrea Armstrong, Shu Yi Chu, and Shibani Ghosh, 2009: “Cities and Climate Change: the Role of Institutions, Governance and Urban Planning", report for the World Bank Urban Symposium on Climate Change, Marseille, http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1256566800920/bulkeley.pdf

Burch, Sarah, and John Robinson, 2007: “A Framework for Explaining the Links Between Capacity and Action in Response to Global Climate Change” *Climate Policy* Volume 7, Issue 4, pages 304-316.

Causton, Helen C., John Quackenbush, and Alvis Brazma (2009): *Microarray Gene Expression Data Analysis: A Beginner's Guide*. Wiley-Blackwell e-book.

Clingermayer, James C. and Richard C. Feiock, 1990: “Constituencies, Campaign Support, and Council Member Intervention in City Development Policy” *American Politics Quarterly* 16: 55-67.

Collier, Ute, 1997: “Local Authorities and Climate Protection in the European Union: Putting Subsidiarity into Practice?” *Local Environment*, 2 (1), 39–57.

Corbett, Judy, and Tom Hayden, 1981: “Local Action for a Solar Future” *Solar Law Reporter*, 2 (5), 952–969.

Darier, Eric, and Ralph Schüle, 1999: “‘Think Globally, Act Locally’? Climate Change and Public Participation in Manchester and Frankfurt” *Local Environment* 4 (3):317–330.

Davies, Anna, 2005: “Local Action for Climate Change: Transnational Networks and the Irish Experience” *Local Environment* 10(1): 21–40.

de Oliveira, Jose Antonio Puppim, 2009: “The Implementation of Climate Change Related Policies at the Subnational Level: An Analysis of Three Countries” *Habitat International* 33 253-259

Dhakal, Shobhakar and Michele Betsill, 2007: “Challenges of Urban and Regional Carbon Management and the Scientific Response” *Local Environment* 12 (5): 549 – 555.

Dierwechter, Yonn and Anne Taufen Wessells, 2013: “The Uneven Localisation of Climate Action in Metropolitan Seattle” *Urban Studies,* May 2013, vol. 50 no. 7, pp. 1368-1385.

Dodman, David, 2009: “Blaming Cities for Climate Change? An analysis of urban greenhouse gas emissions inventories” *Environment and Urbanization* Vol 21, No 1, Pages 185-201.

Engel, Kristen, 2006: “State and Local Climate Change Initiatives: What Is Motivating States and Local Governments to Address a Global Problem and What Does it Say About Federalism and Environmental Law?” 38 *Urban Lawyer* 1015.

Engel, Kirsten and Barak Y. Orbach, 2008: “Micro-Motives and State and Local Climate Change Initiatives” 2 *Harvard Law & Policy Review* 119, 123

Fitzgerald, Joan, 2010: *Emerald Cities: Urban Sustainability and Economic Development.* Oxford: Oxford University Press.

Gerber, Elisabeth R., 2013: “Partisanship and Local Climate Policy” *Cityscape*, Vol. 15, No. 1, pp. 107-124.

Granberg, Mikael and Ingemar Elander, 2007: “Local Governance and Climate Change: Reflections on the Swedish Experience” *Local Environment* 12 (5): 537-548.

Grimmond, Sue, 2007: “Urbanization and Global Environmental Change: Local Effects of Urban Warming” *Geographical Journal* 173, 83–88.

Gurney, Kevin R., Igor Razlivanov, Yang Song, Yuyu Zhou, Bedrich Benes, and Michel Abdul-Massih, 2012: “Quantification of Fossil Fuel CO_2 Emissions on the Building/Street Scale for a Large U.S. City” *Environmental Science and Technology*

Hardin, Garrett, 1968: “The Tragedy of the Commons” *Science*, 162:1243-1248.

Haring, Chelsey Lynn, 2011: *An Examination of Institutional Restructuring and Regime Change in Local Education Politics*. Michigan: Michigan State University.

Hill, Thomas, and Paweł Lewicki, 2006: *Statistics: Methods and Applications: a Comprehensive Reference for Science, Industry, and Data Mining.* StatSoft, Oklahoma (2006)

Hogue, Carma, 2013: “Government Organization Summary Report: 2012” (Washington, DC: U.S. Census Bureau), available at: http://www2.census.gov/govs/cog/g12_org.pdf.

Holgate, Claudia, 2007: “Factors and Actors in Climate Change Mitigation: A Tale of Two South African Cities” *Local Environment*, 12 (5), 471–484.

Hurd, Brian, Mac Callaway, Joel Smith, and Paul Kirshen, 2004: “Climatic Change and U.S. Water Resources: from Modeled Watershed Impacts to National Estimates" *Journal of the American Water Resources Association* 40(1) 129-148

ICLEI – Local Governments for Sustainability, 1997: *Local Government Implementation of Climate Protection: Case Studies*. Toronto: ICLEI

ICLEI – Local Governments for Sustainability, 2009: “ICLEI Members October 2009” See: http://www.icleiusa.org/library/documents/ICLEI_Local%20Governments_members.pdf/view

IPCC, 2007: “Climate Change 2007: Synthesis Report of the IPCC Fourth Assessment Report Summary for Policy Makers” Geneva, Switzerland: IPCC.

Jo, Jin, Jay Golden, and S.W. Shin, 2009: "Incorporating Built Environment Factors into Climate Change Mitigation Strategies for Seoul, South Korea: A Sustainable Urban Systems Framework" *Habitat International* 33 267-275

Koehn, Peter H., 2008: “Underneath Kyoto: Emerging Subnational Government Initiatives and Incipient Issue-Bundling Opportunities in China and the United States” *Global Environmental Politics*, 8 (1), 53–77.

Kern, Kristine and Gotelind Alber, 2008: "Governing Climate Change in Cities: Modes of Urban Climate Governance in Multi-level Systems" *Conference on Competitive Cities and Climate Change*.

Kern, Kristine and Harriet Bulkeley, 2009: “Cities, Europeanization and Multi-level Governance: Governing Climate Change through Transnational Municipal Networks” *Journal of Common Market Studies* 47(2): 309-332

Knuth, Sarah, Brandi Nagle, Christopher Steuer, and Brent Yarnal, 2007: “Universities and Climate Change Mitigation: Advancing Grassroots Climate Policy in the US” *Local Environment*, 12 (5), 485–504.

Kousky, Carolyn and Stephen H. Schneider, 2003: “Global Climate Policy: Will Cities Lead the Way?” *Climate Policy*, 3:359-372.

Krause, Rachel Marie, 2011a: “An Assessment of the Greenhouse Gas Reducing Activities Being Implemented in US Cities” *Local Environment* Vol. 16, No. 2, Pages 193–211.

Krause, Rachel Marie, 2011b: “Symbolic or Substantive Policy? Measuring the Extent of Local Commitment to Climate Protection” *Environment and Planning C: Government and Policy* 29 (1), Pages 46–62.

Krause, Rachel Marie, 2011c: “Policy Innovation, Intergovernmental Relations and the Adoption of Climate Protection Initiatives by US Cities” *Journal of Urban Affairs*, 33 (1), Pages 45–60.

Krause, Rachel M., 2012: “Political Decision-Making and the Local Provision of Public Goods: The Case of Municipal Climate Protection in the US” *Urban Studies,* August 2012, vol. 49, no. 11, pp. 2399-2417.

Krause, Rachel M., 2013: “The Motivations Behind Municipal Climate Engagement: An Empirical Assessment of How Local Objectives Shape the Production of a Public Good” *Cityscape*, Vol. 15, No. 1, Climate Change and City Hall (2013), pp. 125-141.

Krause, Rachel M., Richard C. Feiock, & Cristopher Hawkins, 2015: "The Administrative Organization of Sustainability within Local Government," *Journal of Public Administration Research and Theory*, forthcoming.

Krause, Rachel, 2015: "Integrating Sustainability within City Governments: Administrative Mechanisms to Overcome Functional Collective Action Dilemmas." Evans Research Seminar. Parrington Commons, Seattle. 14 May 2015. Lecture.

Kron, Norman and John Randolph, 1983: *Problems in Implementing Energy Programs in Selected United States Communities* Argonne, IL: Argonne National Laboratory.

Lambright, W Henry, Stanley Chagnon, and L. D. Danny Harvey, 1996: “Urban Reactions to the Global Warming Issue: Agenda Setting in Toronto and Chicago.” *Climatic Change* 34:463-478.

Larsen, Hogne N. and Edgar Hertwich, 2009: “The Case for Consumption-Based Accounting of Greenhouse Gas Emissions to Promote Local Climate Action" *Environmental Science and Policy* 12 791-798

Lindseth, Gard, 2004: “The Cities for Climate Protection Campaign (CCPC) and the Framing of Local Climate Policy”, *Local Environment* 9 (4): 325–336.

Lutsey, Nicholas, and Daniel Sperling, 2008: “America’s Bottom-Up Climate Change Mitigation Policy” *Energy Policy* 36, Pages 673–685.

Mathy, Sandrine, 2007: “Urban and Rural Policies and the Climate Change Issue: the French Experience of Governance” *Environmental Sciences*, 4 (3), 159–169.

Millard-Ball, Adam, 2012: “Do City Climate Plans Reduce Emissions?” *Journal of Urban Economics* Volume 71, Issue 3, Pages 289–311

Mills, Gerald, 2007: “Cities as Agents of Global Change” *International Journal of Climatology* 27 (14), 1849–1857.

Mohr, Lawrence B., 1969: “Determinants of Innovation in Organizations” *American Political Science Review* (63), 1969, pp. 111-126.

Mooi, Erik and Marko Sarstedt, 2011: *A Concise Guide to Market Research: The Process, Data, and Methods Using IBM SPSS Statistics*. Berlin: Springer.

Moore, Jennie, 1994: *What's Stopping Sustainability? Examining Barriers to Implementation of Clouds of Change*. Master's Thesis. Vancouver: School of Community and Regional Planning.

Murnane, Richard, and John Willett, 2011: *Methods Matter: Improving Causal Inference in Educational and Social Science Research.* Oxford University Press, Oxford.

Nijkamp, Peter and Adriaan Perrels, 1994: *Sustainable Cities in Europe: A Comparative Analysis of Urban Energy – Environmental Policies*. London: Earthscan Publications Ltd.

OECD, 1995: *Urban Energy Handbook: Good Local Practices*. Paris: Organization for Economic Cooperation and Development.

Olson, Mancur, 1971: *The Logic of Collective Action*. New York: Schocken Books.

Osofsky, Hari M. and Janet Koven Levit, 2008: “The Scale of Networks?: Local Climate Change Coalitions” *Chicago Journal of International Law* 8 (2): 409-436.

Ostrom, Elinor, 2007: "Institutional Rational Choice: An Assessment of the Institutional Analysis and Development Framework." *Theories of the Policy Process*, 2nd ed., Paul Sabatier, ed., Boulder, CO: Westview Press.

Ostrom, Elinor, 2012: “Nested Externalities and Polycentric Institutions: Must We Wait for Global Solutions to Climate Change Before Taking Actions at Other Scales?” *Economic Theory*, February 2012, Volume 49, Issue 2, pp 353-369.

Papke, Leslie and Jeffrey Wooldridge, 1996: “Econometric Methods for Fractional Response Variables With an Application to 401(k) Plan Participation Rates.” *Journal of Applied Econometrics* 11: 619–632.

Parker, Paul and Ian H. Rowlands, 2007: “City Partners Maintain Climate Change Action Despite National Cuts: Residential Energy Efficiency Programme Valued at Local Level” *Local Environment* 12(5): 505-517.

Parry, Martin, Nigel Arnell, Tony McMichael, Robert Nicholls, Pim Martens, Sari Kovats, Matthew Livermore, Cynthia Rosenweig, Ana Iglesias, and Gunther Fischer, 2001: “Millions at Risk: Defining Critical Climate Change Threats and Targets” *Global Environmental Change* 11 181-183

Pitt, Damian Rogero and Randolph, John, 2009: “Identifying Obstacles to Municipal Climate Protection Planning” *Environment and Planning C: Government and Policy*, 27 (6), 841–857.

Pitt, Damian Rogero, 2009: “The Diffusion of Climate Protection Planning Among U.S. Municipalities” (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.

Pitt, Damian Rogero, 2010a: “The Impact of Internal and External Characteristics on the Adoption of Climate Mitigation Policies by US Municipalities” *Environment and Planning C: Government and Policy*, 28 (5), 851–871.

Pitt, Damian Rogero, 2010b: “Harnessing Community Energy: The Keys to Climate Mitigation Policy Adoption in US Municipalities” *Local Environment*; Sep 2010, Vol. 15 Issue 8, p717-729

Podolny, Joel and Karen Page, 1998: "Network Forms of Organization," *Annual Review of Sociology*, vol. 24: 59. 4.

Population Reference Bureau, 2005: “World Population Data Sheet”

Portney, Kent, 2009: “Sustainability in American Cities: A Comprehensive Look at What Cities are Doing and Why?” in *Toward Sustainable Communities*, edited by Daniel A. Mazmanian and Michael E. Kraft, pp. 227–254. Cambridge, MA: MIT Press.

Potoski, Matthew and Aseem Prakash, 2005: “Green Clubs and Voluntary Governance: ISO 14001 and Firms' Regulatory Compliance” *American Journal of Political Science*, Volume 49, Number 2, pp. 235-248(14)

Rabe, Barry G., Mikael Roman and Arthur N. Dobelis, 2005: “State Competition as a Source Driving Climate Change Mitigation” *New York University Environmental Law Journal* 14 1, 13

Ramaswami, Anu, 2013: “Social Actors and Key Policy Levers for Mitigating the Greenhouse Gas Footprint of U.S. Cities” *Cityscape*, Vol. 15, No. 1, Climate Change and City Hall (2013), pp. 209-232.

Reams, Margaret, Kelsey Clinton, and Nina Lam, 2012: “Achievement of Climate Planning Objectives Among U.S. Member Cities of the International Council for Local Environmental Initiatives (ICLEI)” *Low Carbon Economy*, Vol. 3, No. 4, 2012, pp. 137-143.

Richardson, Jesse J., 2003: “Is Home Rule the Answer? Clarifying the Influence of Dillon's Rule on Growth Management.” Washington, D.C.: Brookings Institution, January 2003.

Robinson, Pamela and Christopher Gore, 2005: “Barriers to Canadian Municipal Response to Climate Change” *Canadian Journal of Urban Research*, 14 (suppl.), 102–120.

Romero Lankao, Patricia, 2007: “How do Local Governments in Mexico City Manage Global Warming?” *Local Environment* 12 (5): 519-535

Rutland, Ted and Alex Aylett, 2008: "The Work of Policy: Actor Networks, Governmentality, and Local Action on Climate Change in Portland, Oregon" *Environment and Planning D: Society and Space* 26(4) 627 – 646

Saavedra, Casilda and William W. Budd, 2009: "Climate Change and Environmental Planning: Working to Build Community Resilience and Adaptive Capacity in Washington State, USA" *Habitat International* 33 246-252

Scheraga, Joel, and Anne Grambsch, 1998: "Risks, Opportunities, and Adaptation to Climate Change" *Climate Research* 10 85-95

Schroeder, Heike, and Harriet Bulkeley, 2009: "Global Cities and the Governance of Climate Change: What is the Role of Law in Cities?" *Fordham Urban Law Journal* 36: 313-359.

Sewell, Granville C., 2005: "Actors, Coalitions, and the Framework Convention on Climate Change." Unpublished dissertation, Massachusetts Institute of Technology.

Sharp, Elaine B., Dorothy M. Daley, Michael S. Lynch, 2011: "Understanding Local Adoption and Implementation of Climate Change Mitigation Policy" *Urban Affairs Review,* May 2011, vol. 47 no. 3, pp. 433-457.

Shipan, Charles R., and Craig Volden, 2006: "Bottom-Up Federalism: The Diffusion of Antismoking Policies From U.S. Cities to States" *American Journal of Political Science* 50(4), 825–843.

Sierra Club, 2006: "Cool Cities Campaign: Solving Global Warming One City at a Time – Activist Toolkit."

Sippel, Maike, and Till Jenssen, 2009: "What About Local Climate Governance? A Review of Promise and Problems" Discussion paper, Institute of Energy Economics and Rational Energy Use, University of Stuttgard, http://ssrn.com/abstract=1514334.

Slocum, Rachel, 2004b: "Consumer Citizens and the Cities for Climate Protection Campaign" *Environment and Planning A* 36 763 - 782

Smith, Joel, Jeffrey Lazo, and Brian Hurd, 2003: "The Difficulties of Estimating Global Non-Market Damages From Climate Change", in *Global Climate Change: The Science, Economics, and Politics* Ed. J Griffin (Edward Elgar, Northampton, MA) pp 114-139

Stewart, Richard B, 2008: "States and Cities as Actors in Global Climate Regulation: Unitary vs. Plural Architectures" *Arizona Law Review* 50 (3): 681-707.

Studenmund, A.H., 2011: *Using Econometrics: A Practical Guide*, 6th ed., Addison-Wesley.

Tang, Zhenghong, Samuel D. Brody, Courtney Quinn, Liang Chang, and Ting Wei, 2010: "Moving from Agenda to Action: Evaluating Local Climate Change Action Plans" *Journal of Environmental Planning and Management* 53:1, pp. 41–62

Tang, Zhenghong, Ting Wei, Courtney Quinn, and Nan Zhao, 2012: "Surveying Local Planning Directors' Actions for Climate Change" *International Journal of Climate Change Strategies and Management,* Vol. 4, No. 1, pp. 81-103.

Toly, Noah J., 2008: "Transnational Municipal Networks in Climate Politics: From Global Governance to Global Politics" *Globalizations* 5 (3): 341-356.

US Conference of Mayors, 2010: “Mayors Climate Protection Center: Cities that have Signed On” See: http://usmayors.org/climateprotection/ClimateChange.asp

U.S. Conference of Mayors, n.d. "U.S. Conference of Mayors Climate Protection Agreement." Web. <http://www.usmayors.org/climateprotection/agreement.htm>. Accessed May 15, 2015.

Varadarajan, Uday and Julia Zuckerman, 2012: “Energy, the U.S. Budget, and Climate Change,” a brief by the Climate Policy Initiative, San Francisco. Available at: http://climatepolicyinitiative.org/publication/energy-the-u-s-budget-and-climate-change/.

Vasi, Ion Bogdan, 2006: “Organizational Environments, Framing Processes, and the Diffusion of the Program to Address Global Climate Change Among Local Governments in the United States” *Sociological Forum*, 21 (3), 439–466.

Wang, Rui, 2013: “Adopting Local Climate Policies: What Have California Cities Done and Why?” *Urban Affairs Review*, July 2013, vol. 49 no. 4, pp. 593-613.

Wheeler, Stephen M., 2008: “State and Municipal Climate Change Plans*:* The First Generation” *Journal of the American Planning Association*, 74(4), 481-496.

White, Rodney, 2004: “Managing and Interpreting Uncertainty for Climate Change Risk” *Building Research and Information* 32 438-448

Wiener, Jonathan B., 2007: “Think Globally Act Globally: The Limits of Local Climate Politics.” *University of Pennsylvania Law Review* 155. U. 1961

Yarnal, Brent, Robert E. O’Connor and Robin Shudak, 2003: The Impact of Local Versus National Framing on Willingness to Reduce Greenhouse Gas Emissions: A Case Study from Central Pennsylvania. *Local Environment* 8(4): 457–469.

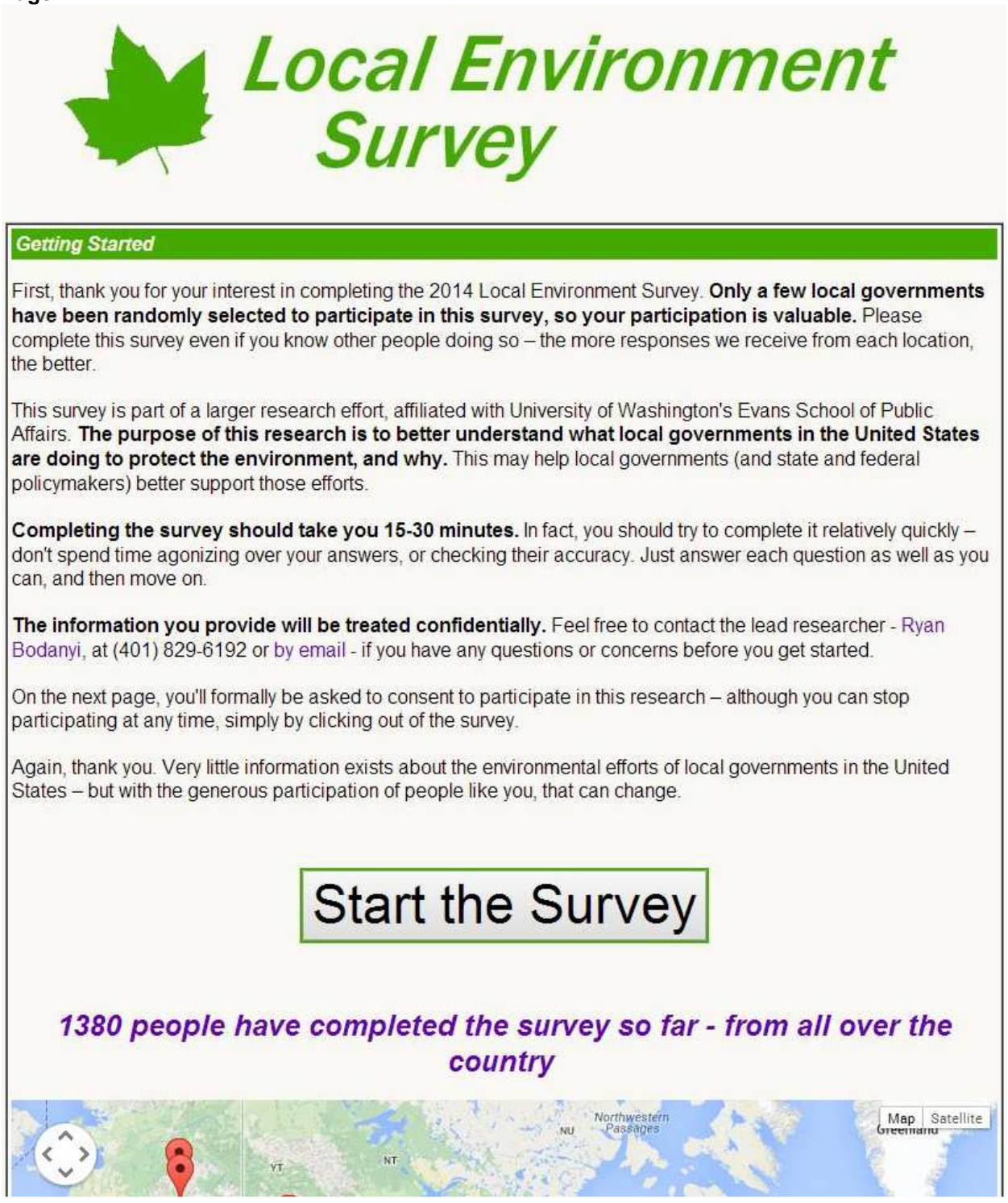
Zahran, Sammy, Himanshu Grover, Samuel D. Brody, and Arnold Vedlitz, 2008a: “Risk, Stress, and Capacity: Explaining Metropolitan Commitment to Climate Protection” *Urban Affairs Review* 43 (4): 447-74.

Zahran, Sammy, Samuel D. Brody, Arnold Vedlitz, Himanshu Grover, and Caitlyn Miller, 2008b: “Vulnerability and Capacity: Explaining Local Commitment to Climate-Change Policy” *Environment and Planning C: Government and Policy* 26: 544-562.

Ziblatt, Daniel, 2008: “Why Some Cities Provide More Public Goods Than Others: A Subnational Comparison of the Provision of Public Goods in German Cities in 1912” *Studies in Comparative International Development* 43 273 - 289

APPENDIX 1: ELECTRONIC SURVEY

Page 1:



Local Environment Survey

Getting Started

First, thank you for your interest in completing the 2014 Local Environment Survey. **Only a few local governments have been randomly selected to participate in this survey, so your participation is valuable.** Please complete this survey even if you know other people doing so – the more responses we receive from each location, the better.

This survey is part of a larger research effort, affiliated with University of Washington's Evans School of Public Affairs. **The purpose of this research is to better understand what local governments in the United States are doing to protect the environment, and why.** This may help local governments (and state and federal policymakers) better support those efforts.

Completing the survey should take you 15-30 minutes. In fact, you should try to complete it relatively quickly – don't spend time agonizing over your answers, or checking their accuracy. Just answer each question as well as you can, and then move on.

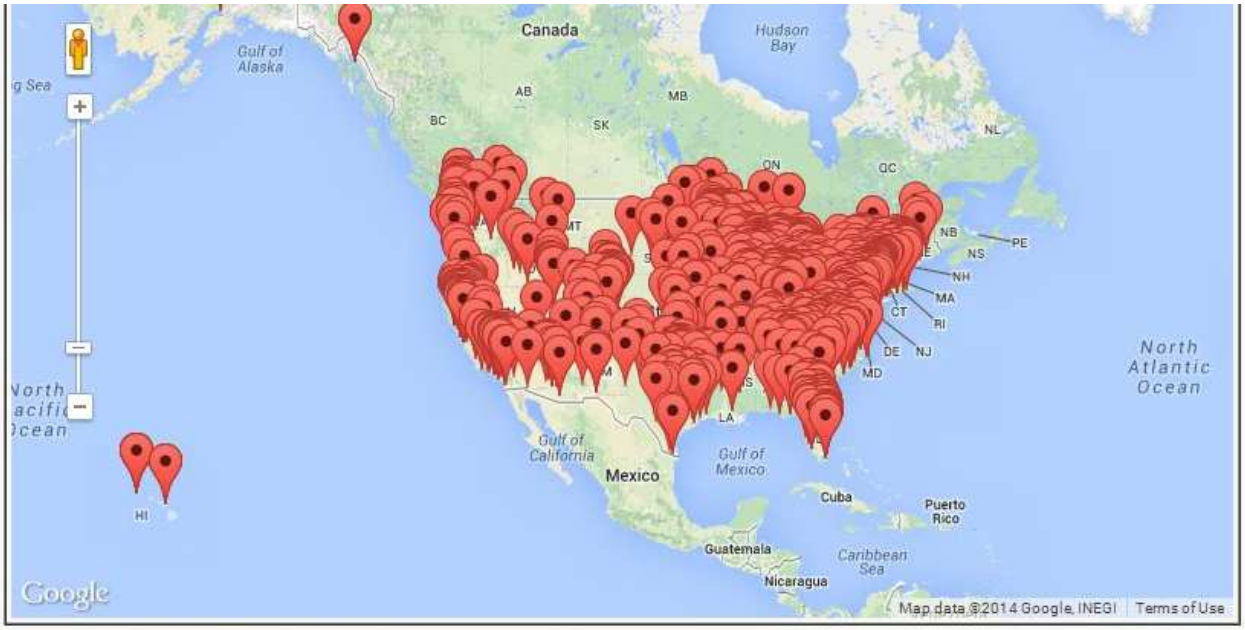
The information you provide will be treated confidentially. Feel free to contact the lead researcher - Ryan Bodanyi, at (401) 829-6192 or by email - if you have any questions or concerns before you get started.

On the next page, you'll formally be asked to consent to participate in this research – although you can stop participating at any time, simply by clicking out of the survey.

Again, thank you. Very little information exists about the environmental efforts of local governments in the United States – but with the generous participation of people like you, that can change.

Start the Survey

1380 people have completed the survey so far - from all over the country



The 2014 Local Environment Survey is part of a larger research effort, affiliated with University of Washington's Evans School of Public Affairs. The purpose of this research is to better understand what local governments in the United States are doing to protect the environment, and why. Only a few local governments have been selected to participate in this survey, so your participation is valuable.

If you have any questions or concerns about this research, you can contact the lead researcher (Ryan Bodanyi) at (401) 829-6192 or by email.

Last updated: May 22, 2014

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Local Environment Survey

Survey Information Statement

Thanks for your interest in completing the 2014 Local Environmental Policy survey!

This survey is part of a research effort affiliated with University of Washington's Evans School of Public Affairs. The purpose of this research is to better understand what local governments in the United States are doing to protect the environment, and why. This may help local governments – and state and federal policymakers – better support those efforts.

Completing the survey should take you about 30 minutes. Only a few local governments have been selected to participate in this survey, so your participation is valuable. However

Yes, I Consent to Participate in this Research

The 2014 Local Environment Survey is part of a larger research effort, affiliated with University of Washington's Evans School of Public Affairs. The purpose of this research is to better understand what local governments in the United States are doing to protect the environment, and why. Only a few local governments have been selected to participate in this survey, so your participation is valuable.

If you have any questions or concerns about this research, you can contact the lead researcher (Ryan Bodanyi) at (401) 829-6192 or by email.

Last updated: May 18, 2014

Page 3:

Local Environment Survey

Part One: About You

0 of 52 Questions Completed

This section asks a few introductory questions about your role within local government. Remember that **all your answers will be treated confidentially**, and that **answers to all the questions are required**.

1. ***What's your first name?***

2. ***What's your last name?***

3. ***What's your email address?***

4. ***What's the name of the local government you work for? (e.g. "Maricopa County")***

5. ***Is the local government you work for a:***

- *County or Parish*
- *City, Town, or Village*
- *Township*
- *Borough*
- *Other*

6. ***In which state is it located?***

7. ***What's your job title with the local government?***

Submit and Continue

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If you have any questions or concerns about this research, you can contact the lead researcher (Ryan Bodanyi) at (401) 829-6192 or by email.

Last updated: May 24, 2014

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Local Environment Survey

Part Two: About The Local Government

7 of 52 Questions Completed

This section asks a few questions about the local government you work for. Remember that **all your answers will be treated confidentially**, and that **answers to all the questions are required**.

To the best of your knowledge, the local government you work for...

8. ***...currently has how many staff that work to protect the natural environment? Please give your best estimate in FTE (full-time equivalent) terms.***

(In other words, if four full-time employees each spend a quarter of their time on efforts to protect the environment, that would be one FTE staff person). Don't include temporary or contract employees.

9. ***...owns and/or operates an electric utility.***

- Yes
- No
- I don't know

10. ***...has elected leaders that are _____ in addressing climate change.***

- Very interested
- Somewhat interested
- Neither interested nor disinterested
- Somewhat disinterested
- Very disinterested

Submit and Continue

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Last updated: May 21, 2014

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Local Environment Survey

Part Three: Local Environmental Policies

10 of 52 Questions Completed

This section asks about the local environmental policies and activities of the local government you work for (which may include municipally-owned utilities). Remember that **all your answers will be treated confidentially**, and that **answers to all the questions are required**.

To the best of your knowledge, the local government you work for...

11. ***...has completed a community-wide inventory of greenhouse gas emissions.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

12. ***...has set formal goals or targets for the reduction of community-wide greenhouse gas emissions.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

13. ***...has created a formal plan to reduce community-wide greenhouse gas emissions.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

14. ***...has a policy to install energy-efficient lighting (e.g. in government buildings or streetlights).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

15. ***...has a policy to only purchase energy-efficient equipment and appliances, as certified by Energy Star.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

16. ***...has a policy to purchase and/or produce clean energy to power its operations.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

17. ***...has energy efficiency standards for the construction or renovation of government-owned buildings.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

18. ***...has regulations requiring private or commercial buildings to meet energy-efficiency construction or renovation standards.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

19. ***...has regulations requiring any new private or commercial buildings to incorporate passive heating, natural lighting, or photovoltaics.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

20. ***...has an anti-idling policy for government-owned vehicles.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

21. ***...bans or regulates idling for private or commercial vehicles.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

22. ***...has, within the past year, acquired hybrid or electric vehicles, alternative-fueled vehicles, or otherwise acted to green its vehicle fleet.***

- *Yes*
- *We're planning to/it's under consideration*
- *No*
- *I don't know*

23. ***...requires contractors to comply with environmental requirements (e.g. green purchasing, anti-idling, energy efficiency, or etc).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

24. ***...provides information to residents about environmentally-friendly behavior.***

- *Yes*
- *We're planning to/it's under consideration*
- *No*
- *I don't know*

Submit and Continue

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Last updated: May 21, 2014

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Local Environment Survey

Part Three: Local Environmental Policies

24 of 52 Questions Completed

This section asks about the local environmental policies and activities of the local government you work for (which may include municipally-owned utilities). Remember that **all your answers will be treated confidentially**, and that **answers to all the questions are required**.

To the best of your knowledge, the local government you work for...

25. ***...offers curbside recycling to residents.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

26. ***...offers composting of residential yard waste to residents.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *I don't know*

27. ***...requires energy audits for residential and commercial buildings before they're sold.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*

28. ***...offers low-interest loans to offset the cost of new, small-scale renewable energy systems (e.g. with a fund set up or administered by your local government).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

29. ***...offers other incentives for new, small-scale renewable energy systems (e.g. property tax exemptions/reductions; grants; rebates; technical assistance; streamlined or fast-track permitting processes, etc).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

30. ***...offers low-interest loans to support energy efficiency (e.g. the construction of new, energy-efficient homes or buildings; energy-efficiency audits or upgrades to existing buildings; the purchase of energy-efficient appliances, etc).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

31. ***...offers other incentives to support energy efficiency (e.g. grants, tax rebates, fast-track permitting, free supplies, etc).***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

32. ***...explicitly considers the effects its planning and zoning decisions have on sprawl or greenhouse gas emissions.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

33. ***...has adopted conservation easements, transfers of development rights, an urban growth boundary, and/or other growth management tools.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

34. ***...requires new developments to plant trees, and/or regulates when existing trees can be cut down.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

35. ***...explicitly considers how its decisions about mass transit service will affect sprawl or greenhouse gas emissions.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *Our local government does not participate in any mass transit service*
- *I don't know*

36. ***...has built new bicycle lanes, multiuse paths, and/or other bicycle and pedestrian amenities within the last year.***

- *Yes*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

37. ***...places a tax on carbon.***

- *Yes*
- *We're working on it/it's under consideration*
- *No*
- *No, because our local government lacks that authority*
- *I don't know*

Submit and Continue

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Last updated: May 21, 2014

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Local Environment Survey

Part Four: Finances

37 of 52 Questions Completed

In this section you'll be asked to ***estimate*** how much money the local government you work for spent, saved, and received because of the environmental efforts listed in this survey. Please use your ***best judgment***, and complete this section even if you have to guess. Remember that **all your answers will be treated confidentially**, and that **answers to all the questions are required**.

To the best of your knowledge, the local government you work for...

38. ***...spent how much to implement and administer the environmental efforts listed in this survey, in the most recently completed fiscal year? Please estimate these expenditures (e.g. staff time and equipment) as well as you can.***

in $ (dollars)

39. ***How sure are you that your estimate is within 10% of the real figure?***

- Very sure
- Fairly sure
- Neutral
- Fairly unsure
- Very unsure

40. ***Do you estimate these expenditures increased or decreased between the year of your estimate and the year just before?***

ON ESTIMATING

Quick, back-of-the-envelope estimates are good enough!

E.g., you might guess it takes 10 full-time staff to implement and administer the efforts listed in this survey. If you assume your local government spends an average of $200,000 for each full-time staff member, including benefits, that would be $2 million. And you might guess that other expenses – contractors, resources, oversight – add 50%, yielding a final estimate of $3 million.

You don't have to provide verified figures. Just use your best judgment to provide quick, thoughtful estimates.

FREQUENTLY ASKED QUESTIONS

- Increased
- Decreased

41. ***By what percent do you think these expenditures increased or decreased? Again, use your best judgment.***

_____ *in % (percent)*

42. ***...saved how much by implementing and administering the environmental efforts listed in this survey, in the most recently completed fiscal year? Please estimate these savings (e.g. reduced maintenance and energy bills) as well as you can.***

_____ *in $ (dollars)*

43. ***How sure are you that your estimate is within 10% of the real figure?***

- Very sure
- Fairly sure
- Neutral
- Fairly unsure
- Very unsure

44. ***Do you estimate these savings increased or decreased between the year of your estimate and the year just before?***

- Increased
- Decreased

45. ***By what percent do you think these savings increased or decreased? Again, use your best judgment.***

_____ *in % (percent)*

Q: What about environmental efforts that aren't listed in this survey? Should I include them in my estimates?

A: NO. **Your estimates should *only* reflect the environmental efforts listed in this survey.**

Q: What if the government I work for received a grant, but hasn't spent it yet? Should I include it in my revenue estimate?

A: Yes - as long as it's received ***because of*** **– or** ***for the purpose of*** **– one of the environmental efforts in this survey**, and within the last fiscal year.

Q: What if the government I work for saved money from an activity we completed years before – like a switch to LED lighting? Or spent money on something that hasn't saved us any money yet, but will in the long term?

A: **Your estimates should be limited to the last fiscal year.** Anything beyond that shouldn't be included.

Q: What if the government I work for received AND spent a grant within the last fiscal year?

A: Include the amount received in your revenue estimate, and the amount spent in your expenditure estimate.

46. ***...received how much by implementing and administering the environmental efforts listed in this survey, in the most recently completed fiscal year? Please estimate these revenues (e.g. external grants, fines, in-kind donations) as well as you can.***

_____ *in $ (dollars)*

47. ***How sure are you that your estimate is within 10% of the real figure?***

- ○ *Very sure*
- ○ *Fairly sure*
- ○ *Neutral*
- ○ *Fairly unsure*
- ○ *Very unsure*

48. ***Do you estimate these revenues increased or decreased between the year of your estimate and the year just before?***

- ○ *Increased*
- ○ *Decreased*

49. ***By what percent do you think these revenues increased or decreased? Again, use your best judgment.***

_____ *in % (percent)*

50. ***What percentage of these revenues came from non-governmental sources? Please give your best estimate.***

_____ *in % (percent)*

Submit and Continue

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Last updated: May 21, 2014

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Local Environment Survey

Part Five: Final Details!

50 of 52 Questions Completed

Remember that **all your answers will be treated confidentially**.

51. ***Do you have any additional comments that may be relevant? If so, please enter them here.***

52. ***Do you want to receive one or two emails over the next year about the results of this research?***

- Yes
- No (default option)

Submit and Finish

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If you have any questions or concerns about this research, you can contact the lead researcher (Ryan Bodanyi) at (401) 829-6192 or by email.

Last updated: May 21, 2014

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Local Environment Survey

Thank you!!

Thank you, thank you, thank you!!

You're one of 1380 people who kindly took the time to complete the 2014 Local Environment Survey.

But don't stop there! If you think someone else within your local government is qualified to complete the survey, let them know, using the tool below.

Your name:

Your email address:

Email to:
(Add as many emails as you like - just separate them with commas)

```
Hi,
I just took the Local Environment Survey, and I think you might want to as well. The email
I'm forwarding has all the details:


Hello,
My name is Ryan Bodanyi, and I'm a Ph.D. Candidate at the University of Washington's Evans
School of Public Affairs. I'm writing to invite you to participate in the Local
Environment Survey, at www.localenvironmentsurvey.com.
```

Sincerely,
[Your Name]

Send the email!

#	Local Government	State
1380	City of Kingston	New York
1379	DEKALB COUNTY	Illinois
1378	City of Troy	New York
1377	White County	Tennessee
1376	City of Tampa	Florida
1375	City of Tampa	Florida
1374	Roswell, Georgia	Georgia
1373	Pulaski County	Arkansas
1372	City of Urbana, IL	Illinois
1371	City of Oakland Park	Florida
1370	County of San Mateo	California
1369	City of high Point	North Carolina
1368	Mesa County	Colorado
1367	Newport News	Virginia
1366	Metro Louisville	Kentucky
1365	Town of Needham	Massachusetts
1364	City of Everett, Massachusetts	Massachusetts
1363	Shasta County	California
1362	Albany County	New York
1361	Albemarle County	Virginia
1360	City of Mission, Texas	Texas
1359	Jackson County	Oregon
1358	Logan County	Illinois
1357	Mower County	Minnesota
1356	DeSoto County Board of County Commissioners	Florida
1355	City of Sammamish	Washington
1354	Town of Groton, CT	Connecticut

APPENDIX 2: SURVEY RECRUITMENT LETTERS

First Email:

Subject: [Respondent Last Name]/[Government Name]: Take the Local Environment Survey

Hello,
My name is Ryan Bodanyi, and I'm a Ph.D. Candidate at the University of Washington's Evans School of Public Affairs. **I'm writing to invite you to participate in the Local Environment Survey, at www.localenvironmentsurvey.com** .

[Government Name] is one of the few governments that's been randomly selected to participate in this year's survey. The purpose of the survey is to better understand what local governments are doing to protect the environment, and why.

Completing the survey should take you 15-30 minutes – and since only a few governments have been selected, your participation is particularly valuable. Please complete this survey even if you know other people doing so – the more responses we receive from each location, the better.

Simply visit www.localenvironmentsurvey.com. Surprisingly little is known about the environmental efforts of local governments in the United States, but with the generous participation of people like you, that can change.

Sincerely,
Ryan Bodanyi
Ph.D. Candidate
Evans School of Public Affairs
University of Washington
http://evans.uw.edu/profile/bodanyi
www.localenvironmentsurvey.com

Second Email:

Hello again!
This is just a friendly reminder that we're hoping you'll complete the Local Environment Survey, at www.localenvironmentsurvey.com .

We know you may be too busy - public servants are increasingly being asked to do more with less. But if you can spare a few minutes, your answers will help reveal what local governments across the United States are doing to protect the environment, and why.

You can fill out the survey at www.localenvironmentsurvey.com . Thank you!

Sincerely,
Ryan Bodanyi
Ph.D. Candidate
Evans School of Public Affairs
University of Washington
http://evans.uw.edu/profile/bodanyi
www.localenvironmentsurvey.com

Third Email:

Hello again!
One last reminder: **our survey closes on July 15**. So please take a moment to visit www.localenvironmentsurvey.com, and share what you know about the environmental efforts of your local government.

And thank you!

Sincerely,
Ryan Bodanyi
Ph.D. Candidate
Evans School of Public Affairs
University of Washington
http://evans.uw.edu/profile/bodanyi
www.localenvironmentsurvey.com

APPENDIX 3: SENSITIVITY ANALYSIS FOR MODEL 1

In the following appendix I test how variations in several parameters affect the findings I reported in Model 1. Specifically, I:

a) Compare the results from a multilevel analysis with those obtained using OLS;
b) Examine the sensitivity of my findings to the number of survey respondents from each municipality.

MULTILEVEL ANALYSIS

Model 1 tests several motivations for local mitigation, including "influence from above" – that is, whether the state or federal government influences local mitigation efforts. To do so, I use OLS, which relies on the assumption that each municipality represents an independent observation, with independently distributed errors. Yet municipalities within the same state are subject to the same state-level political conditions and influence. This leads Krause to argue that OLS may underestimate the standard errors for state-level variables, and therefore inflate the statistical significance of state-level policies on local mitigation (2011c).

Multilevel analysis[117] resolves this problem, because it "allows independent variables at different levels to be analyzed simultaneously and accounts for the likelihood that observations of cities within the same state are not completely independent of each other" (Krause, 2011c, p. 52). That is, multilevel modeling assumes that the dependent variable, *Y*, is influenced both by individual "level-1" (local) variables, and by group "level-2" (state) variables.

From there, matters become somewhat more complex. There are fixed effects models, random effects models, and mixed effects models which combine both fixed and random elements. And if a model involving random effects is chosen, a second choice presents itself: whether to model the random effects using a random intercept model or a random coefficient model.

I choose a mixed-effects, random intercept model, which takes the general form of:

$$Y_{ms} = \beta_{0s} + \beta_{1s}X_{ms} + r_{ms}$$

where

$$\beta_{0s} = \gamma_{00} + \gamma_{01}Z_{1s} + u_{0s}$$

$$\beta_{1s} = \gamma_{10}$$

where *m* represents municipalities, *s* represents states, and β_{0s} is the intercept, which varies according to the value of the level-2 state variable Z_{1s} and the error term u_{0s}.

[117] Also known by other names, including hierarchical linear modeling.

A random coefficient model differs in that, *in addition* to allowing the intercept to vary across clusters (states, in this case), it allows the coefficients of level-1 (municipal) variables to vary across states as well. Let's illustrate this concept with a fictitious variable: the salaries paid by manufacturing businesses to workers within each municipality (`manufacturing`). A random coefficient model assumes that the *effect* of `manufacturing` differs across states, so that it cannot be accurately estimated without knowing both the municipal amount (say $4 million) ***and*** the state (say, Michigan).

It's easy to see how the effect of local manufacturing payrolls – that is, the strength of manufacturing in a local economy – on *state-level* policy may differ, depending on state-level factors (such as the strength of manufacturing in the state economy). A local manufacturing business with a payroll of $4 million in Michigan is more likely to be able to influence state policy than a business with an identical payroll in Hawaii, because manufacturing makes up a larger proportion of the economic base in Michigan than in Hawaii. The voice of that $4 million business is magnified in Michigan because it is part of a much, much larger chorus. Therefore the effect of local manufacturing payrolls on *state*-level variables – such as state-level mitigation targets – may indeed differ across states in some systematic way.

However in this study, we are modeling effects in the other direction – on mitigation decisions taken at the local level. To continue with this particular example, we've already controlled for the direct effect of local manufacturing on local mitigation decisions generally – that's the fixed effect. And we've already controlled for the state-level effect of mitigation targets on local mitigation efforts by including this level-2 variable in the random intercept. A random coefficient model would be a superior model if we believed that the effect of local manufacturing *on local mitigation decisions* differed *across states* in some systematic way. I argue that if it does, the most obvious avenues of that influence – on state-level energy and climate policy – have already been controlled for.

The specification of my mixed-effects, random intercept model looks like this:

$$netspent_{ms} = \beta_{0s} + \beta_1(coastvuln_{ms}) + \beta_2(hazardcost_{ms}) + \beta_3(hazardcasualties_{ms}) + \beta_4(libvoting_{ms}) + \beta_5(polsupport_{ms}) + \beta_6(carbemploy_{ms}) + \beta_7(medincome_{ms}) + \beta_8(munirevenue_{ms}) + \beta_9(pop_{ms}) + \beta_{10}(pop^2_{ms}) + \beta_{11}(educ_{ms}) + \beta_{12}(colltown_{ms}) + \beta_{13}(muniutil_{ms}) + \beta_{14}(staff_{ms}) + \beta_{15}(estsavings_{ms}) + \beta_{16}(cleanair_{ms}) + \beta_{17}(transit_{ms}) + \beta_{18}(govfund_{ms}) + \beta_{19}(dillons_{ms})$$

where

$$\beta_0 = \gamma_{00} + \gamma_{01}(stmandate_s) + \gamma_{02}(stplan_s) + \gamma_{03}(sttarget_s) + \gamma_{04}(stpolicies_s) + u_0$$
$$\beta_1 = \gamma_{10}$$
$$\beta_2 = \gamma_{20}$$
$$\beta_3 = \gamma_{30}$$
$$\beta_4 = \gamma_{40}$$
$$\beta_5 = \gamma_{50}$$
$$\beta_6 = \gamma_{60}$$
$$\beta_7 = \gamma_{70}$$

$$\beta_8 = \gamma_{80}$$
$$\beta_9 = \gamma_{90}$$
$$\beta_{10} = \gamma_{100}$$
$$\beta_{11} = \gamma_{110}$$
$$\beta_{12} = \gamma_{120}$$
$$\beta_{13} = \gamma_{130}$$
$$\beta_{14} = \gamma_{140}$$
$$\beta_{15} = \gamma_{150}$$
$$\beta_{16} = \gamma_{160}$$
$$\beta_{17} = \gamma_{170}$$
$$\beta_{18} = \gamma_{180}$$
$$\beta_{19} = \gamma_{190}$$

Both `govfund` and `dillons` are level-1 (local) rather than level-2 (state) variables, because they vary on the local (rather than state) level – meaning that municipalities *within* the same state may receive differing levels of mitigation funding from state and federal sources, and may score differently on the Dillon's Rule dichotomous variable.

Using multilevel analysis rather than OLS resolves the problem identified by Krause – that OLS results may overstate the statistical significance of the four state-level variables. But using multilevel analysis creates its own problem – it relies on maximum likelihood estimation, which performs best at large sample sizes. Studenmund cites a preference for samples sizes of 500 or more (2011, p. 442), but opinions differ and there are no firm guidelines. Model 1 has only 294 observations, which suggests multilevel analysis may not be a superior method for this dataset.

Results from both methods are presented side-by-side in Table 29. As you can see, the coefficients are unchanged, but the standard errors are consistently smaller – even for the state-level variables that led us to explore multilevel analysis in the first place. The new standard errors don't change the findings from OLS – with the exception of `stpolicies`, which is significant in the multilevel model. So multilevel modeling largely replicates the results from OLS – and the assumption that OLS overstates the statistical significance of state-level variables appears unfounded.

NUMBER OF SURVEY RESPONDENTS

I also examine how the number of survey respondents influences the reported results. In addition to the original Model 1, Table 30 presents the results from two additional analyses: one restricted to incorporated places with two or more respondents; the other, with three or more respondents. And as you can see, the results from Model 1 remain robust across Models 25 and 26: the same variables are statistically significant, and with little change in their reported results.

CONCLUSION

This appendix tested the sensitivity of Model 1 in two respects:

a) To determine whether the use of OLS, as a statistical method, inflates the statistical significance of the state-level variables, as hypothesized by Krause (2011c);
b) To determine whether the reported results are sensitive to the number of survey respondents from each municipality.

In each case, the results support Model 1. OLS doesn't inflate the statistical significance of the state-level variables, and so remains the best choice of statistical method. And the results in Model 1 remain unchanged as the number of respondents vary, indicating results that are consistent and robust.

The next appendix conducts a similar sensitivity analysis for Model 7.

Table 29: Net Mitigation Spending By Incorporated Places: OLS vs. Multilevel Analysis

		Model 1	Model 10
About the Model	**Dependent Variable**	netspent	netspent
	Statistical Method	OLS	Multilevel Analysis
	Adjusted R^2	.7623	–
	Observations	294	294
	Units	$ (in 1000s)	$ (in 1000s)
	Constant	-1037.94	-1037.94
Climate Risk	**coastvuln**	-178.37 *(209.18)*	-178.37 *(200.47)*
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*
	hazardcasualties	-0.27 *(0.24)*	-0.27 *(0.23)*
Internal Determinants	**libvoting**	3.86 *(762.31)*	3.86 *(730.53)*
	polsupport	12.07 *(101.49)*	12.07 *(97.26)*
	carbemploy	330.95 *(1368.14)*	330.95 *(1311.11)*
	medincome	-4.60 *(7.26)*	-4.60 *(6.96)*
	munirevenue	0.00 *(0.00)*	0.00 *(0.00)*
	pop	7.22*** *(1.22)*	7.22*** *(1.17)*
	pop (squared)	-0.01*** *(0.00)*	-0.01*** *(0.00)*
	educ	297.96 *(1011.68)*	297.96 *(969.51)*
	colltown	334.56 *(423.12)*	334.56 *(405.49)*
	muniutil	-104.86 *(259.63)*	-104.86 *(248.81)*
	staff	2.27* *(1.24)*	2.27* *(1.19)*
Excludable Benefits	**estsavings**	0.18*** *(0.05)*	0.18*** *(0.05)*
	cleanair	28.78 *(188.51)*	28.78 *(180.66)*
	transit	500.40 *(841.76)*	500.40 *(806.67)*
Influence From Above	**stmandate**	-389.82 *(270.74)*	-389.82 *(259.45)*
	govfund	-0.68*** *(0.07)*	-0.68*** *(0.07)*
	dillons	119.95 *(161.16)*	119.95 *(154.44)*
	stplan	77.03 *(257.61)*	77.03 *(246.87)*
	sttarget	-282.13 *(251.50)*	-282.13 *(241.02)*
	stpolicies	53.66* *(28.59)*	53.66** *(27.40)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 30: Net Mitigation Spending By Cities: Sensitivity to the Number of Survey Respondents				
		Model 1	**Model 11**	**Model 12**
About the Model	**Dependent Variable**	netspent	netspent	netspent
	Respondents	>=1	>=2	>=3
	Statistical Method	OLS	OLS	OLS
	Adjusted R^2	.7623	.7741	.8318
	Observations	294	193	99
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-1037.94	-977.52	-1872.36
Climate Risk	**coastvuln**	-178.37 *(209.18)*	-213.68 *(304.01)*	-156.01 *(485.15)*
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*	0.00 *(0.00)*
	hazardcasualties	-0.27 *(0.24)*	-0.22 *(0.29)*	-0.39 *(0.39)*
Internal Determinants	**libvoting**	3.86 *(762.31)*	-875.50 *(1148.66)*	-889.24 *(1929.06)*
	polsupport	12.07 *(101.49)*	-26.70 *(190.69)*	167.97 *(354.55)*
	carbemploy	330.95 *(1368.14)*	622.78 *(1979.44)*	148.46 *(3187.26)*
	medincome	-4.60 *(7.26)*	-6.93 *(9.86)*	-13.81 *(19.39)*
	munirevenue	0.00 *(0.00)*	0.00 *(0.00)*	0.00 *(0.00)*
	pop	7.22*** *(1.22)*	8.19*** *(1.70)*	10.76*** *(2.49)*
	pop (squared)	-0.01*** *(0.00)*	-0.01*** *(0.00)*	-0.01*** *(0.00)*
	educ	297.96 *(1011.68)*	916.54 *(1449.76)*	1419.54 *(2908.63)*
	colltown	334.56 *(423.12)*	448.08 *(582.78)*	1454.88 *(1077.53)*
	muniutil	-104.86 *(259.63)*	-140.38 *(408.61)*	-242.37 *(648.06)*
	staff	2.27* *(1.24)*	1.96 *(1.72)*	-0.96 *(2.64)*
Excludable Benefits	**estsavings**	0.18*** *(0.05)*	0.17*** *(0.06)*	0.20** *(0.08)*
	cleanair	28.78 *(188.51)*	64.70 *(276.32)*	6.20 *(459.29)*
	transit	500.40 *(841.76)*	652.06 *(1267.30)*	916.99 *(2039.79)*
Influence From Above	**stmandate**	-389.82 *(270.74)*	-225.15 *(408.04)*	-845.28 *(708.14)*
	govfund	-0.68*** *(0.07)*	-0.69*** *(0.09)*	-0.67*** *(0.12)*
	dillons	119.95 *(161.16)*	76.18 *(240.90)*	455.55 *(416.97)*
	stplan	77.03 *(257.61)*	395.20 *(377.79)*	222.28 *(642.51)*
	sttarget	-282.13 *(251.50)*	-322.17 *(368.96)*	120.71 *(614.11)*
	stpolicies	53.66* *(28.59)*	60.31 *(42.96)*	73.79 *(73.92)*
***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*				

APPENDIX 4: SENSITIVITY ANALYSIS FOR MODEL 7

This appendix closely resembles Appendix 3. As in that appendix, I test a model – Model 7, in this case – to determine how parameter variations influence the reported findings. More specifically, I:

a) Compare the results from a multilevel analysis with those obtained using OLS;
b) Examine the sensitivity of my findings to the number of survey respondents from each municipality.

MULTILEVEL ANALYSIS

Krause (2011c) hypothesizes that, because OLS relies on the assumption that each municipality represents an independent observation, OLS results may overstate the statistical significance of state-level explanatory variables. Instead, she recommends the use of multilevel analysis, which resolves this problem.[118]

So as in Appendix 3, I report both: the original OLS results side-by-side with those from a multilevel analysis, using the same specification I detailed in Appendix 3. Table 31 presents these results.[119]

Again, the coefficients are unchanged, but the standard errors do change – and those changes make two variables significant in the multilevel model that weren't significant in Model 7.[120] However neither change supports the contention that OLS overstates the significance of the state-level variables. The multilevel model does generate larger standard errors for `dillons`, `sttarget`, and `stpolicies`, but that doesn't alter the original OLS findings of statistical significance. Therefore, as in Appendix 3, it appears unfounded that the OLS findings are unreliable for state-level variables.

NUMBER OF SURVEY RESPONDENTS

As in Appendix 3, I examine how the number of survey respondents influences the results. The models are presented in Table 32; Models 28 and 29 are restricted to municipalities with at least two respondents and those with at least three, respectively.

The analysis indicates that Model 7's results are not robust to variations in the number of respondents. `Stplan`, `pop`, and `munirevenue` all lose their statistical significance, while `libvoting`

[118] But creates another: that of potentially too-few observations for a credible maximum likelihood estimation (only 255 for counties). See Appendix 3 for more details.

[119] The rows for `colltown`, `muniutil`, and `stmandate` are shaded – in this table as well as in Tables 39 and 40 – to remind the reader that these results are based on very few observations, and therefore, quite likely, unreliable.

[120] Although it's worth noting that Model 7 is run with robust standard errors, and the multilevel results closely resemble the OLS results ***without*** robust standard errors.

suddenly becomes significant in the latter model. This may simply be a reflection of the fact that municipalities in liberal areas have more staff that respond to a survey about their environmental initiatives, but it would give us greater confidence in the results if they were more consistent.

CONCLUSION

Model 7 isn't as robust as Model 1, but the sensitivity analyses presented here indicate that:

a) OLS doesn't inflate the statistical significance of the state-level variables, as Krause (2011c) hypothesized, and so it remains the best choice of statistical method.

b) The results *are* sensitive to the number of survey respondents. Even if this doesn't incite our distrust, it doesn't increase our confidence, either.

Table 31: Net Mitigation Spending By Counties: OLS vs. Multilevel Analysis

		Model 7	Model 13
About the Model	**Dependent Variable**	netspent	netspent
	Statistical Method	OLS	Multilevel Analysis
	Adjusted R^2	.2216	–
	Observations	255	255
	Units	$ (in 1000s)	$ (in 1000s)
	Constant	-985.30	-985.30
Climate Risk	**coastvuln**	163.01 *(205.08)*	163.01 *(197.55)*
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*
	hazardcasualties	-0.24* *(0.13)*	-0.24 *(0.25)*
Internal Determinants	**libvoting**	-1666.63* *(919.26)*	-1666.63* *(912.14)*
	polsupport	260.01*** *(98.11)*	260.01*** *(94.69)*
	carbemploy	952.08 *(830.17)*	952.08 *(993.24)*
	medincome	16.15 *(14.05)*	16.15 *(12.08)*
	munirevenue	0.00** *(0.00)*	0.00*** *(0.00)*
	pop	0.55 *(0.56)*	0.55 *(0.42)*
	pop (squared)	-0.00** *(0.00)*	-0.00*** *(0.00)*
	educ	471.75 *(1323.74)*	471.75 *(1651.29)*
	colltown	99.35 *(244.5078)*	99.35 *(492.7596)*
	muniutil	-82.00 *(1152.56)*	-82.00 *(757.40)*
	staff	0.82 *(0.76)*	0.82 *(0.82)*
Excludable Benefits	**estsavings**	-0.33 *(0.38)*	-0.33** *(0.16)*
	cleanair	277.23 *(238.74)*	277.23 *(211.45)*
	transit	-869.80 *(732.51)*	-869.80 *(932.37)*
Influence From Above	**stmandate**	2532.74 *(1906.00)*	2532.74*** *(577.38)*
	govfund	0.23 *(0.45)*	0.23 *(0.19)*
	dillons	-53.22 *(155.69)*	-53.22 *(195.77)*
	stplan	601.87** *(268.58)*	601.87** *(240.06)*
	sttarget	-126.51 *(180.69)*	-126.51 *(216.78)*
	stpolicies	-22.01 *(23.11)*	-22.01 *(30.47)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*

Table 32: Net Mitigation Spending By Counties: Sensitivity to the Number of Survey Respondents				
		Model 7	**Model 14**	**Model 15**
About the Model	**Dependent Variable**	netspent	netspent	netspent
	Respondents	>=1	>=2	>=3
	Statistical Method	OLS	OLS	OLS
	Adjusted R^2	.2216	.2679	.1834
	Observations	255	156	81
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-985.30	-1201.88	-497.65
Climate Risk	**coastvuln**	163.01 *(205.08)*	-105.37 *(274.68)*	-123.18 *(343.91)*
	hazardcost	0.00 *(0.00)*	-0.00 *(0.00)*	0.00 *(0.00)*
	hazardcasualties	-0.24* *(0.13)*	-0.27* *(0.15)*	-0.14 *(0.17)*
Internal Determinants	**libvoting**	-1666.63* *(919.26)*	-2159.69* *(1117.43)*	-4250.38** *(2106)*
	polsupport	260.01*** *(98.11)*	563.45*** *(188.03)*	583.46** *(275.80)*
	carbemploy	952.08 *(830.17)*	155.72 *(1086.57)*	59.10 *(1919.30)*
	medincome	16.15 *(14.05)*	13.67 *(15.85)*	-13.90 *(23.11)*
	munirevenue	0.00** *(0.00)*	0.00** *(0.00)*	0.00 *(0.00)*
	pop	0.55 *(0.56)*	0.48 *(0.96)*	0.59 *(1.46)*
	pop (squared)	-0.00** *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	educ	471.75 *(1323.74)*	-553.39 *(1658.22)*	3054.47 *(2820.40)*
	colltown	99.35 *(244.51)*	22.35 *(371.28)*	339.48 *(833.15)*
	muniutil	-82.00 *(1152.56)*	*(dropped)*	*(dropped)*
	staff	0.82 *(0.76)*	0.72 *(0.70)*	-2.44 *(3.06)*
Excludable Benefits	**estsavings**	-0.33 *(0.38)*	-0.22 *(0.54)*	0.91 *(1.20)*
	cleanair	277.23 *(238.74)*	517.95* *(288.47)*	979.15* *(571.45)*
	transit	-869.80 *(732.51)*	-994.38 *(967.65)*	367.85 *(1879.08)*
Influence From Above	**stmandate**	2532.74 *(1906.00)*	4113.07* *(2291.90)*	3917.12 *(3840.07)*
	govfund	0.23 *(0.45)*	-0.47 *(0.80)*	-0.37 *(0.90)*
	dillons	-53.22 *(155.69)*	182.90 *(172.93)*	453.11 *(304.49)*
	stplan	601.87** *(268.58)*	762.72* *(399.45)*	914.06 *(573.10)*
	sttarget	-126.51 *(180.69)*	77.53 *(219.51)*	-129.12 *(378.69)*
	stpolicies	-22.01 *(23.11)*	-37.48 *(36.00)*	-30.46 *(55.29)*
***significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses.*				

APPENDIX 5: INDEPENDENT TESTING OF MOTIVATIONS FOR INCORPORATED PLACES

Krause (2012) tests multiple explanations for municipal mitigation in a single model, arguing this is superior to models that test one motivation at a time, because they may be affected by omitted variable bias. However she presents the models which test the motivations individually as well, and I do the same for incorporated places in Tables 38-43. But first, I reclassify several variables as control variables so that they can appear in each model: the basic demographic variables `pop`, `medincome`, and `educ`, as well as `dillons`, which measures the authority available to each municipality. The remaining variables appear in only one of the individual models for each dependent variable, corresponding to the motivation they're intended to examine.

Both the sign and statistical significance of variables occasionally change between models that test motivations individually (e.g. Models 25-28), and those which examine motivations collectively (e.g. Model 1). This is unsurprising: to a greater or lesser extent, the individual models are afflicted by omitted variable bias. Theoretically, we know this because of the justifications for each variable on pages 23-35. Statistically, we know this because the adjusted r-squared for each of the individual models is consistently lower than for the collective model.

For example, the collective Model 2 explains nearly 85% of the variation in estcost, while Model 15, which tests the climate risk motivation specifically, explains just under 19%. The variables that remain in Model 15 are likely correlated, to some degree, with the variables that have been dropped – and if so, their estimates and statistical significance will be biased to that degree. So when `medincome` (median household income) blooms into statistical significance in Model 15, while remaining insignificant in the collective Model 2, that change shouldn't undermine our credibility in the collective model. Quite the opposite: the limited Model 15 is likely afflicted by omitted variable bias, and its estimates and findings of statistical significance are less reliable.

Nevertheless, I follow the lead of Krause (2012) in presenting the models which test motivations individually here, partly because such models can be helpful in reviewing whether the collective model is affected by multicollinearity. I do the same for counties in the next appendix.

Table 33: Net Mitigation Spending By Incorporated Places: Testing Motivations Individually and Collectively

		Model 1	Model 16	Model 17	Model 18	Model 19
About the Model	**Dependent Variable**	netspent	netspent	netspent	netspent	netspent
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.7623	.6867	.6825	.6848	.7511
	Observations	294	299	296	299	297
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-1037.94	-108.21	235.62	-222.08	-807.48
Control Variables	**pop**	7.22*** *(1.22)*	10.55*** *(0.87)*	9.88*** *(1.33)*	10.41*** *(0.89)*	9.69*** *(0.78)*
	pop (squared)	-0.01*** *(0.00)*	-0.01*** *(0.00)*	-0.01*** *(0.00)*	-0.01*** *(0.00)*	-0.01*** *(0.00)*
	medincome	-4.60 *(7.26)*	-5.47 *(5.04)*	-3.70 *(6.39)*	-9.98 *(6.53)*	-7.46 *(4.57)*
	educ	297.96 *(1011.68)*	272.72 *(748.93)*	-124.37 *(1003.24)*	664.16 *(820.21)*	880.50 *(668.88)*
	dillons	119.95 *(161.16)*	149.49 *(173.04)*	130.00 *(173.10)*	122.52 *(171.48)*	56.89 *(158.98)*
Climate Risk	**coastvuln**	-178.37 *(209.18)*	-149.30 *(178.30)*	–	–	–
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.27 *(0.24)*	-0.35 *(0.26)*	–	–	–
Internal Determinants	**libvoting**	3.86 *(762.31)*	–	-296.76 *(756.34)*	–	–
	polsupport	12.07 *(101.496)*	–	-61.85 *(112.02)*	–	–
	carbemploy	330.95 *(1368.14)*	–	-77.33 *(1546.18)*	–	–
	munirevenue	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
	colltown	334.56 *(423.12)*	–	417.14 *(472.30)*	–	–
	muniutil	-104.86 *(259.63)*	–	-190.91 *(286.58)*	–	–
	staff	2.27* *(1.24)*	–	0.03 *(1.31)*	–	–
Excludable Benefits	**estsavings**	0.18*** *(0.05)*	–	–	-0.03 *(0.05)*	–
	cleanair	28.78 *(188.51)*	–	–	24.99 *(198.99)*	–
	transit	500.40 *(841.76)*	–	–	550.31 *(888.85)*	–
Influence From Above	**stmandate**	-389.82 *(270.74)*	–	–	–	-522.27** *(265.37)*
	govfund	-0.68*** *(0.07)*	–	–	–	-0.52*** *(0.06)*
	stplan	77.03 *(257.61)*	–	–	–	71.56 *(246.36)*
	sttarget	-282.13 *(251.50)*	–	–	–	-197.00 *(241.42)*
	stpolicies	53.66* *(28.59)*	–	–	–	46.08* *(26.23)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 34: Gross Mitigation Spending By Incorporated Places: Testing Motivations Individually and Collectively

		Model 2	Model 20	Model 21	Model 22	Model 23
About the Model	**Dependent Variable**	estcost	estcost	estcost	estcost	estcost
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.8481	.1882	.3366	.8094	.5270
	Observations	295	316	311	302	301
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-1104.31	-166.54	-2384.72	-8.20	-1206.45
Control Variables	**pop**	7.44** *(3.11)*	10.67*** *(3.71)*	6.57* *(3.72)*	7.61*** *(1.80)*	14.97*** *(2.53)*
	pop (squared)	-0.01*** *(0.00)*	-0.00*** *(0.00)*	-0.00* *(0.00)*	-0.00*** *(0.00)*	-0.01*** *(0.00)*
	medincome	-3.28 *(5.31)*	-17.76** *(8.81)*	-10.19 *(13.39)*	-4.54 *(5.19)*	-12.81 *(8.47)*
	educ	241.02 *(775.34)*	3959.98* *(2256.37)*	3953.02 *(2885.13)*	774.88 *(777.36)*	2261.92 *(1529.87)*
	dillons	134.58 *(165.61)*	-91.93 *(324.00)*	-15.58 *(289.14)*	13.80 *(161.41)*	129.24 *(252.14)*
Climate Risk	**coastvuln**	-208.83 *(161.40)*	210.92 *(317.10)*	–	–	–
	hazardcost	0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.31* *(0.16)*	-0.63 *(0.28)*	–	–	–
Internal Determinants	**libvoting**	108.90 *(573.59)*	–	-598.53 *(812.26)*	–	–
	polsupport	15.48 *(82.14)*	–	501.95** *(225.71)*	–	–
	carbemploy	209.96 *(1160.68)*	–	802.05 *(1491.23)*	–	–
	munirevenue	0.00 *(0.00)*	–	-0.00 *(0.00)*	–	–
	colltown	336.10 *(440.79)*	–	-869.70 *(1120.66)*	–	–
	muniutil	-70.81 *(263.59)*	–	1226.13 *(941.57)*	–	–
	staff	2.86* *(1.67)*	–	15.48 *(9.84)*	–	–
Excludable Benefits	**estsavings**	1.17*** *(0.06)*	–	–	1.40*** *(0.19)*	–
	cleanair	61.63 *(180.41)*	–	–	-104.79 *(218.48)*	–
	transit	324.10 *(713.29)*	–	–	127.96 *(725.54)*	–
Influence From Above	**stmandate**	-391.68* *(220.33)*	–	–	–	-1165.65*** *(402.54)*
	govfund	0.59*** *(0.12)*	–	–	–	1.47*** *(0.42)*
	stplan	89.20 *(255.35)*	–	–	–	200.07 *(285.55)*
	sttarget	-276.70 *(230.17)*	–	–	–	97.37 *(389.61)*
	stpolicies	51.06* *(30.20)*	–	–	–	34.21 *(36.82)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 35: Regulatory Preferences By Incorporated Places: Testing Motivations Individually and Collectively

		Model 3	Model 24	Model 25	Model 26	Model 27
About the Model	**Dependent Variable**	regpref	regpref	regpref	regpref	regpref
	Statistical Method	GLM	GLM	GLM	GLM	GLM
	Adjusted R^2	–	–	–	–	–
	Observations	293	336	326	297	300
	Units	% Reg Policies	% Reg Policies	% Reg Policies	% Reg Policies	% Reg Policies
	Constant	-3.43	-2.53	-3.14	-3.31	-3.14
Control Variables	**pop**	–	–	–	–	–
	pop (log)	0.15** *(0.07)*	0.19*** *(0.05)*	0.13* *(0.08)*	0.17*** *(0.06)*	0.18*** *(0.06)*
	medincome	0.00 *(0.00)*	0.00 *(0.00)*	0.01** *(0.00)*	-0.00 *(0.00)*	-0.00 *(0.00)*
	educ	0.60 *(0.65)*	1.00** *(0.45)*	-0.08 *(0.56)*	-1.09** *(0.47)*	-1.01** *(0.44)*
	dillons	-0.16 *(0.11)*	-0.15 *(0.10)*	-0.13 *(0.10)*	-0.17 *(0.11)*	-0.16 *(0.11)*
Climate Risk	**coastvuln**	0.06 *(0.14)*	0.42*** *(0.10)*	–	–	–
	hazardcost	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
Internal Determinants	**libvoting**	0.10 *(0.47)*	–	0.59 *(0.41)*	–	–
	polsupport	0.20*** *(0.08)*	–	0.27*** *(0.07)*	–	–
	carbemploy	-1.71 *(1.19)*	–	-1.69 *(1.13)*	–	–
	munirevenue	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
	colltown	0.03 *(0.25)*	–	0.26 *(0.24)*	–	–
	muniutil	0.15 *(0.16)*	–	0.10 *(0.16)*	–	–
	staff	-0.00* *(0.00)*	–	-0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00** *(0.00)*	–	–	0.00** *(0.00)*	–
	cleanair	-0.34** *(0.13)*	–	–	-0.35*** *(0.13)*	–
	transit	1.08* *(0.64)*	–	–	1.33** *(0.62)*	–
Influence From Above	**stmandate**	0.64*** *(0.17)*	–	–	–	0.57*** *(0.16)*
	govfund	0.00* *(0.00)*	–	–	–	0.00*** *(0.00)*
	stplan	0.26 *(0.17)*	–	–	–	0.27* *(0.15)*
	sttarget	-0.41** *(0.17)*	–	–	–	-0.32** *(0.16)*
	stpolicies	0.04** *(0.02)*	–	–	–	0.05** *(0.02)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 36: Mitigation Policies By Incorporated Places: Testing Motivations Individually and Collectively

		Model 4	Model 28	Model 29	Model 30	Model 31
About the Model	**Dependent Variable**	tota	tota	tota	tota	tota
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.4234	.1931	.3115	.1933	.3384
	Observations	282	340	330	308	304
	Units	# of Policies	# of Policies	# of Policies	# of Policies	# of Policies
	Constant	-5.57	-1.15	-5.94	0.06	-2.98
Control Variables	**pop**	–	–	–	–	–
	pop (log)	0.92*** *(0.36)*	1.79*** *(0.27)*	1.01*** *(0.36)*	1.55*** *(0.31)*	1.51*** *(0.29)*
	medincome	-0.00 *(0.02)*	-0.00 *(0.01)*	0.03* *(0.02)*	0.00 *(0.02)*	-0.02 *(0.01)*
	educ	4.59* *(2.63)*	6.19*** *(1.90)*	1.55 *(2.32)*	4.38** *(2.21)*	6.36*** *(1.83)*
	dillons	-0.80* *(0.42)*	-0.71 *(0.44)*	-0.48 *(0.41)*	-0.72 *(0.46)*	-0.83* *(0.44)*
Climate Risk	**coastvuln**	-0.26 *(0.55)*	1.72*** *(0.45)*	–	–	–
	hazardcost	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
Internal Determinants	**libvoting**	-0.77 *(1.99)*	–	1.65 *(1.77)*	–	–
	polsupport	1.60*** *(0.26)*	–	1.89*** *(0.26)*	–	–
	carbemploy	-1.12 *(3.59)*	–	-0.81 *(3.57)*	–	–
	munirevenue	0.00 *(0.00)*	–	-0.00** *(0.00)*	–	–
	colltown	-0.55 *(1.11)*	–	0.78 *(1.09)*	–	–
	muniutil	0.56 *(0.68)*	–	0.67 *(0.67)*	–	–
	staff	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00** *(0.00)*	–	–	0.00*** *(0.00)*	–
	cleanair	-1.07** *(0.49)*	–	–	-0.22 *(0.54)*	–
	transit	3.47 *(2.20)*	–	–	2.53 *(2.36)*	–
Influence From Above	**stmandate**	4.01*** *(0.70)*	–	–	–	3.67*** *(0.73)*
	govfund	0.00 *(0.00)*	–	–	–	0.00*** *(0.00)*
	stplan	1.96*** *(0.67)*	–	–	–	2.07*** *(0.68)*
	sttarget	-1.63** *(0.66)*	–	–	–	-1.60** *(0.67)*
	stpolicies	0.12* *(0.07)*	–	–	–	0.18** *(0.07)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 37: Climate Plans By Incorporated Places: Testing Motivations Individually and Collectively

		Model 5	Model 32	Model 33	Model 34	Model 35
About the Model	**Dependent Variable**	muniplana	muniplana	muniplana	muniplana	muniplana
	Statistical Method	Logit	Logit	Logit	Logit	Logit
	Adjusted R^2	–	–	–	–	–
	Observations	274	328	319	298	296
	Units	Log Odds	Log Odds	Log Odds	Log Odds	Log Odds
	Constant	-6.69	-4.31	-11.18	-3.67	-3.69
Control Variables	**pop**	-0.00 *(0.00)*	0.01 *(0.00)*	0.00 *(0.00)*	0.00*** *(0.00)*	0.00*** *(0.00)*
	pop (squared)	–	–	–	–	–
	medincome	-0.02 *(0.02)*	-0.01 *(0.01)*	0.01 *(0.01)*	0.00 *(0.01)*	-0.02 *(0.01)*
	educ	3.76 *(3.15)*	3.48** *(1.59)*	0.68 *(2.02)*	2.50 *(1.79)*	3.61** *(1.56)*
	dillons	0.61 *(0.56)*	0.34 *(0.40)*	0.26 *(0.42)*	0.35 *(0.42)*	0.43 *(0.44)*
Climate Risk	**coastvuln**	1.19 *(0.78)*	1.48*** *(0.48)*	–	–	–
	hazardcost	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.01 *(0.00)*	-0.01** *(0.00)*	–	–	–
Internal Determinants	**libvoting**	4.20 *(2.71)*	–	4.96** *(2.00)*	–	–
	polsupport	0.89** *(0.42)*	–	1.17*** *(0.34)*	–	–
	carbemploy	-1.04 *(4.01)*	–	0.85 *(3.64)*	–	–
	munirevenue	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
	colltown	-0.89 *(1.38)*	–	0.13 *(0.95)*	–	–
	muniutil	-0.52 *(0.96)*	–	0.19 *(0.75)*	–	–
	staff	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00 *(0.00)*	–	–	0.00 *(0.00)*	–
	cleanair	-0.92 *(0.62)*	–	–	-0.47 *(0.47)*	–
	transit	2.02 *(2.71)*	–	–	1.15 *(2.22)*	–
Influence From Above	**stmandate**	3.06*** *(0.90)*	–	–	–	2.25*** *(0.68)*
	govfund	0.00 *(0.00)*	–	–	–	0.00 *(0.00)*
	stplan	1.74 *(1.08)*	–	–	–	1.99** *(0.87)*
	sttarget	-0.23 *(0.88)*	–	–	–	-0.44 *(0.66)*
	stpolicies	-0.25** *(0.12)*	–	–	–	-0.07 *(0.09)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

Table 38: Climate Network Membership By Incorporated Places: Testing Motivations Individually and Collectively

		Model 6	Model 36	Model 37	Model 38	Model 39
About the Model	**Dependent Variable**	networkmem	networkmem	networkmem	networkmem	networkmem
	Statistical Method	Logit	Logit	Logit	Logit	Logit
	Adjusted R^2	–	–	–	–	–
	Observations	282	508	330	301	304
	Units	Log Odds	Log Odds	Log Odds	Log Odds	Log Odds
	Constant	-4.17	-1.16	-3.72	-1.65	-1.77
Control Variables	**pop**	0.00* *(0.00)*	0.01*** *(0.00)*	0.00 *(0.00)*	0.01*** *(0.00)*	0.01*** *(0.00)*
	pop (squared)	–	–	–	–	–
	medincome	-0.02 *(0.01)*	-0.03*** *(0.01)*	-0.03*** *(0.01)*	-0.02 *(0.01)*	-0.02*** *(0.01)*
	educ	3.51* *(1.80)*	4.63*** *(0.93)*	3.70*** *(1.41)*	2.73** *(1.25)*	3.44*** *(1.14)*
	dillons	-0.49* *(0.29)*	-0.39* *(0.21)*	-0.56** *(0.25)*	-0.39 *(0.27)*	-0.37 *(0.27)*
Climate Risk	**coastvuln**	0.10 *(0.37)*	0.71*** *(0.22)*	–	–	–
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
Internal Determinants	**libvoting**	3.26** *(1.39)*	–	3.84*** *(1.16)*	–	–
	polsupport	0.20 *(0.18)*	–	0.28* *(0.16)*	–	–
	carbemploy	4.48* *(2.48)*	–	2.93 *(2.22)*	–	–
	munirevenue	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
	colltown	-0.66 *(0.77)*	–	-0.59 *(0.66)*	–	–
	muniutil	-0.34 *(0.50)*	–	-0.05 *(0.43)*	–	–
	staff	-0.00 *(0.00)*	–	-0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00 *(0.00)*	–	–	0.00 *(0.00)*	–
	cleanair	-0.34 *(0.33)*	–	–	-0.22 *(0.31)*	–
	transit	-0.97 *(1.52)*	–	–	-0.75 *(1.40)*	–
Influence From Above	**stmandate**	0.25 *(0.46)*	–	–	–	0.20 *(0.44)*
	govfund	0.00 *(0.00)*	–	–	–	0.00 *(0.00)*
	stplan	0.12 *(0.47)*	–	–	–	0.34 *(0.43)*
	sttarget	0.08 *(0.45)*	–	–	–	0.20 *(0.41)*
	stpolicies	0.03 *(0.05)*	–	–	–	0.05 *(0.04)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses*

APPENDIX 6: INDEPENDENT TESTING OF MOTIVATIONS FOR COUNTIES

As in Appendix 5, I follow the lead of Krause (2012) in presenting the results of models – this time for counties – which test motivations individually. To do so, I again reclassify several variables as control variables: the basic demographic variables `pop`, `medincome`, and `educ`, as well as `dillons`, which measures the authority available to each municipality. The remaining variables appear in only one of the individual models for each dependent variable, corresponding to the motivation they're intended to examine.

Tables for two dependent variables – `muniplana` (whether or not a government has a municipal climate plan) and `networkmem` (whether or not a government has joined a climate network) are missing in this appendix, for the simple reason that the original, collective models are themselves unreliable, due to the small number of relevant observations (only 15 counties in my sample report having a climate plan, and only 19 are climate network members). Results for all the models are reported with robust standard errors.

Both the sign and statistical significance of variables occasionally change between models that test motivations individually (e.g. Models 54-57), and those which examine motivations collectively (e.g. Model 7). This is unsurprising: to a greater or lesser extent, the individual models are afflicted by omitted variable bias. Theoretically, we know this because of the justifications for each variable on pages 23-35. Statistically, we know this because the adjusted r-squared for each of the individual models is consistently lower than for the collective model.

For example, the collective Model 8 explains just under 63% of the variation in estcost, while Model 58, which tests the climate risk motivation specifically, explains just under 34%. The variables that remain in Model 58 are likely correlated, to some degree, with the variables that have been dropped – and if so, their estimates and statistical significance will be biased to that degree. So when `educ` (the percentage of the population over 25 with a bachelor's degree or greater) blooms into statistical significance in Model 58, while remaining insignificant in the collective Model 8, that change shouldn't undermine our credibility in the collective model. Quite the opposite: the limited Model 58 is likely afflicted by omitted variable bias, and its estimates and findings of statistical significance are less reliable.

Nevertheless, I follow the lead of Krause (2012) in presenting the models which test motivations individually here, partly because such models can be helpful in reviewing whether the collective model is affected by multicollinearity. I did the same for incorporated places in the previous appendix.

Table 39: Net Mitigation Spending By Counties: Testing Motivations Individually and Collectively

		Model 7	Model 40	Model 41	Model 42	Model 43
About the Model	**Dependent Variable**	netspent	netspent	netspent	netspent	netspent
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.2216	.0612	.1340	.0688	.1622
	Observations	255	262	258	261	260
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-985.30	-841.48	-1320.89	-620.58	-609.35
Control Variables	**pop**	0.55 *(0.56)*	0.77 *(0.72)*	0.34 *(0.47)*	0.57 *(0.71)*	1.11* *(0.62)*
	pop (squared)	-0.00** *(0.00)*	-0.00 *(0.00)*	-0.00** *(0.00)*	-0.00 *(0.00)*	-0.00* *(0.00)*
	medincome	16.15 *(14.05)*	13.49 *(10.94)*	19.89 *(12.88)*	20.49 *(14.32)*	12.68 *(9.97)*
	educ	471.75 *(1323.74)*	1263.44 *(933.74)*	181.06 *(1334.44)*	365.78 *(1144.45)*	459.54 *(931.62)*
	dillons	-53.22 *(155.69)*	107.34 *(175.63)*	-68.15 *(170.77)*	44.34 *(175.28)*	20.34 *(174.06)*
Climate Risk	**coastvuln**	163.01 *(205.08)*	297.17 *(216.88)*	–	–	–
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.24* *(0.13)*	-0.21 *(0.13)*	–	–	–
Internal Determinants	**libvoting**	-1666.63* *(919.26)*	–	-1332.35* *(790.39)*	–	–
	polsupport	260.01*** *(98.11)*	–	279.36** *(111.01)*	–	–
	carbemploy	952.08 *(830.17)*	–	704.28 *(992.24)*	–	–
	munirevenue	0.00** *(0.00)*	–	0.00*** *(0.00)*	–	–
	colltown	99.35 *(244.51)*	–	-49.63 *(265.60)*	–	–
	muniutil	-82.00 *(1152.56)*	–	922.14*** *(339.29)*	–	–
	staff	0.82 *(0.76)*	–	0.82 *(0.72)*	–	–
Excludable Benefits	**estsavings**	-0.33 *(0.38)*	–	–	0.00 *(0.44)*	–
	cleanair	277.23 *(238.74)*	–	–	469.34 *(294.63)*	–
	transit	-869.80 *(732.51)*	–	–	-997.72 *(779.38)*	–
Influence From Above	**stmandate**	2532.74 *(1906.00)*	–	–	–	2190.32 *(1743.48)*
	govfund	0.23 *(0.45)*	–	–	–	0.54 *(0.39)*
	stplan	601.87** *(268.58)*	–	–	–	477.57** *(229.35)*
	sttarget	-126.51 *(180.69)*	–	–	–	-206.43 *(177.35)*
	stpolicies	-22.01 *(23.11)*	–	–	–	-17.95 *(22.45)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*

Table 40: Gross Mitigation Spending By Counties: Testing Motivations Individually and Collectively

		Model 8	Model 44	Model 45	Model 46	Model 47
About the Model	**Dependent Variable**	estcost	estcost	estcost	estcost	estcost
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.6324	.3395	.4677	.4348	.5572
	Observations	255	273	269	262	262
	Units	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)	$ (in 1000s)
	Constant	-1160.42	-1301.95	-1966.77	-843.38	-799.45
Control Variables	**pop**	0.60 *(0.57)*	0.68 *(1.36)*	0.23 *(0.66)*	0.25 *(0.49)*	1.46*** *(0.41)*
	pop (squared)	-0.00** *(0.00)*	0.00 *(0.00)*	-0.00 *(0.00)*	0.00** *(0.00)*	-0.00*** *(0.00)*
	medincome	19.05 *(15.60)*	17.48 *(13.60)*	29.57** *(14.94)*	26.83** *(13.26)*	15.78 *(9.97)*
	educ	317.75 *(1399.33)*	2925.88** *(1248.61)*	464.81 *(1501.63)*	730.79 *(1606.75)*	977.51 *(1267.81)*
	dillons	-49.72 *(157.19)*	188.43 *(203.53)*	-97.32 *(191.48)*	60.57 *(242.03)*	66.93 *(218.29)*
Climate Risk	**coastvuln**	166.13 *(207.72)*	534.29** *(241.76)*	–	–	–
	hazardcost	0.00 *(0.00)*	0.00 *(0.00)*	–	–	–
	hazardcasualties	-0.23* *(0.13)*	-0.25 *(0.24)*	–	–	–
Internal Determinants	**libvoting**	-1483.22 *(964.78)*	–	-1476.46* *(851.00)*	–	–
	polsupport	262.89*** *(98.83)*	–	414.87*** *(123.01)*	–	–
	carbemploy	1063.6 *(866.29)*	–	304.43 *(1055.64)*	–	–
	munirevenue	0.00** *(0.00)*	–	0.00*** *(0.00)*	–	–
	colltown	135.44 *(256.85)*	–	-313.42 *(374.69)*	–	–
	muniutil	-225.17 *(1235.18)*	–	916.63** *(445.52)*	–	–
	staff	0.74 *(0.81)*	–	0.49 *(0.69)*	–	–
Excludable Benefits	**estsavings**	0.70* *(0.39)*	–	–	1.25*** *(0.19)*	–
	cleanair	262.92 *(241.22)*	–	–	536.48** *(262.52)*	–
	transit	-922.43 *(761.19)*	–	–	-1262.93 *(1151.54)*	–
Influence From Above	**stmandate**	2911.54 *(2045.5)*	–	–	–	2455.52*** *(607.53)*
	govfund	1.24*** *(0.45)*	–	–	–	1.84*** *(0.20)*
	stplan	587.99** *(272.78)*	–	–	–	487.73* *(264.32)*
	sttarget	-117.82 *(184.69)*	–	–	–	-180.03 *(241.78)*
	stpolicies	-24.27 *(23.76)*	–	–	–	-21.70 *(34.24)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*

Table 41: Regulatory Preferences By Counties: Testing Motivations Individually and Collectively

		Model 9	Model 48	Model 49	Model 50	Model 51
About the Model	**Dependent Variable**	regpref	regpref	regpref	regpref	regpref
	Statistical Method	GLM	GLM	GLM	GLM	GLM
	Adjusted R^2	–	–	–	–	–
	Observations	252	275	271	259	259
	Units	% Reg Policies	% Reg Policies	% Reg Policies	% Reg Policies	% Reg Policies
	Constant	-5.59	-3.47	-4.45	-4.10	-4.15
Control Variables	**pop**	–	–	–	–	–
	pop (logged)	0.14 *(0.12)*	-0.01 *(0.11)*	-0.06 *(0.11)*	0.09 *(0.11)*	-0.05 *(0.10)*
	medincome	0.01 *(0.01)*	0.00 *(0.00)*	0.02** *(0.01)*	0.00 *(0.01)*	0.01 *(0.01)*
	educ	2.81* *(1.49)*	3.95*** *(1.16)*	0.79 *(1.39)*	4.09*** *(1.17)*	3.69*** *(1.14)*
	dillons	-0.14 *(0.21)*	-0.01 *(0.20)*	-0.08 *(0.21)*	-0.07 *(0.20)*	-0.12 *(0.21)*
Climate Risk	**coastvuln**	0.41* *(0.23)*	0.75*** *(0.19)*	–	–	–
	hazardcost	-0.00** *(0.00)*	-0.00** *(0.00)*	–	–	–
	hazardcasualties	0.00*** *(0.00)*	0.00*** *(0.00)*	–	–	–
Internal Determinants	**libvoting**	-0.16 *(1.02)*	–	1.22 *(0.86)*	–	–
	polsupport	0.19* *(0.11)*	–	0.22** *(0.11)*	–	–
	carbemploy	-0.27 *(1.34)*	–	-0.50 *(1.27)*	–	–
	munirevenue	-0.00* *(0.00)*	–	0.00 *(0.00)*	–	–
	colltown	0.94*** *(0.36)*	–	0.80** *(0.38)*	–	–
	muniutil	1.93*** *(0.28)*	–	1.48*** *(0.37)*	–	–
	staff	-0.00 *(0.00)*	–	-0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00*** *(0.00)*	–	–	0.00*** *(0.00)*	–
	cleanair	-0.68*** *(0.26)*	–	–	-0.49** *(0.23)*	–
	transit	2.28** *(1.15)*	–	–	2.09* *(1.16)*	–
Influence From Above	**stmandate**	0.03 *(0.54)*	–	–	–	0.34 *(0.50)*
	govfund	0.00 *(0.00)*	–	–	–	0.00 *(0.00)*
	stplan	0.26 *(0.28)*	–	–	–	0.24 *(0.26)*
	sttarget	-0.26 *(0.25)*	–	–	–	-0.30 *(0.25)*
	stpolicies	0.03 *(0.04)*	–	–	–	0.06 *(0.04)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*

Table 42: Mitigation Policies By Counties: Testing Motivations Individually and Collectively

		Model 10	Model 52	Model 53	Model 54	Model 55
About the Model	**Dependent Variable**	tota	tota	tota	tota	tota
	Statistical Method	OLS	OLS	OLS	OLS	OLS
	Adjusted R^2	.4747	.2786	.3765	.3274	.4011
	Observations	258	284	279	266	266
	Units	# of Policies	# of Policies	# of Policies	# of Policies	# of Policies
	Constant	-7.48	-3.19	-6.72	-3.50	-4.06
Control Variables	**pop**	–	–	–	–	–
	pop (logged)	0.74*** *(0.26)*	0.80*** *(0.29)*	0.43* *(0.25)*	0.87*** *(0.29)*	0.68*** *(0.25)*
	medincome	0.03 *(0.02)*	0.01 *(0.02)*	0.04* *(0.02)*	0.02 *(0.03)*	0.01 *(0.02)*
	educ	11.00*** *(3.91)*	15.21*** *(3.88)*	10.83*** *(3.70)*	13.89*** *(4.11)*	14.69*** *(3.47)*
	dillons	-0.58 *(0.46)*	-0.27 *(0.44)*	-0.51 *(0.45)*	-0.36 *(0.46)*	-0.40 *(0.46)*
Climate Risk	**coastvuln**	0.38 *(0.47)*	1.14** *(0.49)*	–	–	–
	hazardcost	0.00 *(0.00)*	-0.00 *(0.00)*	–	–	–
	hazardcasualties	0.00*** *(0.00)*	0.00 *(0.00)*	–	–	–
Internal Determinants	**libvoting**	1.33 *(1.99)*	–	3.91** *(1.82)*	–	–
	polsupport	0.88*** *(0.21)*	–	0.91*** *(0.22)*	–	–
	carbemploy	2.06 *(2.53)*	–	2.12 *(2.53)*	–	–
	munirevenue	-0.00* *(0.00)*	–	-0.00*** *(0.00)*	–	–
	colltown	0.29 *(1.63)*	–	0.56 *(1.56)*	–	–
	muniutil	2.40* *(1.40)*	–	3.48*** *(1.09)*	–	–
	staff	0.00 *(0.00)*	–	0.00 *(0.00)*	–	–
Excludable Benefits	**estsavings**	0.00*** *(0.00)*	–	–	0.00*** *(0.00)*	–
	cleanair	-0.76* *(0.42)*	–	–	-0.49 *(0.50)*	–
	transit	-0.48 *(1.84)*	–	–	0.48 *(1.94)*	–
Influence From Above	**stmandate**	3.48*** *(1.09)*	–	–	–	4.28*** *(1.22)*
	govfund	0.00** *(0.00)*	–	–	–	0.00*** *(0.00)*
	stplan	1.06** *(0.47)*	–	–	–	1.22** *(0.48)*
	sttarget	-0.79 *(0.50)*	–	–	–	-0.57 *(0.53)*
	stpolicies	0.04 *(0.07)*	–	–	–	0.07 *(0.07)*

****significant at 0.01 (two tailed); **significant at 0.05 (two tailed); *Significant at 0.10 (two tailed); standard errors in parentheses. Shaded findings are likely unreliable.*

VITA

I used to be a pastry espionage agent. Yes, I smuggled samples of flour and melted chocolate; yes, I shamelessly videotaped the baking of bread; yes, I stole the cookie from the cookie jar. No, this never bothered my conscience one bit. But occasionally I found myself in a hard place – forced to rub out an éclair or two. The scream of custard shooting from beneath my shoe: that's what bothers me, in hindsight.

I earned my undergraduate degree – a BA in Environmental Public Policy – at the University of Michigan, in 2003.

Guess which part is true.