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An assessment of the greenhouse gas reducing activities being implemented in US cities

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Local climate protection initiatives are receiving increased attention and support. However, most of the current understanding about their content, motivation, and impact is based on a relatively small number of unrepresentative cities. There is a lack of information about the type and extent of GHG-reducing actions that "typical" cities have implemented, whether or not they are explicitly framed as part of a broader climate protection strategy. In an effort to address this gap, this paper examines original data collected from a nation-wide sample of US cities on their implementation of a comprehensive list of greenhouse gas-mitigating activities. An assessment of the data reveals considerable variation in the frequency with which the different activities are implemented, particularly when considered across policy instrument type and target population. Further analysis suggests that cities utilize three broad "types" of climate protection strategies, based on the number and nature of the relevant actions that they have implemented.

Keywords: GHG mitigation; climate protection; cities; implementation

Introduction

Climate change is arguably the most significant environmental and sustainability issue of modern time. Scientific consensus regarding its occurrence is firm and the Intergovernmental Panel on Climate Change (IPCC) most recently concluded, with over 90 percent probability, that the human burning of fossil fuels is impacting the global climate (IPCC 2007a). The achievement of

a 50 to 85 percent reduction in worldwide anthropogenic greenhouse gas (GHG) emissions below 2000 levels by 2050 is often stated as necessary to forestall major climactic change (IPCC 2007b). It is increasingly recognized that the "top down" approach traditionally used to address global public goods problems is floundering in regards to climate protection and efforts would benefit by shifting to a multi-level, multi-pronged strategy (Kates and Wilbanks 2003, World Bank 2010). City, state, and regional governments would be more significant players under this approach.

Considerable numbers of municipal governments are already taking initiative to reduce the GHG emissions sourced within their boundaries. This type of voluntary action is unexpected, as it appears counter to several established political and economic theories about the behavior of rational actors. Namely, when the benefits of an action, such as GHG abatement, are necessarily enjoyed by all (i.e. they are non-excludable) but the costs of those actions are born by the few who undertake them, a rational actor would not engage and instead free-ride on the benefits being produced by others (Olson 1965). Because voluntary municipal involvement in climate protection seemingly contradicts this rationale, much of the academic research being produced on the topic focuses on the question of *why* cities choose to become involved in the global effort of climate protection. Numerous studies have been conducted identifying the drivers and obstacles to engagement, and consensus is emerging about the importance of local attributes such as high governmental capacity, political entrepreneurs, healthy finances, and locally accruing co-benefits (Betsill and Bulkeley 2004, Krause 2010, Sippel and Jenssen 2009). These conclusions are primarily based on findings qualitative small-n or case-specific studies of explicitly committed and/or "best practice" cities. Several quantitative large-n studies have also been produced, but consider only the surface-level adoption of mitigation goals. No published

studies have systematically gathered and analyzed data from a nation-wide sample of cities on the climate-relevant activities that have actually been implemented. The lack of information about the GHG-mitigating activities of cities that are *not* explicitly committed to climate protection is particularly notable. Moreover, drawing conclusions about *why* cities are pursing climate protection without having a generalizable understanding of *what* they are doing is akin to "putting the cart before the horse." This study, therefore, takes a necessary step back and utilizes newly collected survey data to describe the type and extent of GHG-reducing actions that have been implemented by cities in the United States. It further analyzes this data to determine the relevant "policy bundles" that cities are implementing and uses them to characterize three primary climate-relevant strategies being pursued by U.S. cities.

Cities and Climate Change

Although the concentration of greenhouse gases is clearly a global phenomenon, some researchers contend that the majority of the impacts and driving forces of climate change are local in nature (Association of American Geographers 2003, Bai 2007, Kates and Wilbanks 2003). The framing of climate change as an exclusively global issue is thus seen as both imprecise and detrimental, as it distances the problem from local realities and makes it more difficult for municipalities and sub-national governments to engage with this issue. Attempts are underway in various academic, advocacy, and governmental circles to recast the understanding of climate change so to better link it with the local context. Their efforts are tied to an emerging three-fold frame which simultaneously depicts cities and urban areas as important contributors to the *problem* of climate change, key *sufferers* of its effects, and an essential part of the potential *solution* (Bai 2007, Bulkeley and Betsill 2003, Kates and Wilbanks 2003, Mills 2007).

Cities as Drivers of Climate Change

Although urban areas cover less than 3 percent of the world's livable land area, they are home to approximately 50 percent of the world's population, or 3.2 million people. This number is projected to increase both in proportion and absolute value, reaching 60 percent and 5 million people by 2030 (Mills 2007). Moreover, the consumption patterns of urban residents are different, and often more resource intense than their rural counterparts. Thus cities are increasingly viewed as a key "battleground for sustainability" (Clark 2003).

An increasingly accepted estimate is that 30 to 40 percent of global anthropogenic greenhouse gas emissions emanate from within cities' boundaries (IPCC 2007b, Satterthwaite 2008). Other, less conservative, estimates suggest cities are responsible for closer to 80 percent of such emissions[1] (Koehn 2008, O'Meara 1999). The discrepancies are rooted in various ideas that exist over the proper accounting framework to use when assessing local GHG emissions, including how to determine appropriate urban boundaries and whether to use a production or consumption-based emissions methodology (Dodman 2009, Larsen 2009). Production-based methodologies consider only the emissions coming from sources physically located within a specified urban boundary, whereas consumption-based approaches act more like "carbon footprint" calculations and attribute GHG emissions to a particular city if they are a by-product of some end-good consumed in that city (regardless of where they were actually emitted). The Satterthwaite (2008) calculation utilizes a production-based methodology and thus results in a lower-end estimate. None-the-less, the above range of estimates makes it clear that, regardless

[1] O'Meara's estimate specifies anthropogenic carbon dioxide emissions.

of the exact proportion of emissions they are responsible for, cities are a key driver of climate change.

Cities as Sufferers of Climate Change

Urban areas are particularly vulnerable to the effects of climate change (World Bank 2010). The projected average temperature increase is consistently larger for urban areas than corresponding global-scale projections (Grimmond 2007). This can simplistically be thought of as an exacerbation of the heat island effect and is tied directly to the extensive land cover modifications that characterize urban settings. Cities also generally have reduced wind speed and poorer air quality than near-by areas, which reduces people's capacity to cope with heat (Mills 2007). As such, urban residents are more vulnerable to the effects of higher air temperatures than their rural counterparts. Other projected impacts of climate change are not specifically urban in nature. Floods, drought, hurricanes, fires, etc. can impact urban and non-urban areas alike. However, because of the density and concentration of people the human toll of extreme weather events is likely to be higher in cities.

As a response to the recognition of urban vulnerabilities, local adaptation to climate change is emerging as a new area of policy as a small but growing number of cities are reflecting on their specific risks and taking precautionary measures to protect infrastructure and resources. In many ways adaptation is more complex than GHG mitigation as, for each relevant threat, adaptation requires the cooperation of diverse sets of actors with objectives that range from immediate disaster relief to long-term prevention planning (Bulkeley *et al.* 2009).

Cities as Part of the Solution

Finally, local governments are also regarded as important parts of the climate change solution. Some suggest local leadership, particularly with policy implementation, is crucial to the success of GHG mitigation efforts (Bai 2007), while others suggest it is an important mechanism to enhance the effectiveness of policies developed at higher levels of government (Koehn 2008), and still others view it as a second best approach, useful when the first best solution of coordinated global action is unavailable (Engel and Orbach 2008). Municipal governments have authority over a significant number of climate relevant activities, frequently including local land use and transportation planning, the operation of public buildings and vehicle fleets, waste disposal, and urban forestry efforts. They are also the level of government closest to the citizen and to many of the behaviors that result in GHG emissions (Bai 2007, Coenen and Menkveld 2003). They therefore have the ability to influence the type and efficiency of local resource use in a more targeted way than other levels of government. Additionally, proponents of local climate action regularly emphasize the direct and exclusive "co-benefits" that city governments and the broader community can receive from engaging in GHG reduction efforts (i.e. energy cost savings and traffic reduction).

In the United States, two affiliated organizations have assumed lead roles promoting local action as an important part of the climate change "solution." The first is ICLEI – Local Governments for Sustainability.[2] ICLEI's Cities for Climate Protection (CCP) program urges members to reduce local greenhouse gas emissions by progressing through five pre-specified milestones. They include: (1) conducting an emissions inventory, (2) adopting an emissions reduction target, (3) developing and approving a climate action plan, (4) implementing the policies contained in the plan, and (5) monitoring, evaluating and reporting on progress (ICLEI

[2] The organization's original name was the International Council for Local Environmental Initiatives, but now it is simply known by its acronym: ICLEI – Local Governments for Sustainability.

2009). ICLEI provides its municipal members with software, trainings, and best practice resources to "empower" them to reduce GHG emissions and improve the quality of life in their communities (ICLEI 2009). The second organization is the Mayors' Climate Protection Agreement (MCPA). Sponsored by the U.S. Conference of Mayors, the MCPA reflects the commitment of signatory cities to reduce their GHG emissions by seven percent below their 1990 levels. The U.S. Conference of Mayors sponsors occasional studies of member initiatives, provides awards for best practices, and recently has been active in lobbying the Federal government, but is a less vigorous program than ICLEI CCP (U.S. Conference of Mayors 2010). As of December 2010, 1044 municipalities had signed the MCPA and over 600 had joined ICLEI. This equates to approximately five percent of all U.S. municipalities, covering nearly 30 percent of the population, that have made an explicit climate protection commitment via membership in these organizations.

Past Research and Findings

Much of the research conducted on local climate protection has examined explicitly committed cities, specifically those that are members of a climate network, and has followed one of two dominant lines. First, a number of efforts have been made to evaluate cities' follow-through to their stated reduction objectives and/or assess the quality of their climate action plans (Aall *et al.* 2007, Tang *et al.* 2010, Wheeler 2008). Only a minority of cities, about 5 percent in the U.S., have made GHG commitments and far fewer have developed a formal strategy for how to achieve them. The cities under study are thus already at the forefront of this effort.

Three components have been identified as critical for the successful incorporation of climate change mitigation into local action plans: Awareness, Analysis, and Action. Even the small number of local governments that have developed climate action plans consistently

perform well only on awareness (Tang *et al.* 2010). That is, they demonstrate high levels of understanding about the causes and likely local impacts of climate change and include reasonable long term goals and incremental targets. Examined city plans are evaluated as demonstrating modest analytical capabilities, which include being able to identify and quantify the sources of local emissions and to project their trends. Finally, action components are the plans' weakest points and, across the board, local governments have trouble identifying and implementing concrete measures that will reduce GHG emissions (Wheeler 2008, Tang *et al.* 2010). Although plan quality varies from city to city, they are evaluated as almost universally inadequate to achieve their reduction goals (Wheeler 2008, Tang *et al.* 2010).

A second line of research has addressed the question: "Why do cities voluntarily engage in climate protection?" As previously mentioned, there are several relevant and well-supported theories that suggest local governments would not voluntarily participate in GHG reduction efforts. Determining when and why these theories do not apply is thus of significant theoretical interest and much of the research done on local climate protection initiatives centers around the various factors that drive and block engagement.

In a 2009 discussion paper, Sippel and Jenssen offer a comprehensive summary of the findings of research conducted on this question. Tables 1 and 2 present a modified outline of their findings. They divide the factors identified as motivators for local climate policy into four over-arching categories. Many of the motivators are characterized as "co-benefits," i.e. locally accruing benefits of GHG mitigation that help meet other objectives whose importance has already been established. They are identified by an asterisk (*) in Table 1.

(Table 1 about here)

Most co-benefits line up under the economic and quality of life categories. The pursuit of climate protection can reduce energy costs for local governments, bring in grants and external funding, and attract outside businesses interested in locating in a place with a "green" reputation. In terms of quality of life, many of the actions taken to reduce GHG emissions also abate other types of air pollution, several of which are covered under the Clean Air Act's air quality standards for criteria pollutants. Traffic reduction can be a co-benefit of climate protection measures aimed at the transportation sector and community building and increased civic engagement can result from a participatory process of plan development. Although co-benefits are generally community-wide, they can also accrue for specific individuals within city government. Political entrepreneurs can latch on to innovative policies, such as local climate protection, claim credit for them, and use them to advance their careers.

The remaining motivators are either political or informational/psychological in nature. Political motivators can come in the form of pressure from external sources, such as higher levels of government, and from internal sources, such as interest groups within the community. Another political motivation for involvement is the desire to make a political statement and compel national action on the issue (Engel 2009). In terms of informational or psychological motivators, exposure to real or perceived climate-related risks has been associated with the increased adoption of climate policies. Climate related disasters can act as "trigger events" and open a window of opportunity for local governments (Bulkeley *et al.* 2009, Sippel and Jenssen 2009). A final motivation of cities to engage in climate protection is rooted in an altruistic desire to "lead by example" and demonstrate to residents and businesses that big cuts to emissions are possible (Bailey 2007).

As the flip side to examining why cities pursue climate protection initiatives, many studies also explore factors that inhibit their involvement. Table 2 offers a summary of frequently identified obstacles.

(Table 2 about here)

Again Sippel and Jenssen (2009) divide the obstacles identified in their literature review into four categories. Additionally, two over-arching obstacles warrant discussion. First is the Tragedy of the Commons idea, which is consistent with standard economic theory and the rational choice perspective. It is premised on the fact that any one city's GHG reduction efforts will have a negligible impact on climate change as a whole and, moreover, will not protect that particular city actually making the reductions (Betsill 2001, Engel 2009). A "rational actor" would, therefore, not voluntarily behave in such a manner and would instead free-ride on the actions of others (Olson 1965). The second over-arching obstacle has to do with the scale of climate change. Bai (2007) describes the issue of scale as the commonly held belief that global problems are outside municipalities' spheres of influence and concern. She divides scale into three relevant dimensions - spatial, temporal, and institutional – and succinctly illustrates up the rationales behind them with the statements "not on my turf, not in my term, not my business." Climate change is thus difficult for many local governments to even consider becoming involved in because it is often believed, by decision makers and the public alike, that the issue is (1) beyond their physical boundary of concern; (2) too long term to be addressed in an urban political context where leaders, funding, and hot-button issues are subject to frequent and rapid

changes; and (3) it simply is not local government's "business" to address transboundary environmental concerns.

Beyond these over-arching barriers, multiple more pointed ones exist. Economics and the cost of engaging in climate protection is a first major obstacle. Although cost savings are often promoted as a benefit of GHG reduction activities, their start-up and capital costs can be significant. Politics can similarly provide motivation for local participation or create challenges for it. Often the issue simply cannot find a foothold in an environment of short time horizons and competing policy interests. A related political obstacle is a lack of policy entrepreneurs. Policy entrepreneurs are influential in the adoption of innovative policies in public organizations and have been identified as playing particularly key roles in the advancement of sub-national climate protection (Bulkeley and Betsill 2003, Rabe 2003). A lack of policy entrepreneurs within a particular city's government may simply be because there is no capable individual on staff with a dedicated interest in climate protection or because something in the institutional environment prevents them from emerging (Schnieder and Teske 1992).

Common institutional barriers to climate protection governance include local governments having limited professional capacity and internal coordination problems. The activities associated with climate protection span multiple relevant city departments (e.g. public works, planning, waste, etc) and motivation and cooperation can be difficult to maintain when responsibility is spread thin and/or jurisdictional lines are fuzzy (Betsill 2001). Additionally, local governments often lack the expertise or data needed to develop comprehensive plans, conduct GHG emissions inventories, or to monitor or evaluate progress. Limitations imposed on local actions by higher levels of government can act as another institutional constraint. Finally, Sipple and Jenssen (2009) also identify a lack of control over climate relevant facilities, such as

utilities or landfills, as an obstacle to climate governance. However, other studies draw the opposite conclusion and suggest that owning a municipal utility often acts as a barrier to local climate governance (Krause 2010). This is because municipal utilities tend to be small and carbon-intensive and would have a particularly hard time making the changes necessary to be consistent with a local climate protection agenda (Wilson *et al.* 2008, Krause 2010).

Research Gaps and Challenges

Local involvement in climate protection in the United States is voluntary. No federal or state laws have been passed which require municipalities to engage in specific greenhouse gas mitigating activities, nor are there requirements to report either local GHG emissions or the actions being undertaken to reduce them. Thus, all data on local climate protection is necessarily obtained with the cooperation of the municipality. This immediately raises concerns about bias caused by self-selection for analysis intending to yield generalizable conclusions: The locales that choose to cooperate with data collection efforts may be systematically different from those that opt not to cooperate. However, unless the national or state governments change municipal obligations, researchers examining local climate protection will have to contend with this reality.

Four main research designs have been used to study local climate protection: in-depth case studies that describe the dynamic of (typically) best practice cities; small-n studies that qualitatively assess how a small sample of cities develop or implement their climate protection strategies; quantitative large-n studies that examine the factors that influence cities to make explicit climate protection commitments; and write-ups by climate protection networks on their member cities' activities. Upon consideration of these methodologies, gaps become obvious. First, a majority of studies look exclusively at municipalities that have made an *explicit*

commitment to reduce GHG emissions. More common, however, is *implicit* climate protection which is included in local land use, energy use, and transport policies (Aall *et al.* 2007). Moreover, little is known about the climate relevant activities occurring in the majority of cities that have not joined any climate protection network. The focus on explicitly committed municipalities can result in an undercount and potential mischaracterization of total local GHG activities (Krause forthcoming). It also limits the ability to draw conclusions on the effectiveness of climate protection networks as this requires information on both members and non-members alike. Second, there are no large-n studies that consider the depth of a locale's commitment. It is not clear whether the factors that influence commitment-making also influence the actual implementation of GHG mitigating policy, or whether the commitments themselves affect implementation activity. Finally, very little research has been conducted on the cumulative impact, either actual or potential, that local GHG abatement efforts have on net emissions. While there is anecdotal evidence of a "stubborn gap between the rhetoric and reality of local climate policy," that gap has yet to be quantified (Betsill and Bulkeley 2007 p.448).

Sample and Data Collection

Research on local climate protection has been limited by a lack of comprehensive data. That which has been previously collected is insufficient for research seeking to draw generalizable conclusions on the causes or effects of substantive local climate governance. To address this data gap, this study embarks on an original data collection effort to gather consistent and comprehensive information on the actions cities and towns in the United States have implemented that reduce GHG emissions. The sample includes all incorporated places in the United States with populations greater than 50,000, according to the U.S. Census Bureau's 2005

population estimate. [3] There are 665 such locales, together containing over 108 million residents.

Web-based questionnaires were sent directly to the city employee identified as in charge of environmental and/or sustainability programs in each of the municipalities in the sample. Approximately 32 percent of the individuals contacted held a leadership position in an office of environment or sustainability and/or held the designated position of sustainability coordinator. The majority of other contact persons held leadership positions in departments of public works or utilities (22 percent), departments of planning or community development (21 percent), or in mayor or city manager's offices (15 percent).

Although the survey focuses on GHG reducing activities, it was not introduced to potential respondents as specifically about climate protection. Rather, it was presented as a survey about local environmental quality, energy efficiency, and sustainability practices; an accurate and related frame. This decision was made because climate change can be a polarizing issue in the United States and reflected my concern that if the survey was described as explicitly about climate change, some cities would be less inclined to complete it. Moreover, the "type" of city that declines to participate in a survey about climate change may be meaningfully different from the "type" that does participate. Therefore, in an attempt to minimize this potential source of bias, the survey was framed as about environmental quality and sustainability. Surveys were collected between April and June of 2010. Usable surveys were received from 329 cities, equating to a response rate of 49.5 percent.

Despite achieving a response rate considered good for web-based surveys, it is important to consider whether the cities that chose to respond to the survey are systematically different

[3] The term "incorporated places" refers to cities, towns and villages, which are chartered by the State. For ease of language, these political distinctions are collectively referred to as cities or municipalities. Counties are addressed separately.

from those that did not. Key characteristics of the responding cities reflect those of the larger sample reasonably well, as shown in Table 3. The most notable differences are seen with regard to participation in climate protection networks. When compared to the full sample, there is a considerable over-representation of MCPA and ICLEI participants among responding cities. This is not surprising as staff in these city governments are likely more aware of and interested in sustainability and climate related issues, and thus more inclined to respond to a survey about them. The over-representation of climate committed cities in the sample should qualify attempts to generalize findings from this study to non-responding cities.

(Table 3 about here)

What Climate-Protecting Actions are US Cities Taking?

In order to develop a general picture of the GHG-mitigating activity that U.S. cities are under-taking, this paper examines the local implementation of twenty-six distinct climate-relevant initiatives. Multiple sources were consulted to determine the variety of ways that local governments can realistically abate area GHGs. First, publications from the U.S. Conference of Mayor's Climate Protection Center and ICLEI were reviewed, as both organizations offer regular summaries of current "best practices" and recommendations for local action. Relevant academic literature was also examined and a consultation with local government employees active in urban sustainability shaped the final list (see Table 4). It is comprised of actions cities can take to (a) institutionalize climate protection within governance structures, (b) make city government operations less carbon intensive, and (c) alter the GHG-emitting behaviors of the larger community.

An Assessment of Descriptive Statistics

An initial observation is that every responding city has implemented some initiative that has the effect of abating greenhouse gas emissions. Indeed, each city has implemented between 8 and 98 percent of the 26 activities indicated, with the average implementation rate being approximately 48 percent. As shown in Table 4, considerable variation exists in the frequency at which the different GHG reducing actions have been employed by the responding cities. On the high end, 91 percent of cities in the sample provide curb-side recycling to residents. On the low end, only 14.5 percent of cities have formally adopted a plan to reduce their GHG emissions and 17 percent have a designated budget line for explicit climate protection activities or coordination.

The frequency of activity implementation varies noticeably by the type of policy instrument employed. Four broad modes of governance through which local governments advance climate protection have been identified; each is associated with specific policy instruments (Bulkeley and Kern 2006). The first mode is based on enabling, or supporting the actions of other actors, often via the policy instruments of information or positive incentives. A second is *authority*-based and utilizes regulatory instruments and/or negative incentives to compel action. The third is the facilitation of GHG-mitigating behaviors through the *provision of services*, which make desired behaviors more convenient. The final mode is *self-governance*, which focuses on municipalities' own operations. An examination of the percentages shown in Table 5 suggests that cities are more willing to employ certain types of instruments/modes of governance than others to advance climate protection.

(Table 4 about here)

(Table 5 about here)

All of the actions specified under the first two headings in Table 4 are examples of self-governance. The institutionalization actions are steps that formalize climate protection into local government structures. They do not result in the direct reduction of emissions and do not yield co-benefits, but they are often considered necessary components of a comprehensive and effective local climate protection strategy. Self-governance actions that focus on city government operations, on the other hand, do directly reduce emissions and most also result in the production of co-benefits. As shown in Table 5, cities are more inclined to engage in projects that contribute directly to energy savings and GHG-reduction than on policies which institutionalize climate protection. Indeed, institutionalization actions have the lowest average rates of implementation, suggesting that most cities take a relatively *ad hoc,* project-based approach to GHG reduction.

Cities can support behaviors that would reduce GHG emissions in the broader community via the provision of information, incentives, and services. The implementation rates in Table 5 show that information and services are employed to encourage GHG-reducing behaviors over twice as frequently as incentives. The use of regulatory authority is more varied. Nearly 75 percent of cities have an ordinance in place dictating tree planting and/or removal specifications for developers, and 66 percent use planning and zoning authority to control emissions and sprawl. On the other hand, only 22 percent have an ordinance requiring new private or commercial buildings to meet energy efficiency standards. Local government's propensity to use regulatory mechanisms appears quite subject specific.

These descriptive statistics provide an overview of how often the GHG reducing actions that *can* be implemented by local governments *are* being implemented. Having an accurate picture of this is important: it shows us what cities are inclined to do voluntarily and what they

are not. Certain activities, notably the provision of several types of services and information, are already being carried out by a large proportion of local governments, presumably primarily for reasons other than climate protection. At the same time, local governments appear reluctant to utilize certain other types of policy instruments, particularly incentives. This information could prove useful to decision makers interested in promoting climate protection at the local level as it indicates the activities that cities are inclined to pursue on their own and those for which outside encouragement might be needed. It also indicates that, although relatively few cities have taken steps to institute climate protection within their government structures, most are engaged in multiple forms of GHG-mitigation.

Overall, cities appear to be implementing GHG-reduction actions in a piecemeal fashion, as opposed to institutionalizing climate protection and creating comprehensive strategies based on existing emissions, as climate networks like ICLEI and the MCPA suggest. This begs the question of whether cities that are members of a climate protection network pursue mitigation more or differently than those which are not. Figure 1 offers some insight. Although it cannot support claims that membership *causes* increased action, Figure 1 reveals that, overall, cities which have made explicit commitments to climate protection via membership in ICLEI and/or the MCPA have implemented the identified activities with greater frequency than non-members. This difference is particularly notable with regard to institutionalization. Only a small percent of non-member cities have conducted local GHG inventories, adopted GHG reduction goals and plans, designated responsibility for climate protection coordination, or included climate protection in the budget. Two to four times more member cities have implemented each of these activities than non-members. On the other hand, membership does not appear to influence the propensity of cities to pursue certain other self-governing behaviors like installing efficient

lighting in city buildings or streets. Likewise, a similar percent of members and non-members offer incentives to take public transit, consider sprawl and GHGs in zoning decisions, and have tree ordinances in place. The majority of other activities in Figure 1 are implemented10 and 20 percent more frequently in cities that are members of ICLEI and/or the MCPA than by those that are not.

However, the fact that these differences cannot be attributed to network membership warrants reiteration. Other features, more common to network members than non-members, may in fact cause the observed differences in activity. Indeed, as Table 6 makes clear, cities that are members of the MCPA and ICLEI differ from those that are not members on several key characteristics, particularly population, education rates, and political affiliation. Larger cities with higher educated and more politically liberal residents appear more inclined to join climate protection networks. It is possible that these characteristics, rather than network membership its-self, lead to higher activity. Moreover, it is logically possible that the cities which have already implemented GHG reducing initiatives would be more likely than those which have not to join a climate network in the first place. Determining the "treatment effect" of membership in climate protection networks is an area for future research.

(Table 6 about here)

Policy Bundles and Strategy Types

Although a description of the relative rates of implementation for various climate protecting activities is interesting in and of its-self, this data can be examined further to see if there are any identifiable "policy bundles" or groupings of GHG-reducing activities that cities tend to deploy

together. It can further be examined to see if certain "types" of cities tend to utilize the different types of strategies identified. Cluster analysis is run on the survey data with these aims in mind. Cluster analysis is an exploratory technique which seeks to establish clusters (categories) of observations which are similar on select attributes (variables). Cluster analysis arranges observations such that resulting clusters have as much internal homogeneity as possible and are as different from other clusters as possible (Aldenderfer and Blashfield 1984). The cluster analysis employed in this study applies hierarchical agglomerative clustering methods, using Ward's linkage and the Jaccard similarity measure, to dichotomous variables representing cities' involvement in the GHG mitigating activities listed in Table 4. Ward's linkage minimizes the within group error sum of squares for each cluster. The Jaccard binary similarity coefficient forms clusters based only on positive matches and not on negative ones. In other words, when searching for clusters of "like" cities, it only considers the GHG reducing actions that cities *do* have in place and not those that they *do not* have in place. This is the appropriate similarity measure because policy non-bundles are of limited interest.

The resulting dendrogram suggests a three cluster solution (see Table 7). This means that, based on the GHG relevant activities that they have implemented, the 152 cities in cluster one are more like each other than they are like the 73 cities in cluster two or the 104 cities in cluster three. Cities in each cluster have implemented similar "policy bundles" and utilize similar climate strategies. An inspection of their defining variables leads to the following characterization of approaches: (1) Limited environmental service, (2) High environmental service with a limited climate protection frame, and (3) High environmental service with an explicit GHG and climate protection frame.

(Table 7 about here)

Table 7 provides descriptive statistics relating to the three clusters. It is broken down to indicate the frequency with which cities in each group have implemented activities that focus on certain target populations, utilize different policy instruments, and target different emissions sectors. Demographic statistics characterizing the cities in each cluster is also provided. The first cluster of cities, which employs a *limited environmental service* (LES) approach, has the lowest average implementation rates for all of the activities identified. This remains true whether they are aggregated by target, instrument, or sector. Even activities with notable co-benefits, such as those associated with transportation or energy efficiency, have low implementation rates in LES cities. This suggests that these cities are not inactive only when it comes to GHG reduction, but that, when compared to other cities in the sample, they simply take less initiative on environmental improvements in general.

A comparison between the cluster of cities using the *high environmental services, limited climate protection* (HSL) frame and those in the third cluster characterized as *high environmental services, explicit climate protection* (HSE) reveals more about the practical impact of utilizing a climate specific approach. First, the HSE cluster of cities has a notably higher average rate of implementation when municipal government operations are targeted. However, the difference between the two clusters on actions that target the larger community is small. The cities in the HSE cluster likewise generally have the highest rates of implementation for the groupings of activities aggregated according to the policy instruments that actions utilize and the emissions sectors they target. However, the differences are modest and they alternate with HSL cities on a few indicator sets: Cities in the HSL cluster more frequently implement activities that operate via service provision as well as those policies that specifically target waste

management and urban tree cover. The largest between-cluster difference is seen with the indicators that target GHG emissions explicitly and provide no visible co-benefits: HSE cities have implemented an average of 71 percent of the five actions that explicitly target GHG emissions, whereas HSL cities have implemented approximately 20 percent; an over 50 percent difference. The fact that HSL and HSE cities differ so dramatically on their implementation of activities in two related groupings – those focused specifically on GHG emissions and those that target city government operations – but have relatively modest and unsystematic differences in others is notable. The institutionalization of policies that are explicitly framed as about climate protection appears to be most strongly associated with the implementation of activities to improve the efficiency and sustainability of cities' own operating procedures. It appears to have little effect on the implementation of similarly focused community-wide policies.

In Table 7, the rows under the sub heading "Mean City Characteristics" utilize census and voting data to describe the clusters of cities on select demographic characteristics. Significant differences between groups are observed and reinforce the idea that the different policy bundles are implemented by different "types" of cities. Indeed the only demographic variables that do not appear to vary meaningfully between the three clusters are the related measures of income and poverty. LES cities, which have low environmental services, and HSL cities, which have high environmental services but do not utilize an explicit climate protection frame, have quite similar demographic characteristics. The primary difference is their size – HSL cities are larger on average – which may account for the increased number of environmental activities that have been implemented. Indeed, a longstanding consensus in the literature suggests that larger entities have greater resources and capacity and are likely to engage in a wider range of policy (Walker, 1969). Expanding the comparison to include the cluster of

cities that have high environmental services and utilize an explicit environmental frame shows that their residents tend to affiliate more strongly with the Democratic Party and have higher education than do residents in the other two categories of cities. As previously described, HSL cities engage in *community-focused* environmental activities at levels that are very close to those of the more liberal and educated HSE cities. The observed differences between them are primarily related to self-governance activities and the institutionalization of explicit GHG reduction measures. This suggests that the interests represented by education and political leaning are less associated with the overall levels of environmental or sustainability related activities that municipalities are engaged in community-wide, but instead relate to whether these actions are *framed* as part of comprehensive climate protection efforts and applied to city operations.

Discussion

This paper examines a new set of descriptive statistics characterizing the actions that U.S. cities are taking that reduce GHG emissions. The variation in the frequency with which the different climate-relevant activities have been implemented reveals where outside encouragement will and will not be needed, if local leadership in this area is determined to be socially valuable. Either in response to the existing incentive structure or because of the co-benefits generated, most cities already to do things like provide curbside recycling, public transportation, and bike lanes in roadways. A large majority are also in the process of converting to a "green" city vehicle fleet and provide residents with information on energy efficiency. Indeed, nine of the 26 identified activities have already been implemented by over 60 percent of responding cities (see Table 4). Additional, outside encouragement is unnecessary to compel action in these areas. On the other

hand, it appears that, under current conditions, cities are unlikely utilize financial incentives to promote mitigating behaviors. They are also unlikely to address climate protection in a comprehensive and coordinated manner in the absence of outside encouragement or assistance. This knowledge can help climate protection organizations and state and federal governments target their efforts to encourage local GHG abatement.

All of the cities in the sample are engaged in some GHG-reducing efforts, although they are often *ad hoc*, project-based, and are not necessarily characterized as part of a broader climate protection effort. This raises questions regarding the importance of having an explicit and coordinated local climate strategy. Namely, does the institutionalization of explicit climate protection initiatives lead to more GHG emissions being reduced than does the *ad hoc* implementation of a series of related municipal projects? In other words, do HSE cities reduce more emissions than HSL cities? The data does not currently exist to answer this question empirically, but climate networks like ICLEI view the development of GHG inventories and climate protection plans as important. Their rationale is that, in order to reduce emissions effectively and efficiently, it is essential to know where the bulk of local emissions come from, and thus what sectors should be targeted to achieve maximum reduction. Measuring emissions over time is likewise fundamental to monitoring and evaluating progress. A counter argument, however, suggests the emphasis on measurement and the technical challenges associated with explicit climate planning are misplaced and can postpone progress (Bulkeley *et al.* 2009).

The majority of the GHG-reducing efforts considered in this paper are "low hanging fruits." They are relatively uncontroversial, inexpensive, and provide city governments and/or communities with co-benefits above and beyond simply mitigating GHG emissions. They are therefore relatively easy to pursue outside of the "climate protection" umbrella. For the near

term, energy can be saved and GHG emissions can be reduced without ever conjuring the term "climate protection," making related action possible in places where it might otherwise not be politically feasible. However, as the low hanging fruits are picked and larger emissions reductions become necessary, a comprehensive strategy, requiring explicit recognition of the underlying problem may prove necessary.

Conclusion

The results of the municipal climate protection survey presented in this paper represent an improvement to previous data collection efforts and contribute to a more comprehensive picture of the relevant programs, policies, and activities that have been implemented across the country. The responses of 329 climate committed and non-committed cities with populations ranging from 50,045 (Minnetonka, MN) to over 2.8 million (Chicago, IL) present a cross-section of local government involvement on this issue. They reveal that U.S. cities are taking actions that reduce GHG emissions with considerable frequency, although these actions are often not considered part of an over-arching local climate protection initiative. The data shows that a majority of cities already undertake certain types of GHG reducing activities, primarily those that involve the provision of services or the distribution of information. It also identifies the initiatives that only the most active climate leaders appear to pursue, and the spectrum of activities between these extremes. The data additionally reveals three groupings of cities that have implemented similar "bundles" of climate relevant policies. These are broadly characterized as being low environmental service, high environmental service, and high environmental service with an explicit climate protection frame. Moreover, exploratory analysis suggests that meaningful

differences exist between the cities engaged in implementing these different bundles. The data examined in this paper increases understanding about the type and extent of GHG-reducing activities that have actually been implemented by local governments in the U.S. and offers a solid foundation upon which future analysis can build.

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Table 1: Motivators of Local Climate Policy

Economic	Political	Quality of Life	Informational / Psychological
Cost savings* Ability to attract external funding* Fuel green jobs / local green industry*	External pressure Internal stakeholder pressure Credit claiming by elected officials* Symbolic political statement	Air quality improvements* Traffic reduction* Civic engagement & community building*	Perceived risk/ vulnerabilities Leading by example
* Indicates co-benefit			

Adapted from Sippel and Jenssen 2009

Table 2: Challenges for Local Climate Policy

Economic	Political	Institutional	Informational
Over-arching challenges:(1) Tragedy of the Commons / free-riding (2) Scale issues and traditional global framing of climate change			
Cost Lack of internal finances Limited accessibility to outside funds Path dependency	Lack of political support Short time horizons Competing policy issues Lack of policy entreprenuers	Limited institutional / human capacity Internal coordination problems State or national limits on authority Limited control over utilities, landfills, etc	Lack of expertise Limited local information or data Inability to monitor or evaluate

Adapted from Sippel and Jenssen 2009

Table 3: Comparison of Survey Respondents with all U.S. Cities with Populations of 50,000 or Larger on Select Characteristics

	All cities receiving survey (n=665)	Responding cities (n=329)
Population (median)	84,533	86,527
Mayor's Climate Protection (pct members)	51.1	56.5
ICLEI Member (pct members)	30.1	39.2
Med. Household Income	54,261	55,579
Poverty Rate	14.5	14.2
Education (pct with BA)	29.4	31.7
Political Leaning (pct Democrats)	56.01	56.7

Table 4: Percent of Cities (n=329) that have Implemented each of the Identified GHG-Reducing Actions

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

Table 5: Average Implementation Rate for GHG-Reducing Activities as Categorized by Governance Mode

Self-Gov Institution (Table 4: 1-5)	**Self-Gov Operations** (6-14)	**Enabling – Information** (15, 18)	**Enabling – Incentives** (12, 16, 21)	**Service Provision** (20, 22-25)	**Authority** (17, 19, 26)
31.68%	50.09%	66.46%	32.85%	69.84%	54.30%

Table 6: Characteristic of Climate Network Members and Non-Members

	Climate Network Member (n = 218)	**Non-member** (n = 111)
Population (mean)	185,295	94,300
Household income (median)	54,868	56,974
Poverty rate	14.8	13.1
Education (pct w BA)	33.9	27.5
"College town" (Phds/1000)	19.3	9.3
Political leaning (pct Democrat)	59.5	51.3

Table 7: Cluster Results - Climate Protection Strategies and Policy Bundle Characteristics

		1: Limited environmental service (LES) (n=152)	2: High envi service, limited CP frame (HSL) (n=73)	3: High envi service, explicit CP frame (HSE) (n=104)
Percent of activities implemented – Scales derived from cluster-defining activities[4]				
Target	City	20.5	33.0	62.9
	Community	47.5	67.3	70.8
Instruments	Services	58.4	81.4	78.0
	Incentives	17.3	36.3	50.3
	Information	49.5	75.5	84.5
	Self-governance	23.2	35.9	64.8
	Authority	42.0	50.0	56.0
Emissions sector	Waste mgmt.	68.5	86.5	83.0
	Trees	37.3	77.7	69.7
	Transportation	38.1	54.9	62.0
	Buildings	21.0	33.0	54.3
	Energy use	38.6	43.0	64.2
Frame	Explicit GHG / institutionalized CP	6.40	19.8	70.8
Mean City Characteristics – External to cluster-defining activities				
	Population	99,531	131,203	251,492
	Med. HH Income	55,344	54,817	56,456
	Pct. Poverty	13.57	14.52	15.01
	Pct. Democrat	54.09	54.31	62.27
	Pct. Adults with BA	28.14	31.49	37.17

[4] With reference to the numbering system in Table 4, the following GHG actions are associated with each of the below categories: City Institutions and Operations – 1-14; Community – 15-26; Services – 20, 22-25; Incentives – 12,16,21; Information – 15,18; Self-governance – 11-14; Authority – 17,19,26; GHG(explicit) – 1-5, 26; Waste – 24,25; Trees – 14,18,19; Transport – 10-12, 20-23; Buildings – 9,16,17; Energy – 6-8,13,15.

Figure 1: Percent of Climate Network (CCP and/or MCPA members) and Non-Network Cities that have implemented Various Greenhouse Gas-Reducing Activities