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U.S. Local Government Adaptation to Climate Change:

An Examination of Influences on the Decision of Local Governments to Conduct Planned Adaptation to Climate Change in Urban and Rural New York State

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Declaration of conformity

This is to certify that this copy is fully congruent with the original copy of the thesis with the topic:

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Abstract

The desire for local governments to adapt to climate change seems logically relevant as weather extremes inhibit the ability of local governments to protect public health and safety and to ensure delivery of public services. By conducting planned adaptation to climate change local governments enable themselves to minimize risk and increase adaptive capacity to deal with climate change impacts. In the midst of a federal government, minus the Obama administration, that has tended to downplay the importance of climate change, action by local level governments - cities in particular - in the U.S. have been at the forefront of action on climate change. Little attention has been given to local government adaptation in rural areas by both researchers and policy makers alike. Rural areas are at risk to changes in climate because they tend to be reliant on climate sensitive industries, comprised of vulnerable populations, such as the elderly and very young and to possess few resources to conduct land-use and other planning. This dissertation expands upon previous research by examining the decision to conduct planned adaptation by both urban *and* rural local government adaptation to climate change (RQ1) and by identifying the influences on the decision of local governments in both urban and rural areas to conduct planned adaptation to climate change (RQ2).

New York State was selected as an appropriate case study to answer research questions because of the drastic contrast between urban and rural areas of the state. On the one hand, it has been one of the most progressive states in terms of climate change policy including its largest local government New York City; on the other hand, it is comprised of many rural local governments suffering from population and economic decline. An online survey was distributed to all New York State local governments in November/December 2011 and supplemented by informant discussions conducted before and after the survey. While a considerable amount of time has passed since the survey was conducted, it took place during what appears to be a particular timeframe in political history where the U.S. president supported action on climate change. Results of this study show strong differences in resource availability and the likelihood of urban vs. rural elected officials to conduct planned adaptation.

One hundred and forty-two responses were received from large and small cities, towns, villages and counties. A traditional deductive research design was deployed to answer research questions. To examine the influences on the decision of local elected officials to conduct planned adaptation hypotheses were developed based on previous empirical studies and Mohr's 1969 hypothesis that "Innovation is 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. 111). Two dependent variables were measured (1) **planned**

adaptation or conscious decisions to adapt to climate change and an alternate dependent variable (2) **formal and informal discussion of climate change** within the local government. Independent variables measured related to local elected official **motivation** to conduct planned adaptation in the form of climate weather related concerns in New York State (i.e. extreme weather, water quality, and ecological changes), **resource availability** within the local government (i.e. budget, staff, climate change expertise) and the **existence of obstacles** toward planned adaptation external to local governments (i.e. public support, federal and state informational and financial support).

The results of the survey showed that a small minority of local governments in New York State had decided to conduct planned adaptation to climate change. Over half of the sample was identified as conducting some form of spontaneous or reactive adaptation which consisted mostly of actions to minimize flood risk (i.e. update storm-water infrastructure, manage flood plains, promote open space). However, no local government surveyed had been identified as having successfully implemented an adaptation plan. Informal discussions were found to be occurring among half of the sample surveyed with a small number of local governments discussing climate change formally. According to informant discussions, the low level of planned adaptation among New York State local governments can be explained by a number of factors including a non-requirement to conduct planned adaptation, varying policy, resource and incentive conditions throughout the state, a lack of urgency to adapt to climate change and, finally, the absence of a support system to conduct planned adaptation.

Results of hypothesis testing indicate that local governments are more likely to conduct planned adaptation to climate change where: A) climate change concerns are water related, B) budget, staff and climate change expertise are available and C) public support to address climate change impacts as well as state and federal informational support are available. Financial support from state and federal governments did not appear to influence the decision to conduct planned adaptation. Rural local governments were found less likely than urban local governments to be discussing climate change and to be conducting planned adaptation which is likely to be related to organizational size and the availability of resources to conduct planned adaptation measures.

This dissertation contributes to understanding how local governments are adapting to climate change in New York State, what influences the decision of elected officials to conduct planned adaptation to climate change and how experiences may differ from municipality type — especially related to urban vs. rural local governments.

Table of Contents

List of Tables

List of Figures

List of Images

List of Abbreviations

ACES	American Clean Energy and Security Act
ARRA	American Recovery and Reinvestment Act
CDKN	Climate Development Knowledge Network
CEQ	Council on Environmental Quality
ClimAID	Integrated Assessment for Effective Climate Change Adaptation Strategies in New York State
CMP	Coastal Management Program
COP	Conference of Parties
CRC	Climate Resilient Communities Program
CSC	Climate Smart Community
DOE	Department of Energy
DOT	Department of Transportation
EU	European Union
FEMA	Federal Emergency Management Agency
GHG	Greenhouse Gas
ICLEI	International Council for Local Environmental Initiatives
IIP	Bureau of International Information Programs
LWRP	Local Waterfront Revitalization Program
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NCA	National Climate Assessment
NEPA	National Environmental Protection Policy Act
NOAA	National Oceanic and Atmospheric Administration
NWEAC	North Westchester Energy Action Coalition
NYC	New York City
NYCDEP	New York City Department of Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy and Research and Development Authority

NYSG	New York Sea Grant
RGGI	Regional Greenhouse Gas Initiative
RQ	Research Question
SIRR	Special Initiative for Rebuilding and Resiliency
UK	United Kingdom
U. S.	Unites States
U. S. EPA	United States Environmental Protection Agency
USGCRP	United States Global Change Research Program

1 Introduction

Climate change is one of the biggest challenges facing current and future generations. Regardless of what is accomplished now to reduce greenhouse gas emissions, we will continue to see changes in climate as a result of anthropogenic climate change. Thus, our ability to reduce vulnerabilities to climate change or adapt will remain an important part of our response to climate change now and in the future. This dissertation provides a clearer picture concerning the level of adaptation taking place in the United States (U.S.) specifically New York State, and the influences affecting the decision of local elected officials to conduct planned adaptation. The current chapter begins by providing an introduction and overview to the dissertation work including: an overview of the problem, significance of the study, dissertation aims, research questions and hypotheses, and concludes with an overview of the dissertation structure.

Problem Overview

It is becoming increasingly difficult to ignore the need to adapt to climate change as the prevalence of natural disasters, economic loss and fatalities increase due to changing climatic conditions. The United States and other developed nations are often perceived as having low vulnerability and high adaptability to climate change. In reality, doubts exist to both the preparedness and willingness to deal with climate change impacts (especially in the U.S. among researchers (Carmin et al., 2012; Easterling et al., 2004; Moser, 2009, p. 2; Repetto, 2008) and policy experts (Polansky, 2015). For the most part the U.S. is not well prepared to deal with the impacts of climate change; reactions to natural disasters tend to be preceded by a lack of planned adaptation and an over-response after a weather event has occurred (Repetto, 2008, p. 2).

Local governments are in a position to guide the community, act as a service provider and manager of infrastructure and to provide leadership on climate change. More importantly local governments are responsible for citizen well-being within their jurisdictions (e.g. health, safety, provision of public services) (Staden 2010, p. 23). In the midst of a non-requirement to plan for climate change it is up to local governments to decide whether or not to plan for climate change impacts. Thus, understanding what deters and motivates planned adaptation to climate change is important. Research examining the factors which influence adaptation decision especially among small local governments is lacking.

Significance of the Study

As societies tend to adapt to changes in their environment, adaptation to changes in climate are expected. However, whether or not conscious "choices to adapt" are being made is largely unknown (Easterling et al., 2004, p. 29). In relation to this, the social factors which drive or inhibit adaptation are under researched (Carlson, 2015). There is a need for research that offers a more "comprehensive, structured and nuanced" understanding of barriers and potential drivers of climate change adaptation (Massey et al., 2014; Waters et al., 2014). Past adaptation studies have not examined how to overcome barriers toward adaptation in both urban and rural contexts (Biesbroek et al., 2013; Eisenack, 2014; Lal, 2011; Waters et al., 2014). The focus of adaptation research has primarily been focused on urban adaptation among large cities (>100,000 residents) rather than rural adaptation among small local governments. Rural areas are defined in this study as areas containing a small number of residents as compared to urban areas (25,000 or less)[1]. The failure to examine adaptation among rural local governments is present both in the U.S. and New York State in particular (Lal, 2011; Tryhorn, 2010).

A lack of planned adaptation to climate change in rural areas is likely to result in negative consequences for the country as a whole. The rural U.S. contributes to the overall economy in a number of industries such as, energy production including renewable energy, tourism, recreation and food production (The White House, 2010). Furthermore, a failure to conduct planned adaptation to climate change will have a number of consequences for residents of rural areas. Rural residents depend on climate sensitive industries such as; tourism, recreation and agriculture. These industries that rural residents often rely on as part of their livelihoods are particularly sensitive to changes in climate. What is more, rural areas tend to consist of vulnerable populations such as the elderly and very young. The highly educated tend to migrate from rural to urban areas resulting in a lack of expertise to address climate change adaptation. Further, rural areas are also plagued by low provision of public services such as public transportation and healthcare facilities, and decaying public infrastructure (U.S. Environmental Protection Agency, 2012; Howitt, 2011; Lal, 2011; The White House, 2010). Rural areas face a unique challenge in terms of adapting to climate change in that they must adapt to changes in climate in the midst of economic decline, population shrinkage and often a lack of planning and climate change specific expertise.

[1] THE TERM RURAL IS FURTHER DEFINED IN CHAPTER 2.

Dissertation Aims-Significance of Research Study

Based on research needs the aim of this dissertation is to provide a structured examination of adaptation to climate change by both urban and rural local governments while examining the influences on the decision to conduct planned adaptation to climate change (or not). By examining adaptation and influences on the decision to adapt specific gaps in research knowledge can be addressed. Examination of adaptation and the influences on the decision to adapt can help to shed light on whether or not conscious decisions are being made to adapt, what potential barriers and drivers of planned adaptation are and how to overcome barriers in both urban and rural contexts. This dissertation examines the influences[2] on the decision of local governments to adapt to climate change especially as it relates to internal resources, obstacles external to local governments and decision-maker motivation. U.S. federal and state policies (specifically New York State) are analytically examined to identify their possible influences on the decision of local governments to conduct planned adaptation to climate change. Lastly, a review of existing innovation studies which examine innovation decision-making as well as adaptation research is provided where hypotheses are developed and tested.

The Area of Study, New York State

The dichotomy between the New York City area (urban) and the remainder of New York State (rural) is rather striking and provides an ideal study area to expand on previous research.

New York City--located in New York State, has been one of the most forward thinking and acting cities nationally as well as internationally in climate change adaptation (Carmin et al., 2012). New York City is also the most heavily populated city in the U.S. and one of the most economically well-off cities in the world (McKinsey Global Institute 2011; U.S. Census Bureau 2000). The city has implemented an adaptation plan, which is something only 18% of ICLEI members world-wide have been able to do (Carmin et al., 2012). Motivation to adapt to climate change is obvious as New York City is also among the world's top 10 cities at risk of flooding due to climate change (The World Bank, 2013). However, the remainder or majority of New York State's local governments face very different conditions to that of New York City. Population growth in New York State has been isolated to New York City and neighboring regions (i.e. Long Island and Mid-Hudson) (Division of Local Government

[2] FACTORS WHICH MAY INFLUENCE THE TENDENCY OF LOCAL GOVERNMENTS TO ADAPT TO CLIMATE CHANGE INCLUDE: DECISION-MAKER MOTIVATION TO INNOVATE, THE STRENGTH OF OBSTACLES TOWARD AN INNOVATION, AND AVAILABILITY OF RESOURCES TO OVERCOME OBSTACLES. ORGANIZATIONAL SIZE HAS BEEN FOUND BY A NUMBER OF RESEARCHERS TO HAVE A LARGE IMPACT ON THE LEVEL OF RESOURCES PRESENT AND THUS A LARGE IMPACT ON INNOVATION ADOPTION.

Services & Economic Development, Date Unknown). Conversely, the majority of cities in New York State have experienced a 30% decline in population (Division of Local Government Services & Economic Development, Date Unknown). Most of the state is rural with approximately 15% of the population living in poverty (New York State Office for the Aging, Date Unknown, p. 4). These rural areas which are already challenged by economic and poverty related issues will be further challenged by climate related impacts.

The weather experienced in New York State is extreme and climate change is expected to exacerbate already extreme weather conditions (Rosenzwieg et al., 2011b). Major climate change impacts in New York State include changes in precipitation, sea-level rise, temperature extremes and worsening air quality (Rosenzwieg et al., 2011b). Negative impacts on public health, public services and the economy are expected as a result of climate change. Outside of New York City climate sensitive industries such as agriculture, dairy and tourism play an important role in the economy (Rosenzwieg et al., 2011a). Furthermore and pertinent for local governments, climate change is predicted to result in challenges in maintaining water quality and delivery, energy delivery and infrastructure (Rosenzwieg et al., 2011b). These are challenges all local governments will face (not just large cities) including those in rural areas.

To expand upon and address research gaps the following questions will be addressed as it relates to New York State:

1. *Are local governments in New York State adapting to climate change?*
    a. *Is adaptation to climate change taking place?*
    b. *What types of governments are adapting (e.g. towns, villages, cities/large or small)?*
    c. *Is adaptation planned or spontaneous adaptation?*
2. *What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?*
    a. *What has motivated local governments to conduct planned adaptation to climate change?*
    b. *What has deterred local governments from conducting planned adaptation to climate change?*

SPECIFIC HYPOTHESES TESTED ARE:

Research Question 1:

- Hypothesis I: The majority of local governments are not conducting planned adaptation to climate change. (Based on research and informant discussions)
- Hypothesis II: Local governments with large populations are more likely to conduct planned adaptation than local governments with small populations (Specific variables: population, urban versus rural). (Relates to the influence of size on the decision to adapt)

Research Question 2:

- Hypothesis I: Local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments spontaneously adapting (specific variables: extreme weather, ecosystem changes). (Relates to motivation to adapt)
- Hypothesis II: Local governments perceiving the existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change than local governments spontaneously adapting (specific variables: budget, staff, expertise). (Relates to resources)
- Hypothesis III: Local governments perceiving the existence of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change (specific variables: state financial, federal financial, general public, state informational and federal informational support). (Relates to obstacles)

Methods

The main method employed to address research questions was an online survey conducted in November and December of 2011. In order to address the issue of the survey data being relatively dated a number of steps have been taken. Current literature has been reviewed in the discussion chapter and again in the conclusion chapter to identify whether or not other researchers have found similar results. In the conclusion chapter the likelihood of motivation, obstacles and resources to conduct planned adaptation having changed is also discussed. Additionally, political conditions in New York State and at the federal government level are discussed pre and post survey dissemination in order to identify what effect this may have had on survey responses.

A traditional deductive approach was employed to answer research questions. Hypotheses were generated based on research examining adoption of innovations theory and previous research examining local government adoption of climate change policies. The main dependent variable measured was (1) planned adaptation. However a second dependent variable was measured, as it was thought possible that no planned adaptation was to be taking place, (2) discussion of climate change within the local government. Independent variables measured related to concern regarding climate change impacts (motivation), perception of resources (resources) and obstacles to climate change adaptation (obstacles).

Statistical significance for the cross-tabulation tables were tested using either the Fisher's exact test or the Chi-square depending on the resulting cross-tabulation cell sizes[3]. In addition to using simple percentages and sums to describe data and cross-tabulations to test hypotheses, open-ended and other response options were analyzed using qualitative data techniques.

Dissertation Structure

The current chapter so far has provided an introduction and overview to the dissertation work including: an overview of the problem, research gaps, dissertation aims, research questions and hypotheses. The next and last section of this chapter is used to provide an overview and description of the dissertation's structure.

In chapter two the cost of climate change in the U.S. both in terms of economics and loss of life are discussed in order to highlight the need to adapt. Climate change impacts are discussed as they impact the ability of local governments to fulfill their duties (i.e. ensure public health, safety and provision of public services). The influence local governments possess on climate change preparedness in both "home rule" and non-home rule states are reviewed (i.e. infrastructure management, land-use controls). The process of conducting formal adaptation planning is reviewed and examples of climate action plans are provided for both small and large local governments. Differences in vulnerabilities and needs are discussed as they relate to urban and rural adaptation to climate change. Here it is argued that there is a need to take adaptation in rural areas more seriously.

The third chapter provides an overview of the actions being taken by federal, state and local governments to address climate change including mitigation. The responsibilities as well as the potential of each level of government in adapting to climate change are discussed. The beginning of chapter three is focused on the critical role of the federal government in guiding national adaptation policy. The

[3] RELATIONSHIPS WERE CONSIDERED TO BE SIGNIFICANT OR LIKELY TO BE OCCURRING IN THE POPULATION AT ALL LEVELS BELOW .05.

progression of U.S. climate change policy from the 1960's to the Obama administration is provided. Despite interest of the Obama administration to adopt more progressive climate change policies strong legislation requiring approval from congressional Republicans have remained impossible. Legislation requiring only executive approval from the president has remained focused on greenhouse gas mitigation rather than adaptation (as has climate change funding). The next section of chapter three provides an overview of efforts by U.S. States to address climate change. According to their constitutional powers, states can play a role in promoting action to adaptation by collaborating with the federal government, other states and facilitating adaptation from the local level. The federal and state government sections of this chapter provide a background to understand the potential of federal and state governments to effect local level adaptation (i.e. influences on the decision to adapt). The final section of chapter three is used to highlight the need for more research which examines adaptation among the general population of local governments including small rural local governments (i.e. is planned adaptation taking place?).

The fourth chapter lays out the theoretical dimensions of the dissertation highlighting the potential of local governments to change, however challenging it may be. Here an effort is made to understand and outline under what conditions local governments are willing to change (i.e. adopt new policies). Research gaps are identified within the climate change adaptation field. Mohr's hypothesis consisting of three basic components-motivation, resources and obstacles- is used as a heuristic to guide scientific inquiry. Mohr's hypothesis is used to bridge innovation research to that of adaptation research and create hypotheses which address research questions. The basics of innovation theory as well as the possible influence of spatial aspects, federal and state governments, and community attitudes are discussed in the context of climate change adaptation. Here hypotheses are developed which address the research question, "What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?". One hypothesis relating to local government size is used to examine whether or not local governments are adapting and furthermore can be applied to answer both research questions.

In chapter five the research design, data collection methods, strengths and weaknesses of research design and data analysis are outlined. The main method of data collection conducted was an online survey; however other data collection methods (i.e. informant discussions) were used in conjunction. How these data collection methods were carried out and analyzed is discussed in detail. Finally, an introduction and background to the online survey is provided including a description of the political and other circumstances leading up to the survey, response rate and sample characteristics as well as the strengths and limitations of the sample.

In the sixth chapter a review of the study area New York State is given. A more in-depth look at climate change vulnerabilities and impacts as well as climate change policies originating from New York State are provided. Specific challenges local governments are likely to face, such as flooding, poor air quality and extreme heat as a result of climate change and as well as adaptation actions available to minimize these impacts are deliberated (i.e. land use controls/planning instruments). This chapter provides a basis to understand the content of the online survey conducted (e.g. types of climate change concerns measured, land use controls/adaptation actions measured) as well as possible motivation to address climate change by local governments (e.g. flooding and other impacts), obstacles which may be present (e.g. lack of funding/guidance to conduct planned adaptation) and resources (e.g. may vary according to local government size expertise, information, funding).

Chapter seven contains the results for research question 1 where adaptation to climate change is examined in New York State. “Whether or not adaptation is taking place and how” is discussed based on informant discussions and the survey. Results of hypothesis testing are also given. In the following chapter eight, results are provided pertaining to research question 2: “What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?”. First, an overview of informant discussions are given – these are opinions of professionals in the field. Then motivation, obstacles and perceived availability of resources toward planned adaptation to climate change are identified according to data gathered via the survey- these are opinions of local governments themselves. Finally, hypotheses based on innovation theory are tested using data gathered from the survey. Three hypotheses were examined: I.) relates to concern about climate change impacts (i.e. motivation: concern regarding extreme weather, water quality, ecological changes), II.) relates to availability of internal resources to address adaptation (i.e. resources: budget, staff, expertise) and finally III.) relates to availability of external resources to address adaptation (i.e. public support, state and federal informational and financial support).

The final chapter entails the discussion and conclusions of the dissertation. First, a synthesis of empirical results is provided. Second, the theoretical implications including general observations of how the research findings relate to innovation theory as well as specific theoretical implications related to the hypotheses tested as part of this study are given. Third, policy implications of research findings are discussed as they relate specifically to New York State. Fourth, methodological and other limitations of the study are given as well as suggestions for future research. In order to deal with the problem of dated data collection argumentation is given to support validity of data collected. For example, political conditions have not significantly changed especially at the local level, thus conditions under which local

governments are to adapt to climate change have not improved (i.e. availability of financial and other resources, level of political and public support to take action on climate change). Furthermore, support for research findings can be found among more recent research studies especially as it relates to the level of planned adaptation taking place, flooding as motivation to adapt, the influence of public support as well as state and federal governments and the influence of internal resources on the decision to conduct planned adaptation. Finally, the dissertation closes with suggestions as to what is needed to increase the likelihood of local governments to decide to conduct planned adaptation to climate change.

2 The United States, Climate Change and the Importance of Local Governments in Adapting to Climate Change

2.1 U.S. Vulnerability to Climate Change Impacts

In the last 30 years there has been a dramatic increase in the number of billion dollar weather related disasters in the United States. Tornados, tropical storms, drought and wildfire have resulted in substantial economic and health related losses. These types of impacts as related to climate change are predicted to only increase as greenhouse gas emissions have steadily continued to rise. World-wide greenhouse gas emissions were the largest ever recorded in 2011. The continuing increases in greenhouse gas emissions has been attributed to the burning of fossil fuels such as coal and oil and are predicted to continue to increase in the foreseeable future. As of 2012 the largest contributors to greenhouse gases worldwide were China, the United States, The European Union and India, respectively (Global Carbon Project, 2012). In the U.S. the steady increase in greenhouse gas emissions has been due to electric power generation but has also been attributed to petroleum and natural gas systems, refineries, chemicals, other sources, waste, metals, minerals and pulp and paper (United States Environmental Protection Agency, 2011b), all of which should continue to see widespread use in the United States. There are a number of social, physical, economic, and health related reasons the U.S. should be concerned about continued climate change, including the prevalence of weather related disasters, economic loss and fatalities.

Between the years 2011 and 2013 there were 32 weather related disasters resulting in a billion dollars of economic loss each and causing 1,249 deaths in total.

There has been a steady increase in the number of billion dollar disasters in the U.S. since the 1980's. In 2011 the U.S. experienced 14 weather related disasters each costing a billion dollars and resulting in 646 fatalities (National Oceanic and Atmospheric Administration, 2011). Similarly, 2012 was comparable with 11 billion dollar weather and climate related disasters and 349 fatalities. Roughly half of the fatalities were caused by Hurricane Sandy and the remaining fatalities caused by heat waves and drought (National Oceanic and Atmospheric Administration, 2012b). In 2013 there were fewer billion dollar disasters than previous years but still recorded 7 billion dollar disasters including severe weather, tornados, flooding, drought and heat waves resulting in 109 fatalities (National Oceanic and Atmospheric Administration, 2013a).

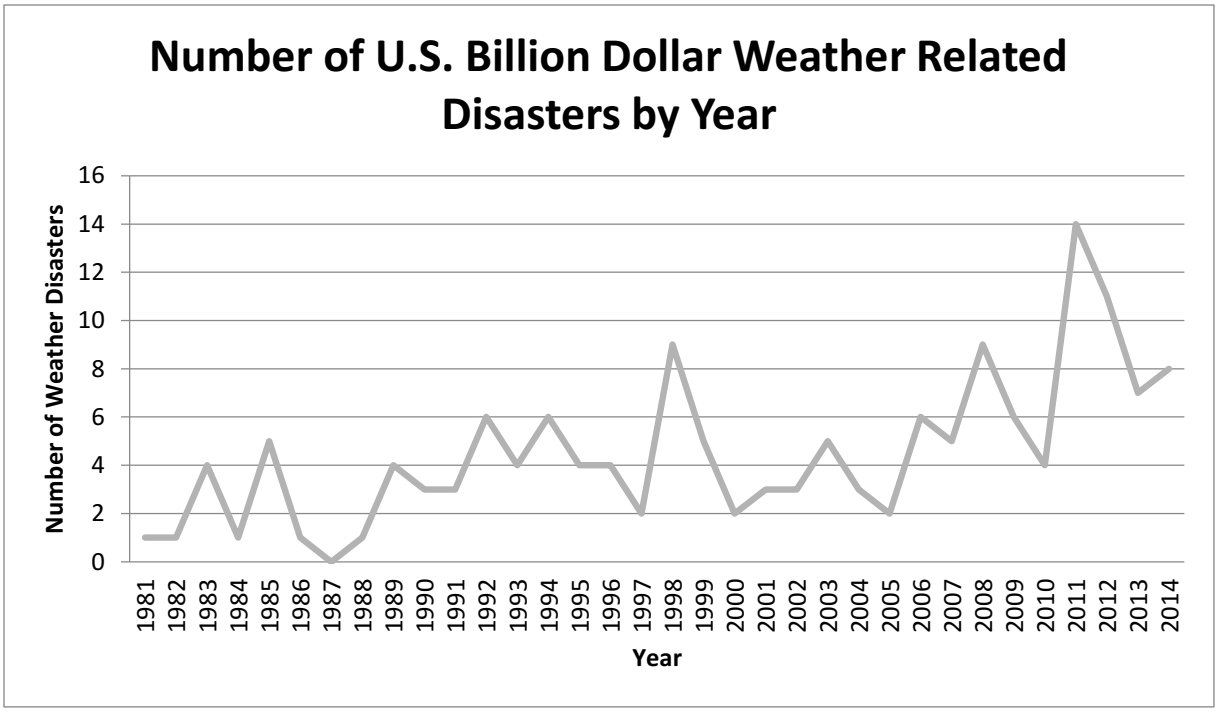

Figure 1: Number of Billion Dollar Weather Related Disasters by Year in the U.S. (Source: Author's Illustration based on National Oceanic and Atmospheric Administration, 2012a; National Oceanic and Atmospheric Administration, 2013a)

The number of weather related disasters have not been the only weather related changes experienced in the U.S. in previous decades. The United States Global Change Research Program has identified a number of changes that have occurred across the U.S. in the past 50 years.

Some of the weather related changes in the U.S. in the last half a century have included increases in temperature, precipitation, heavy rainfall and the number of hurricanes. Coastal areas in the U.S. have experienced rises in sea level in the previous decades as well. According to The U.S. Department of State, climate change is expected to impact the United States negatively in a number of ways. Expected impacts include disruptions to water and energy delivery, transportation delays, reduced agricultural productivity, altered ecosystems and negative impacts on health and society in general (U.S. Global Change Research Program, 2009).

These events can also have a cumulative effect creating compounded problems. For example, conditions such as drought, snow and ice melt will impact water cycle patterns resulting in diminished quality of water resources. Temperature extremes both in winter and summer months are likely to result in a greater need to regulate housing temperatures via heating and cooling, causing increased energy demand and resulting in increased possibilities of "black outs". Climate change can impact human behavior and result in changes to service demands. If caught unprepared

governments risk failing to provide uninterrupted services to their communities and jeopardize public safety and risk economic loss.

For example, in 2003 increased demand for electricity due to extreme heat resulted in the failure of electricity grids in eight U.S. States. In New York City the blackout resulted in many challenges. One of the biggest challenges for New York City was maintaining an efficient transportation system. The “blackout” of 2003 caused a number of disturbances including 600 stranded trains requiring evacuation of thousands of passengers from underground tunnels, individuals becoming trapped in elevators, re-routing of airplanes as well as impairment of street lights (Barron, 2003). This is just an example of one type of climate change impact on a large city with more resources than most other cities. The combination of multiple impacts simultaneously on local governments with lesser resources, such as in smaller rural communities, could be catastrophic.

Other types of impacts such as flooding and sea level rise are also predicted to impair the functioning of airports, roads, rail lines and tunnels. Weather extremes like hurricanes are predicted to result in evacuations, disruptions to travel and further damage to infrastructure. These types of impacts can occur in succession or simultaneously further complicating adaptation and exaggerating negative impacts to human systems. Beyond the micro level interruptions to daily life, climate change is predicted to result in longer term impacts such as on the economy and the environment.

Although some increases in crop production are expected, the majority of climate change impacts in the agricultural sector are expected to be negative. Heavy rain and drought are predicted to decrease crop production, the quality of pasture and rangelands as well as livestock productivity. Predicted changes in ecosystems are also expected to result in economic losses. Regions with economies dependent on fisheries, such as trout and salmon populations are expected to suffer economically as ecosystem changes reduce fish populations. Finally, climate change is predicted to have a number of negative impacts on the health of U.S. citizens.

To start with, extreme temperatures such as heat and cold are predicted to result in illness or in extreme cases death, especially for vulnerable populations such as the elderly. Furthermore, due to increases in certain insect populations such as mosquitos, the spread of infectious diseases for example, the West Nile Virus, are expected to increase in occurrence (U.S. Global Change Research Program, 2012). Essentially, climate change increases the challenge of local governments to provide uninterrupted services such as, energy, water and transportation as well as economic prosperity and protecting human health.

2.2 Identifying and Defining the Role of Local Governments in Adapting to Climate Change

Staden (2010) identified three main roles local governments play in local climate action they include: guiding the community, acting as service provider and manager of infrastructure, and providing leadership. Local governments have been identified as key actors in climate mitigation and adaptation for many reasons.

The term local government in the U.S. is broad, referring to county and municipal level governments. Municipal level governments are closest to communities and are referred to as: villages, towns (or townships) or cities according to respective state constitutions. County level governments are also considered to be part of local government but are second tier to municipal governments (whitehouse.gov 2012). As the level of government closest to citizens local governments have been deemed by the federal level of government to be in the best position to meet the needs of citizens (Bureau of International Information Programs (IIP), 2012). These administrative bodies are responsible for the well-being of the citizens within their jurisdictions in a number of ways, including health and safety and provision of services which contribute to a functioning society (Staden, 2010, p. 23).

Services Provided by Local Governments

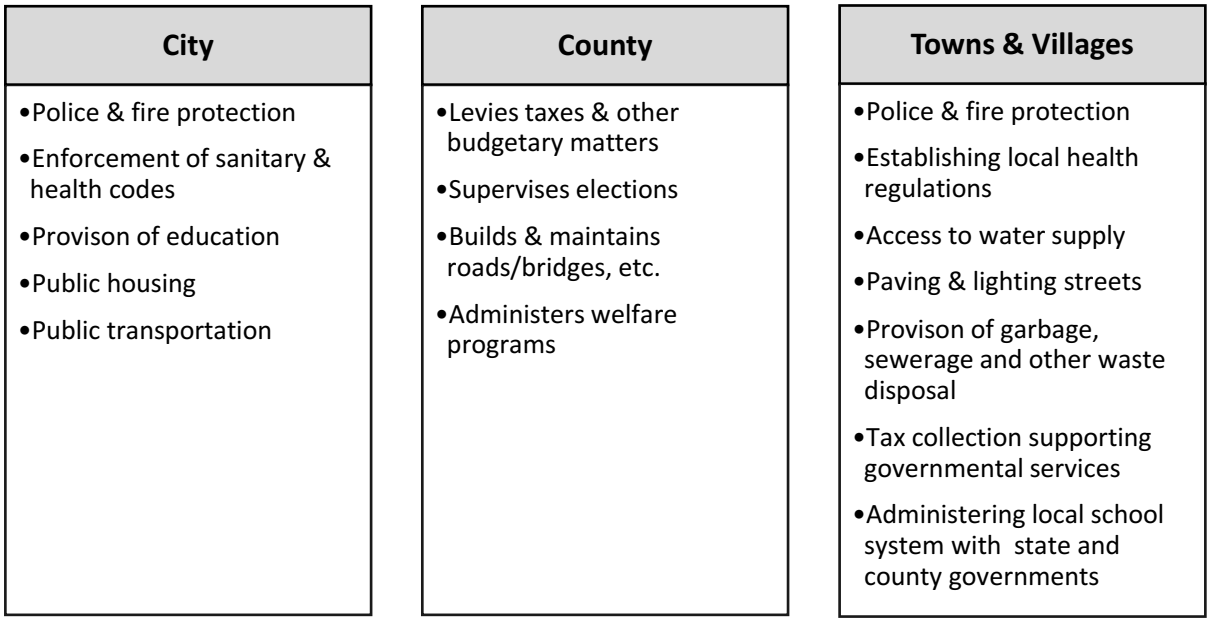

Figure 2: Standard Basic Services Provided by Local Governments in the U.S. (Source: Author's Illustration based on whitehouse.gov, 2012)

The services provided by local governments in the U.S. differ depending on the government type and whether the local government is municipal (i.e. town, village or city) or county. For example, county governments serve a different purpose than

municipal level governments. Counties typically operate as an intermediary between state and local governments performing tasks such as levying taxes, supervising elections as well as building and maintaining transportation infrastructure. County level governments often administer welfare programs (whitehouse.gov, 2012). Municipal level governments provide police and fire protection services, public housing, public transportation and education and enforce sanitary and health codes. Cities often provide these services together with federal and state governments.

As cities provide many services in coordination with other governmental levels, adaptation is likely to require collaboration at state and federal levels. Town and village municipal governments on the other hand are more focused on meeting local needs (e.g. water delivery or water access, garbage and waste disposal as well as collection of taxes to support governmental services). Nevertheless, town and villages may also be responsible for fire and police protection, establishing local health regulations, maintenance of roads and administering local school system in conjunction with state and county governments (whitehouse.gov, 2012). In addition to the provision of services local governments are often in charge regulating the way land is used and the building of new infrastructure.

Local Government Management of Infrastructure and/or Land Use

Municipalities given the legislative authority of "Home Rule" (decided according to state) are more flexible in deciding how to exercise land-use controls so long as they have not been prohibited by the state. That is, local governments located in home-rule states are in general flexible in deciding how to govern their municipality. Municipalities located in "Dillon's Rule"[4] states must first be granted land-use controls by their respective state (Katz, 2003), and thus cannot react as quickly to changing conditions as municipalities located in home rule states. Despite this difference, most municipalities still have the powers to regulate land use, oversee infrastructure projects and enforce building codes (Pitt, 2009). The powers local governments possess to regulate land use are important in influencing the ability of communities to adapt to climate change and to reduce greenhouse gas emissions. The decisions made by local governments in land use and building code regulation affect the level of greenhouse gas emission produced as well as the ability of communities to adapt to climate change impacts (Davoudi et al., 2009, p. 14). Climate adaptation strategies

[4] THERE ARE 39 DILLION'S RULE STATES: ARIZONA, ARKANSAS, CONNECTICUT, DELAWARE, GEORGIA, HAWAII, IDAHO, KENTUCKY, MAINE, MARYLAND MICHIGAN, MINNESOTA, MISSISSIPPI, MISSOURI, NEBRASKA, NEVADA, NEW HAMPSHIRE, NORTH CAROLINA, NORTH DAKOTA, OKLAHOMA, PENNSYLVANIA, RHODE ISLAND, SOUTH DAKOTA, TEXAS, VERMONT, VIRGINIA, WEST VIRGINIA, WASHINGTON AND WYOMING (NATIONAL LEAGUE OF CITIES, 2013).

can be integrated into climate action, hazard mitigation or comprehensive plans (ICLEI, 2011). Each one of these plan types has a different purpose and presents a new opportunity to integrate adaptation into current and future local government operations.

Local Government Adaptation Planning

Before adaptation planning takes place within any local government a decision has to be made to adopt such a policy. Any decision to adopt a new policy must first be decided by either the executive or legislative branches or both (Bingham, 1976, p. 217). This makes elected officials key players in climate change adaptation. The decision to intentionally adapt to climate change must first start with them. The organizational structure of local government in the U.S. varies from state to state but in general includes an elected central council and an executive officer. Cities have a number of departments and department heads appointed by their elected officer. Town and village governments tend to be smaller and instead of containing departments and department heads have executive officers charged with specific tasks (i.e. clerks, treasurers and those that deal with police, fire and social welfare) (whitehouse.gov, 2012). A decision to formally adapt to Climate Change must originate from the executive or legislative branches or sometimes both.

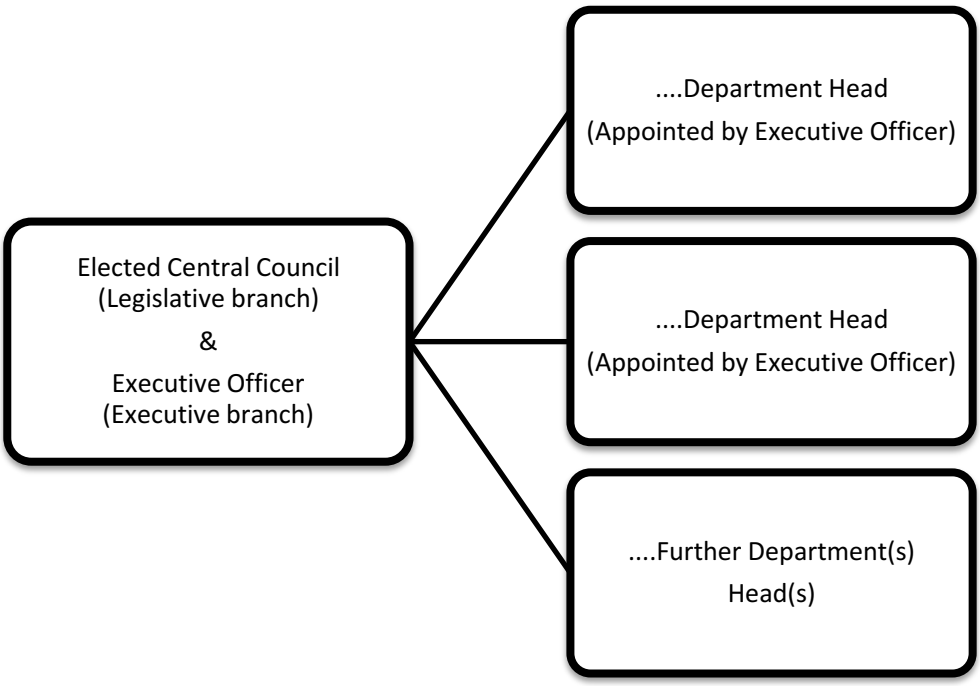

Figure 3: Basic Internal Organizational Structure of Local Governments in the U.S. (Source: Author's Illustration based on whitehouse.gov, 2012)

U.S. States Delegate Responsibilities to Local Governments via State Constitutions

U.S. local governments are not required by the federal government or states to plan for climate change impacts. Although local governments are required to plan for certain emergencies as part of hazard mitigation planning by the Federal Emergency Management Agency (FEMA) and as directed by local and state laws, they are not required to incorporate climate related disasters or impacts into their hazard mitigation or emergency planning (Sussman, 2010). In addition to not being required to consider climate change as part of their operations local governments for the most part have been left on their own to decide if and how they plan to deal with climate change. Local governments should have an interest in climate change because it is expected to impact the ability of local governments to provide uninterrupted services to their citizens. Some local governments do see the need to create a climate action plan.

A climate action plan is a document outlining how a local government intends to reduce greenhouse gas emissions both within the local government itself and within the community. Actions to reduce greenhouse gas emissions are identified in a variety of sectors such as energy, infrastructure and waste or water treatment. However, some local governments may take additional efforts other than focusing on current operations such as the creation of renewable energy projects or encouraging green job development (Local Governments for Sustainability-ICLEI, 2009). Climate action plans have been developed at a variety of local government levels and may be defined differently depending on the type of entity.

The White House defines a climate action plan as "…a strategy, including specific policy recommendations, that a state will use to address climate change and reduce its greenhouse gas emissions" (United States Environmental Protection Agency, 2014). However, cities can also create climate action plans and may define climate action plan differently. For example, Boulder, Colorado defines climate action plan as "an integrated, aggressive set of programs and strategies to reduce Boulder's greenhouse gas emissions and address the growing impact of human activity on global climate change" (City of Boulder Colorado, 2014). A variety of definitions for climate action plan exist however; in general a climate action plan can be defined as a written strategy, policy or plan to reduce greenhouse gas emissions.

A second method of integrating adaptation plans into already existing operations is by incorporating it into hazard mitigation planning. A hazard mitigation strategy helps communities to prepare for natural hazards such as earth quakes, flooding or hurricanes. A hazard mitigation plan may have already been created by a local government in order to fulfill federal or state guidelines. The process of creating a hazard mitigation plan includes organizing resources within the community to

address natural hazards and identifying and assessing risks within the community (Federal Emergency Management Agency, 2012). With some of the risks posed by climate change (e.g. extreme heat, wind cold and flooding) it is difficult to imagine a comprehensive hazard mitigation plan that does not address the risks associated with climate change, yet this is often the case.

Finally, adaptation measures can be integrated into a community's comprehensive plan. A comprehensive plan is used to guide policy development and other decisions regarding community development. This is usually created based on the decision of the local government themselves. A comprehensive plan may include "existing conditions, a discussion of future trends, goals, and objectives…land use patterns, housing conditions, population, roadways, and other infrastructure issues" (University of Illinois Extension, 2013). Once again, it is difficult to imagine a thorough comprehensive plan that does not in some way refer to climate change adaptation especially considering the present and predicted impacts climate change pose on housing, roadways and infrastructure.

Conditions such as extreme heat waves, more frequent severe storms, water shortages, increased air pollution, rising sea levels and increased spread of diseases will continue to pose challenges for local governments (Local Governments for Sustainability (ICLEI), 1995-2012d). Climate change will impact local governments in a number of ways. Requiring local governments to alter the way services are provided. Local governments may experience an increased demand for services, for example during periods of drought which could result in forest fires resulting in an increased need for fire protection. Drought is also likely to increase the demand for water. Increases in various types of precipitation, such as snow and rain, result in wear and tear on infrastructure, such as streets and bridges that consequently may require maintenance more frequently. Additionally, an increase in snow or extreme weather may increase the need for roadways to be cleared of snow and debris. Lastly, local governments may need to alter health codes to manage the increased spread of infectious diseases such as West Nile Virus.

Climate Change Adaptation Defined

The ability of local governments to make adjustments in behavior, resources and technology to minimize the negative impacts of climate change is referred to as their adaptive capacity (Local Governments for Sustainability (ICLEI) 2007b). Examples of specific actions local governments can take to reduce climate change vulnerability include: expanding water resources, harvesting rainwater, upgrading building standards and other infrastructure, promotion of functional watersheds and healthy forests and the planting of trees and other vegetation (ICLEI, 2011). Climate change

adaptation has been referred to as a manifestation of adaptive capacity and ultimately attempts at reducing vulnerability (Smit, 2006, p. 282).

Vulnerability to climate change has been referred to as "the propensity of human and ecological systems to suffer harm and their ability to respond to stresses imposed as a result of climate change effects." (Local Governments for Sustainability (ICLEI), 2007b). Beyond examining adaptation as just the ability to reduce vulnerability The Intergovernmental Panel on Climate Change[5] (IPCC) has defined climate change adaptation[6] to include exploiting beneficial opportunities.

Adaptation versus Mitigation

Climate adaptation differs from climate change mitigation sometimes referred to as climate protection in a number of ways. Mitigation of climate change occurs when humans reduce greenhouses gases both at the source and by improving uptake of greenhouse gas via sinks (IPCC, 2012). The effect of actions taken to reduce greenhouse gases will be seen in the future, whereas measures to reduce vulnerability may have an immediate effect (Hall, 2009). It could be argued that the reduction of greenhouse gases may have social or monetary rewards depending on external circumstances such as the existence of a cap and trade program or a support from the community for such actions. Whereas mitigation has a global benefit, adaptation often has an impact at the local and regional level. Actions involving reduction of greenhouse gases usually take place in a few areas such as energy or transportation. Adaptation on the other hand requires involvement from a variety of sectors such as agriculture, tourism, recreation, human health, water supply, coastal management, urban planning and nature conservation. Mitigation or adaptation to climate change could also both be taking place for reasons not related to climate change. For example, local governments maybe responding to weather related stimuli without relating the impacts to climate change, additionally, they may be conducting measures that reduce greenhouse gases as a means to save on energy costs and spur the economy rather than to address climate change.

In addition to the dissimilarities in conducting mitigation and adaptation, the measurement of success also differs. The concept of measuring mitigation is more cut and dry. One measures current greenhouse gas emissions and adopts a

[5] THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) IS AN INTERNATIONAL BODY ESTABLISHED IN 1988 BY THE UNITED NATIONS ENVIRONMENTAL PROGRAMME AND THE WORLD METEOROLOGICAL ORGANIZATION TO IDENTIFY ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACTS (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), 2013).

[6] THE IPCC DEFINES ADAPTATION AS "ADJUSTMENT IN NATURAL OR HUMAN SYSTEMS IN RESPONSE TO ACTUAL OR EXPECTED CLIMATIC STIMULI OR THEIR EFFECTS, WHICH MODERATES HARM OR EXPLOITS BENEFICIAL OPPORTUNITIES" (LOCAL GOVERNMENTS FOR SUSTAINABILITY (ICLEI), 2007A).

greenhouse gas reduction goal. Here success is measured by the ability to meet or break the set emission target. Success in terms of adaptation is not as tangible as with mitigation (Hall, 2009, p. 239). At present it is not meaningful to measure adaptation based on outcomes of implemented adaptation measures. Few local governments have succeeded in implementing adaptation plans; therefore it is more meaningful to measure success based on implementation of adaptation measures rather than of adaptation outcomes. As stated by Moser, “Merely advancing or progressing can be used as a proxy for success” (Moser, 2013, p. 97).

The Importance of Considering Mitigation while Implementing Adaptation Measures

Implementation and selection of measures to reduce climate change impacts is not simply about addressing climate change impacts but also about considering the impacts that selected actions may have on mitigation. Careful consideration of climate change adaptation measures are important as trade-offs and synergies between adaptation and mitigation measures exist (Wilson, 2006 and 2010). Care must be taken not to undermine mitigation efforts or to contribute to greenhouse gas (GHG) emissions when implementing adaptation measures. For example, if a local government were to expand the availability of air conditioning to citizens’ during periods of extremely high temperatures then an increase in greenhouse gas emissions is expected. Efforts to benefit from climate change may also further contribute to greenhouse gas, for example promotion of tourism as a result of warmer than usual temperatures may translate to increases in energy and water demand and thus an increase in greenhouse gas production. On the other hand, adaptation measures can be chosen which help to mitigate greenhouse gas emissions, for example energy efficiency measures, implementation of renewable energy, land-use and other policies which preserve resources address both adaptation and mitigation (Wilson 2010). In addition to making changes internally local governments can promote adaptation on a broader scale.

Planned, Anticipatory and Spontaneous Adaptation

ICLEI has identified three types of adaptation: spontaneous, anticipatory and planned. Spontaneous adaptation takes place without the actor deliberately taking actions to address climate change as such but simply reacting to environmental stimuli. It has been defined as “adaptation that does not constitute a conscious response to climate stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems” (Local Governments for Sustainability (ICLEI), 2007a). A local government constructing a dam post flood event is an example of spontaneous adaptation. In this case, the decision maker(s) within the local government construct a dam based on the flood event but not based

on their belief in climate change or based on predictions of future climate change. The second type of adaptation, anticipatory, occurs before an impact is experienced (Local Governments for Sustainability (ICLEI), 2007b). Here a local government constructs a dam based on the likelihood of a flooding event occurring and not because they have already experienced flooding. Planned adaptation goes beyond both spontaneous and anticipatory adaptation as adaptation in this respect is a deliberate policy decision. The local government in this case is aware of climate change and is attempting to "return to, maintain, or achieve a desired state" (Local Governments for Sustainability (ICLEI), 2007a). A local government conducting planned adaptation takes deliberate actions, for example altering building codes based on past and predicted flood conditions to protect the current and future housing base against climate related impacts. (Specific weather related impacts were identified for New York State and include flooding, extreme heat, infectious diseases, poor air quality and wildfires).

Local Governments and Planned Adaptation

Planned adaptation is considered to be deliberate attempts by local governments to utilize the powers granted by state and federal constitutions to reduce community vulnerability to climate change. For the purposes of this research study, adaptation was simplified to include two types, spontaneous and planned adaptation. Adaptation was simplified as it was not necessary to measure all three types in order to answer research questions. The focus was to examine if local governments are conducting planned adaptation or not. Although the definition of successful adaptation is important it is not measured in this study. As the aim of this study is to understand what influences the decision to adapt, to climate change, it was not necessary to measure successful adaptation but rather if adaptation was taking place and what type. In this study adaptation is also defined to include both reduction of vulnerability and taking advantage of beneficial opportunities. Both are included because all actions to adjust or adapt to climate change have been identified as important in ensuring successful local government operations. Local governments may decide to adapt to climate change differently depending on whether or not they are deliberately addressing climate change as such or whether or not they are reacting to past experience or predicted impacts. In this study local governments conducting autonomous or planned adaptation are considered to be better prepared to deal with climate change impacts than those taking no action. However, planned adaptation has been identified as the most desirable as related to climate change as it provides the best opportunity to minimize risk and improve adaptive capacity (Local Governments for Sustainability (ICLEI), 2007b).

Local governments conducting planned adaptation follow a general framework which has been identified by both practitioners working in the field and by researchers studying adaptation. Moser (2010) presented a framework to examine the process of adaptation decision making based on rational decision making. This framework is based on the process of planned adaptation and includes three major phases: understanding, planning and managing. In general while conducting planned adaptation local governments first try to understand the problem. In order to understand climate change they need to detect it as a problem and begin to gather and use information. In the next phase, local governments begin planning by developing adaptation options. Lastly, the managing phase entails evaluating the situation and implementing options (Moser, 2010).

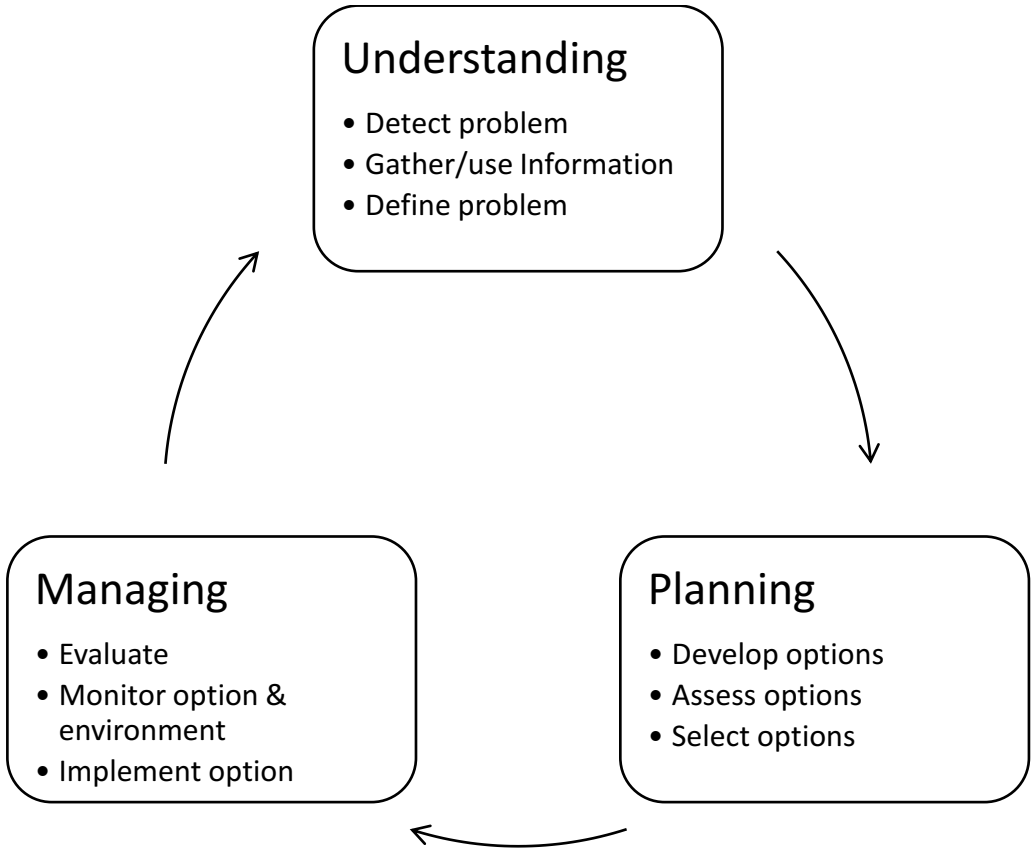

Figure 4: Process of Planned Adaptation to Climate Change Developed by Moser, 2010) (Source: Author's Illustration based on Moser, 2010)

As part of ICLEI's Climate Resilient Communities Program local governments are advised to follow a 5-step program called the "Five Milestones for Climate Adaptation". Local governments conduct a vulnerability assessment, set preparedness goals, develop and publish and implement a climate preparedness plan, lastly, local governments must monitor and re-evaluate resiliency. Both of these

models would not make sense for local governments conducting spontaneous adaptation to climate change because understanding the problem and planning both require detecting climate change as a problem and understanding it as such. Understanding probability and risk in relation to climate change adaptation are important in deciding how to adapt (Davoudi et al., 2009). Therefore the planning and implementation stages of adaptation would not work if the local government in question had an incorrect understanding climate change.

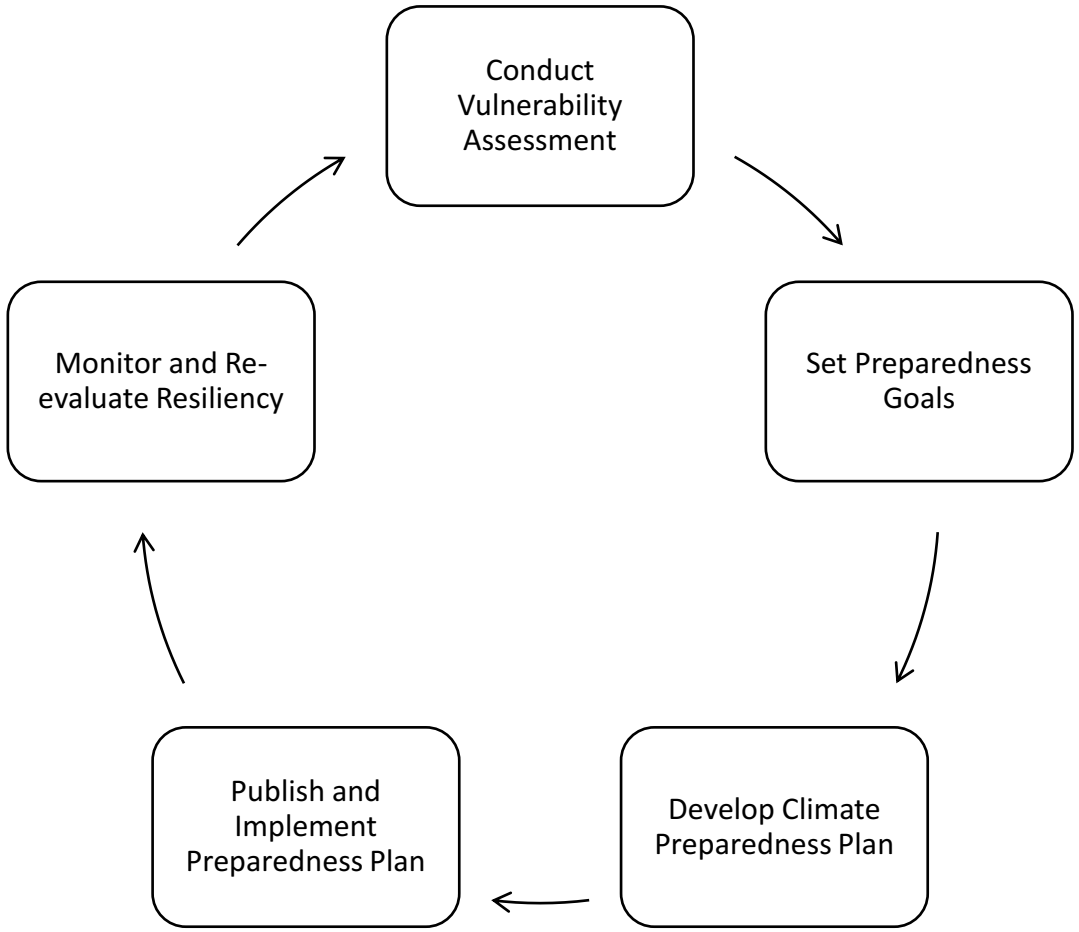

Figure 5: The Five Milestones for Climate Adaptation According to ICLEI
(Source: Author's Illustration based on Local Governments for Sustainability (ICLEI), 1995-2012b)

While in some respects, the Five Milestones of Adaptation may look simple from the model diagram, the process of adapting to climate change is much more complex in practice. The City of Keene, New Hampshire was the first local government to develop an adaptation plan in the U.S. as part of ICLEI's Climate Resilient Communities Program (CRC), a review of this process is provided in the box below to display this point.

Example of Planned Adaptation from a Small Local Government:

City of Keene, New Hampshire

A relatively small city of just under 25,000, Keene has made a considerable effort to adapt. The city was met with a number of challenges specifically in developing adaptation options and implementing an adaptation plan (United States Census Bureau, 2014b). In general the city was able to easily identify areas where the city was vulnerable to climate change and set preparedness goals. The City of Keene began the adaptation process by first establishing a climate change committee consisting of elected officials, members of the scientific community, planning professionals as well as public health officials. The climate change committee began the adaptation process by identifying sectors and sub-sectors vulnerable to climate change. Three sectors were identified as being vulnerable to climate change: the built, natural and social environments. Sample subsectors from the built environment include buildings and development, transportation infrastructure, storm water infrastructure and energy systems. After identifying vulnerabilities the committee worked to identify adaptation goals and targets which proved to be a challenge. There was a realization among the committee that a lack of knowledge on reducing vulnerability in a number of areas existed, thus, making identification of specific actions difficult. According to the City of Keene's adaptation plan, the committee decided to base much of their adaptation efforts on established mitigation efforts.

Some of the committee's goals included "decrease the ways in which energy supplies could be interrupted", "Increase the resiliency of emergency energy systems" and "Increase municipal and community energy security, use of renewable resources, and overall energy efficiency". To accomplish these goals the committee identified targets, such as burying electrical lines, utilizing renewable energy as a secondary source of electricity during storm emergencies and increase usage of local renewable energy. The committee completed this process in a number of areas including building and development, transportation infrastructure, storm-water systems, wetlands, agriculture, economy, public health and emergency services (City of Keene New Hampshire, 2007).

The Keene, New Hampshire adaptation plan has been successful in getting various parties involved and thinking about climate change adaptation within the community. Nevertheless, the plan lacked a scientific basis for the vulnerabilities identified and adaptation actions chosen. Further recommendations in the adaptation plan included conducting more in-depth studies, such as identifying all construction located within the 200-year flood plain as well as consulting the scientific community. According to the Keene, New Hampshire website there has been no follow-up adaptation plan created as suggested in the adaptation plan itself. Although, there have been a

number of smaller measures taken to adapt such as: integration of adaptation in Keene's comprehensive plan, modification of ordinances to take climate change into account, deterrence of rainwater runoff via rain gardens and use of porous pavement. It can also be gathered from the Keene website, the city has largely continued to focus mainly on mitigation measures rather than adaptation (Lamb, 2011).

There are likely a number of explanations for the challenges Keene experienced while adapting to climate change. First of all, Keene was one of the first local governments to create an adaptation plan in the U.S. as part of the CRC program. The CRC program in the beginning stages as the program began had not even developed the milestones toward adaptation planning (City of Keene New Hampshire, 2007), meaning the city of Keene had to decide independently the form adaptation should take. However, the five milestones of adaptation planning are similar to planning for adaptation which Keene had already completed (likely reasons the city was chosen as a pilot for the CRC program). Second, as a city with a small population the resources Keene has to conduct planned adaptation with the resources available to a small city in comparison to large cities such as New York City are limited.

The basic structures shown in the adaptation process developed by Moser and in the ICLEI model are very common. ICLEI uses a similar circular diagram depicting specific milestones local governments should proceed through while developing plans for both their mitigation and adaptation programs (Local Governments for Sustainability ICLEI, 1995-2012a, 1995-2012c). The Climate Development Knowledge Network uses a similar framework including problem definition, identification of options, policy selection, implementation and evaluation but also includes raising awareness in their model (CDKN, 2012).

Local governments conducting planned adaptation consider future impacts of climate change and anticipate those changes in their programming. When planned adaptation is conducted successfully local governments are flexible in adapting to changing environmental conditions and their actions are justified economically, that is, benefits exceed the costs (Easterling et al., 2004, p. 24). The execution of planned adaptation translates to more efforts by present decision-makers but more importantly, planned adaptation today is likely to ease the burden of adapting to climate change on future generations, especially in comparison to other forms of adaptation (Smith et al., 1996, p. 199). Spontaneous adaptation for example is likely to lag behind future climate change risks as greenhouse gas emissions rise and negative climate impacts intensify (Repetto, 2008, p. 2). Although planned adaptation is considered to be optimal there has been limited research examining the impacts to

U.S. society if no planned adaptation were to occur (Easterling, 2004, p. 14). Thus, there is a level of uncertainty when it comes to knowing the exact risks local governments are taking when not conducting planned adaptation.

Example of Planned Adaptation from a Large Local Government

King County, Washington

County adaptation is particularly important because it can impact the ability of the region to adapt. In order to provide some idea of what climate change planning may look like at the county level an overview of King County, Washington's Climate Action Plan is provided. Before the Climate Action Plan of King County is discussed an overview of the county is provided in order to better understand the financial and other circumstances with which the county approaches climate change. King County, Washington has been proactive in addressing both climate change mitigation and adaptation. King County is located on the Western Coast of the U.S. in Washington State. It is one of the most heavily populated counties in the U.S. with a population of just over 2 million residents. The county comprises 2,131 square miles or 3,430 square kilometers. Within the county borders are an abundance of lakes, rivers, wetlands and reservoirs and 100 miles of marine coastline. In addition to an abundance of water bodies, King County also contains 850,000 acres or 343,980 hectares of forested land (King County Washington, 2008). The financial circumstances of the county place it in a good position to have the means to address climate change in comparison to other counties nationally. On average, King County residents have a higher median income than the national average ($63,000 compared to $48,500 respectively). The per capita personal income, that is, income earned outside of direct earnings, such as dividends and interest ranked highest among Washington State counties and is one of the highest in the U.S. overall (King County Washington, 2008). According to the King County's government website their efforts to address climate change began in 2005 after sponsoring a climate change conference on regional impacts with the local university.

The county succeeded in creating a greenhouse gas inventory and breaking down emissions by sector. The goals and actions to achieve goals are well developed. For instance one of the goals listed is to "…achieve a climate stabilization target in government operations by reducing greenhouse gas emissions 80 percent below current levels by 2050". To achieve this goal specific Executive Orders are listed which help fulfill this goal and detail how greenhouse gas emission targets are to be reached, such as increase amount of biodiesel fuel used by all county vehicles or ensure 50 percent of total non-transit energy come from renewable energy resources. A second example, "…will promote the use of climate-friendly modes of

transportation by King County employees" by providing transportation benefits to eligible county employees through the Employee Transportation Program and incentivizing car sharing via "Wheel Options". Beyond Identifying already well developed actions to help promote climate-friendly modes of transportation other possibilities were also suggested such as "providing parking preference or benefits for employees whose vehicles have low or no greenhouse gas emissions". King County also identified specific and in-depth options to adapt to climate change in five of what they refer to as "strategic focus areas", they include:

- Climate Science
- Public Health, Safety and Emergency Preparedness
- Land Use, Buildings and Transportation
- Surface Water Management, Freshwater Quality and Water Supply
- Economic Impacts and Biodiversity and Ecosystems

Under strategic focus area "Climate Science" King County made it a goal to lead in climate research, monitoring and the use of climate science in policy decisions. One example of an action to reach their climate science goal is continuing to work with their current interdepartmental adaptation team, and improving their adaptation team by selecting future adaptation team members based on "significant scientific experience and ability to understand and explain climate science". By selecting these actions the county has shown they believe it is important for climate change adaptation that individuals from various backgrounds and those with scientific expertise are part of the adaptation process. Technical experience is also seen as being important in the adaptation process as the county identified the creation of a technical advisory group as well as the downscaling of climate data at the county level. Finally, in relation to climate science King County set the goal of raising awareness concerning climate change among both the public and private institutions and even collaborating internationally.

Under the strategic focus of "Public Health, Safety and Emergency Preparedness" King County's goal in collaboration with county health departments is to protect public health from climate change impacts. Examples of actions provided to accomplish this goal include working together with a variety of stakeholders to identify climate change impacts on public health, educate county departments on public health in relation to climate change, and collaborate with county departments to reduce risks to already identified health. An additional goal is to increase understanding within the region concerning risk natural hazards pose on public health by updating emergency plans.

Under the strategic focus of "Land Use, Buildings and Transportation Infrastructure" the selected goal is to "…guide the region to build preparedness for climate change

impacts into all major investments in land and infrastructure". One example to accomplish this goal: review county plans (i.e. comprehensive plan, regional hazard plan and shoreline master program) evaluate consideration of predicted climate change impacts to identify the level of overall climate change preparedness. There were a number of other goals within the Strategic Focus of "Land Use, Buildings and Transportation Infrastructure" including reduce risks of fall and winter flooding, reduce risks of coastal flooding related to climate change, adapt park operations and maintenance of parks to climate change impacts, promote green building practices, protect historic and archaeological proprieties from climate change impacts, protect regional transportation.

Under the strategic focus of "Surface Water Management, Freshwater Quality and Water Supply" King County identified in their climate change plan a goal to "understand and share information about climate change impacts to safe and reliable drinking water supplies and protection of fish and wildlife habitat conditions".

To accomplish this goal they decided on a number of actions such as, develop a workgroup to identify impacts to streams, work with state, regional and local governments to address drinking water supply as well as protect fish and wildlife habitat conditions. Other goals in this sector include dispersing information concerning safe and reliable water supplies and protection wildlife and habitats, promote coordination between the counties various water departments to address water management in the face of projected climate impacts, explore ways to reuse water to promote water supply resilience among other things.

Within the Financial and Economic Impact Strategic Focus, King County made it a goal "…to limit financial damage and economic consequences of climate change to the region" by means of evaluating potential climate change impacts on the county and region and sharing this information with the public (King County, 2007). Other goals within this category include consideration of climate change impacts on forest economy and agriculture and improving resiliency of energy supply to climate change impacts.

Lastly, in terms of climate change adaptation King County identified goals and actions in the sector of Biodiversity and Ecosystems. One goal listed was to "work to support the resilience of salmon, fish, wildlife, habitat conditions and biodiversity to climate change impacts" (King County, 2007). This goal is to be accomplished by collaborating with regional climate scientists and other experts to cultivate knowledge in this area, evaluating existing biodiversity monitoring program as further climate change data become available and integrate predicted climate change impacts into already operating salmon recovery plans (King County, 2007).

As can be seen by the actions selected by King County to address climate change, counties play an important role in regional adaptation to climate change. A number of the actions selected by King County if implemented would place King County as an adaptation leader in the region paving the way for local governments such as towns, villages or cities. For example, if King County produces downscaled climate data for the county this could be used by local governments to create their own climate action plans, especially where resources or expertise are lacking. Furthermore, not only would altering already existing plans (e.g. comprehensive and hazard mitigation plans) present the possibility to reduce vulnerability to climate change on county lands and in the region in general, it could also serve as an example for other local governments within the county looking to adapt to climate change. Local governments within the county face similar climate change impacts and the county can lead local governments in addressing those impacts. As the entity encompassing towns, villages and cities—counties provide oversight on a number of climate change related topics, such as climate preparedness of the county/region as a whole, expected health related impacts (e.g. drinking water quality) and potential financial ramifications of climate change in the region. Not only are county level governments important in leading the way toward climate change adaptation and communicating with local and state governments but they also have a responsibility to ensure delivery of services such as public transportation and health services. Failure of counties to consider impacts of climate change on the transportation sector or on health could result in for example transportation delays or illness. While counties are important climate change actors, they are not the be-all and end-all of government adaptation. Other governmental entities are important in successful adaptation as well as identified by King County "…King County government and officials cannot alone ensure that the King County region will be resilient to climate change impacts. Resilience to climate change impacts will require a high degree of coordination among state, regional and local governments, business leaders, and residents" (King County, 2007, p. 100).

A local government budget is an important influencing factor on the types of actions a local government may take. A local government budget is typically created and approved by "finance departments, executive offices and local legislative bodies (e.g. city council, school board)" (Huddleston, 2005, p. 1). Local government budgets are one of the most important if not *the* most important factor in determining which programs are carried out each year. A local government budget is one of the areas where the public and media are critical of local governments. Therefore, if the public is against or likely to be against allotting public monies toward climate change mitigation or adaptation planning it is not likely to be financed in the local government budget (Huddleston 2005). That is to say, legislative bodies are influential in deciding

what types of actions to include in the budget but may also be influenced by the public or media or both.

The planning and development budget are commonly outlined in the annual operating budget, therefore it is likely the funding for climate change planning would also have to originate here. An annual operating budget outlines the planned spending for the year and where the revenues for spending are expected to originate. However, the capital budget is used to identify yearly expenditures which may include infrastructure projects (Huddleston, 2005, p. 2). As climate change impacts are likely to require either infrastructure upgrades (e.g. expanding water resources) or new infrastructure altogether (e.g. flood prevention barriers, creation of renewable energy projects) the implementation of adaptation (or mitigation) projects would originate here.

Local governments are largely dependent on revenue gained from property taxes but may also receive state or federal aid (Huddleston, 2005, p. 2). Traditionally, local governments in the United States were heavily dependent upon revenue generated from property taxes. However, demand for services has increased resulting in the need to collect a greater amount of revenue. As a result, states collect sales and income taxes and local governments may receive aid from the state depending on the condition of the economy. Local governments themselves collect 75% of their revenue via property taxes; they are also permitted in most cases to create other types of taxes (Katz, 2003). This means financial resources within and across local governments differ which may impact their ability to implement new policies or programs and thus their ability to address climate change.

The largest outside contributor to municipal budgets are state governments whereas a small amount of revenue is received from the federal level government (Huddleston, 2005). If local governments are not able to cover expenses they may privatize services or collaborate within the private sector as a means to cut costs (Katz, 2003). Local governments can use debt to fund infrastructure projects such as sewage treatment, parking garages or electric utilities. Local government budgets are created on a yearly basis. Local governments receive instructions often in July outlining what the budget should cover generally. Following this, each entity submits requests for their individual budgets. Budget requests include ordinary expenses (i.e. wages and salaries, operating costs) but may include requests for funds to conduct capital improvements. Based on requests submitted a draft budget is created which must be approved by the elected legislative body. Budget requests usually need to be prepared and submitted by August each year (Huddleston, 2005). If special funding is needed to conduct adaptation planning or implement measures it must be requested. Those responsible for conducting adaptation (if not dually responsible for budget requests) should ensure funds for adaptation have been requested.

Local Government Budget: Example of an economically well-off City

New York City, New York

One of the most climate adaptation active cities nationally and internationally has been New York City. New York City has an annual budget in the billions which has steadily increased over time. The budget for 2013 was around $68 billion dollars and increased to $75 billion dollars for 2015. New York City funds the budget through a collection of local taxes, user charges and other sources as well as from state and federal grants. The city receives a considerable number of budget requests from some 59 community boards. General areas of expenditure include public safety, education, social services, community and economic revitalization and environmental protection (The City of New York Office of Management and Budget, 2014). The city is able to accept many budget requests for a diversity and multitude of community and capital projects.

In 2010 Mayor Bloomberg was chosen to Chair the C40Cities Climate Leadership Group - a network of megacities addressing climate change (The Office of Long Term Planning and Sustainability, 2011; C40 Cities, 2011).

The City of New York began addressing climate change within their city-wide comprehensive plan called PlaNYC. The PlaNYC was created as part of an initiative to address projected increases in population and improvements to the economy in New York City. Climate change was selected as one of the factors expected to impact New York City economically, therefore measures to address climate change were included among several initiatives (Office Long Term Planning and Sustainability, 2007). The City has been successful in implementing an abundance of measures both pertaining to climate change mitigation and adaptation. The PlaNYC has also been updated periodically outlining measures already completed and identifying areas for new action (New York State Sea Level Rise Task Force, 2010). As a result of PlaNYC greenhouse gas emissions in New York City have been reduced 13% below 2005 levels (The Office of Long Term Planning and Sustainability, 2011). In 2012, Mayor Bloomberg introduced an additional initiative: “The Special Initiative for Rebuilding and Resiliency” (SIRR) to rebuild in the aftermath of Hurricane Sandy.

Some financially well off local governments (towns/townships), villages, counties and cities) may be in a similar situation to New York City. They have a sound tax base on which to base their budgets, they are able to increase the budget when needed and are in a position to accept and take on new projects or policies. On the other hand, there are local governments with diminishing tax bases and budgets, that are merely

struggling to meet basic needs and maintain a quality standard of life within their jurisdictions.

Local Government Budget: Example of an economically struggling City

Buffalo, New York

The Mayor of Buffalo, New York has been focused on reducing the yearly budget by means of property and commercial tax reductions. The 2013-2014 budget for Buffalo New York was around $480 million and many of the highlighted budgeted areas have dealt with crime and poverty (e.g. strengthening police services to eliminate crime, illegal guns, gang activity and drug trafficking). Another telltale sign of the city's struggle is approximately $500,000 provided in the budget to conduct 325 demolitions throughout the city. One of the major areas addressed in the City of Buffalo's budget was "Growing Buffalo's Economy" via tax relief measures as provided in previous years. The city has reduced residential taxes by 15% and commercial property taxes by 28% since 2006 (City of Buffalo, 2014). As it appears elected officials in Buffalo are focused on current issues, such as retaining residents, businesses and reducing crime. The capacity of the city in terms of resources and expertise to plan for the long-term appears limited.

The comprehensive plan available from the City of Buffalo website is of poor quality (e.g. poor writing, failure to implement analytical tools: population estimates, economic tools, etc.) which has even been identified, confirmed and explained by the person(s) writing the comprehensive plan. The comprehensive plan states: "The Comprehensive Plan is not a traditional master plan. It is intended to be a general guide – not a detailed and rigid prescription – for land use, development, urban design, capital investment and related activities". It is also claimed the comprehensive plan incorporates a number of local and regional plans (e.g. Regional Action Plan for Downtown, the 2030 Long Range Action Plan for Downtown). Regardless as to whether the lack of "a detailed rigid prescription" is intentional in the comprehensive plan, it leaves the impression of a poorly prepared or overburdened city that is in no means prepared to tackle the problem of climate change. That is not to say the City of Buffalo is not willing to do so if the financial and expertise were available. There is some degree of awareness and willingness to address the problem of climate change. According to the Buffalo comprehensive plan the city is a member of the Climate Protection Campaign and has been able to conduct a greenhouse gas emissions inventory. The city has yet to conduct the remainder of the five step program (i.e. set reduction targets, create action plan and implement plan). Additionally, the city is aware of the major impacts expected to occur in Buffalo

and the region but has yet to take action to adapt to climate change impacts (City of Buffalo, 2006).

The City of Buffalo has been overwhelmed dealing with current pressing issues and unable to take action on climate change. Resources and expertise are lacking as could be witnessed from the city comprehensive plan. New York City on the other hand has been able to - with the resources available - take a number of actions to address both climate change mitigation and adaptation including developing, implementing and updating a climate action plan. Both have shown interest and awareness in climate change but only New York City has been able to take significant actions. This probably has not been due to the budget alone as other social factors may be at play however; the financial situation of each city has undoubtedly played a role in the capacity of each city to adapt.

Adaptation in Urban versus Rural Areas

The efforts local governments take to ensure the basic needs of their citizens are met in the face of climate change are very important to equitable adaptation to climate change because some sectors of the U.S. population have been identified as being more vulnerable to climate change than others (U.S. Department of State, 2010). The elderly, children and low income individuals are some of the most vulnerable to climate change impacts affecting health. These vulnerable groups often possess few resources and are therefore less mobile, meaning they are less able to evade climate change impacts, such as extreme heat, cold or poor air quality. The additional stress climate change poses, such as home displacement, is expected to result in higher instances of mental health among vulnerable populations (U.S. Global Change Research Program, 2012).

There are a number of reasons to be concerned about climate change vulnerabilities in urban areas. Firstly, cities worldwide are expected to struggle with temperature variations and extremes as well as increased sea level and extreme weather events such as heavy precipitation and drought (United Nations Human Settlements Programme, 2011). Secondly, urban infrastructure tends to exacerbate already challenging climate change impacts such as extreme wind and heat (U.S. Department of State, 2010). Challenges posed by city infrastructure include minimizing wind tunnel effects as well as the urban heat island effect. Cities have even been referred to by climate reach scientists as “The ultimate landscape modeling challenge” (Dixon, 2010). Finally, not only are cities expected to experience intensified climate change impacts, they are expected to experience population growth.

According to the World Health Organization, by 2030 six of every 10 individuals will live in a city. That is, by 2030 six of every 10 individuals will be experiencing exacerbated effects of climate change if steps are not taken to alter city infrastructure in order to protect against climate change impacts. In brief, adaptability of city infrastructure to handle climate change impacts is vital in minimizing negative impacts of climate change worldwide. On the other hand, nearly all population growth is expected to occur in cities located in developing countries.

In high income countries such as the U.S. and Germany, the urban population is expected to remain largely unchanged. In fact, populations in already developed countries would stagnate in large part if not for migration from outside countries to urban areas (World Health Organization, 2014). This puts into perspective the need to also consider the impacts climate change will have on populations located in rural areas. Almost 30% of the U.S. population lives in non-urban areas. It should also be noted that local government level jurisdictions may consist of both urban and rural areas. Counties, the local government encapsulating cities, villages and towns, are likely to consist of some combination of rural and urban areas (Huddleston, 2005). In this case, to exclude adaptation of climate change in rural areas would mean failing to consider adaptation throughout the entire county. A “Rural area of the state” is defined as “…cities, towns and villages having a population of less than twenty-five thousand” (Law Server, 2012). According to the U.S. Census Bureau “rural” encompasses all population, housing, and territory not included within an urban area; urban areas consist of areas of 50,000 or more people (U.S. Census Bureau, 2016).

In general, successful adaptation of society as a whole may not be dependent on whether or not individuals in both rural and urban areas adapt. As Easterling (2004, p. 21) states “It is important to note that complete adaptation by all regions, populations, or individuals is not a necessary condition for society on the whole to adapt successfully. Indeed, successful adaptation can entail a loss of livelihood and migration for many people”. However, for ethical and moral reasons it is important to consider the impact of climate change on all populations and to attempt to reduce the number of individuals negatively impacted by climate change. Furthermore, failure to consider individuals in rural and urban regions in the adaptation process may stifle adaptation overall.

The U.S. is dependent on rural areas in a number of domains including energy, tourism/recreation and food production (The White House, 2010). Traditional energy sources, such as coal and nuclear power as well as renewable energy sources are often located in rural areas. Rural areas also provide the opportunity to expand energy production to include renewable energy, such as wind, solar and biomass which for the most part have not been taken advantage of (Brown et al., 2011). Currently, a number of states have focused on developing wind power, for example,

Texas produces the most electricity via wind power than any other state in the U.S. Additionally, mid and southwest states have been some of the most progressive in wind power generation (Kelly-Detwiler, 2014). Tourism related to outdoor recreation alone contributed $730 billion dollars to the overall U.S. economy in 2011 (McKalip, 2012). Finally, the agricultural sector including crops and livestock contributes approximately 300 billion dollars per year to the U.S. economy (Agency, 2013). Failure of rural areas to adapt to climate change would likely result in economic decline for the U.S. in general. Unfortunately, there has been very little research conducted examining climate change adaptation among rural communities both in the U.S. and in the area studied New York State (Lal, 2011; Tryhorn, 2010).

Historically, rural U.S. areas were over-represented as compared to urban communities among state legislatures. This began to change in the 1960's when representation among state legislatures were altered to more fairly represent the population. This resulted in lessened political power for rural areas (Rogers et al., 1988). Today, approximately 16% of U.S residents live in "non-metro" or rural areas. Eighty percent of land area in the United States is considered rural and is home to 50 million Americans (Lal, 2011). This is roughly one sixth of all U.S. residents (i.e. the U.S. population as of 2012 was 316,128,839 (United States Census Bureau, 2014a).

Rural areas are less poised than urban areas to deal with a changing climate in a number of ways. First, individuals in rural areas are often dependent on industries directly sensitive to climate change impacts such as agriculture, tourism, forestry and fisheries (Lal, 2011). Second, rural areas often lack the expertise to deal with the highly complex nature of climate change adaptation. Rural areas tend to lose highly educated residents through migration to urban areas or suffer from what is called "brain drain". What is more, the academic achievement of younger generations in rural areas is lagging in comparison to the national average (The White House, 2010).

Rural populations are largely comprised of vulnerable populations such as the young and the elderly (Lal, 2011). Moreover, these vulnerable populations are plagued by concentrated poverty and face low provision of public services. For example, access to public transportation and healthcare is not as prevalent as in urban areas (Howitt, 2011). Emergency response systems tend to be weaker and travel costs for residents seeking health services tend to be higher in rural areas (Lal, 2011). As one can imagine the combination of vulnerable populations and limited public resources during a natural disaster could be catastrophic.

In addition to dependency upon climate sensitive industries, concentration of vulnerable populations, prevalence of brain drain and low provision of public services rural areas are also plagued by ageing infrastructure. Waste and drinking water

systems are one such example of the implications ageing infrastructure have in the face of climate change. The U.S. EPA has identified water infrastructure as largely inadequate and in need of replacement or improvement as it is ageing and expected to be pushed beyond capacity as a result of climate change, among other things. Water systems, if expected to still function in the midst of climate change, must be updated to function during weather extremes such as drought (U.S. Environmental Protection Agency, 2012). Although funding was made available to local governments to update infrastructure as part of the Economic Recovery Act of 2010 the challenge of ageing and outdated infrastructure still likely persists (The White House, 2010). To some extent the federal government has shown interest in improving the conditions rural areas are faced with. In 2011 the Obama administration created the White House Rural Council to promote job creation and economic development in rural areas. In addition to addressing economic issues the council also sought to address quality of life in rural areas specifically focusing on improving access to health care, education and housing in high poverty areas (The White House, 2011a).

While important, the interest of the federal government alone is not enough to reduce vulnerability of communities to climate change. Elected officials at the local level must decide if and exactly how to adapt to climate change within their jurisdictions. As Pizzaro (2009) states, no design can mitigate all impacts nevertheless planning at the local level should consider vulnerabilities of the community in question. The next chapter provides an overview of federal, state and local governments to address both mitigation and adaptation to climate change. An overview of actions by federal and state level governments is given in order to better understand the present climate change policy environment local governments find themselves in and which incentives and obstacles may be present to conduct planned adaptation to climate change. An overview of the actions being taken by local governments to address climate change and the need for more research in this area are highlighted.

3 A Review of Federal, State and Local Government Climate Change Policy in the United States

Although research questions are focused on examining climate change adaptation the review of actions already being taken to address climate change also includes mitigation. Actions at federal and state levels to address climate change mitigation have come first. At the local level this also appears to be true. Secondly, it is difficult to discuss adaptation without discussing mitigation because they are closely related and efforts to address one may affect efforts to address the other. Additionally, including mitigation in the discussion has helped to provide a background for research questions.

A review of actions by different governmental levels in the U.S. is provided as a means to understand the political climate local governments are operating under when dealing with climate change impacts. By understanding the level of support that has existed in the past and present one can gain a better understanding of the possible barriers and incentives which may be present for local governments attempting to adapt to climate change.

The U.S. has a highly decentralized governmental structure; each governmental level passes powers onto the next. The federal level passes on powers to the states and the states in turn to the local government. As a result of decentralized government and absence of a strong position on climate change at the federal level, actions to address climate change at state and local government levels are inconsistent and vary within and across states and locally. Decentralization of powers has resulted in, for example, doubling of efforts such as a number of cap and trade programs (operating independent of one another rather than operation of one national program) (Meyer, 2010, p. 182). What is more, there are a multitude of extremely small local governments maintaining the same powers of larger local governments such as land use and provision of public services, but, have few funds and staff, making it difficult to carry out sound economic planning or local level land use planning (Meyer, 2010, p. 184). According to Meyer, it is rare that a jurisdiction below the state level has enough power to “effectively engage in spatial (land use or spatial) planning” (Meyer, 2010, p. 184).

3.1 A Review of Federal Government Policy Efforts to Address Climate Change

The U.S. federal government guides national policy to secure resources such as food, water, energy and transportation. Federal Departments such as The Departments of: Agriculture, Energy, Human Health and Services, Housing and

Urban Development and Transportation are together responsible for ensuring national food and energy security, proper housing, and a fast, safe, efficient, accessible and convenient transportation system. Federal Departments fulfill their responsibilities by securing resources and protecting health through development and enforcement of policy, creation of state and local programs, collection of scientific data and provision of services to the public (The White House, 2013). As previously discussed, climate change is expected to cause disruptions in many of the sectors operated by the federal government; therefore the federal government should have a vested interest in adapting to climate change. Furthermore, the federal government should play an important role in guiding public policies to secure resources and protect health against changes in climate.

The Pew Center on Global Climate Change released a report in 2010 called "Adapting to Climate Change: A Call for Federal Leadership" where the role of federal government in adapting to climate change was identified. The federal government was identified as being unique and critical in providing "leadership, guidance, information, and resources" nationally. More specifically, although it was recognized many of the actions toward adaptation take place at state and local levels, the federal government was identified as being important in providing an "effective and coordinated approach to climate change adaptation in the United States" (Smith et al., 2010, p. 1). In the Pew Center's 2010 report three approaches were identified to creating a national adaptation program in the U.S. The three approaches included the creation of a strategic plan identifying objectives and milestones, a National Climate Service to provide information on climate change impacts and adaptation options, and the creation of an Adaptation Research Program to refocus adaptation research as part of the greater federal program. Furthermore, modification of already existing policies has been identified as another approach the federal government could take to increase consideration of climate change in decision making. For example, modification of The National Environmental Protection Policy Act (NEPA) could be instrumental in a nation-wide planning effort to adapt to climate change if consideration of climate change adaptation would be required in the process of environmental decision making (Smith et al., 2010).

The diagram below shows the sequence of major events occurring at the federal level relating to climate change related policy. In 1988 attention was brought to the U.S. Congress of the urgency and need to address a very real and existing threat of climate change. Thereafter, the Global Research Act, one of the most progressive pieces of climate change legislation was born, establishing the Global Change Research Program. Nonetheless, it did not satisfy the needs of decision makers. Following the passing of the Global Research Act a number of attempts were made to form more concrete policies to guide the nation in addressing climate change all of

which have failed to pass legislation. Although concrete legislation has failed to pass at the federal level, climate change has been gaining attention as the severity and frequency of weather disasters has increased.

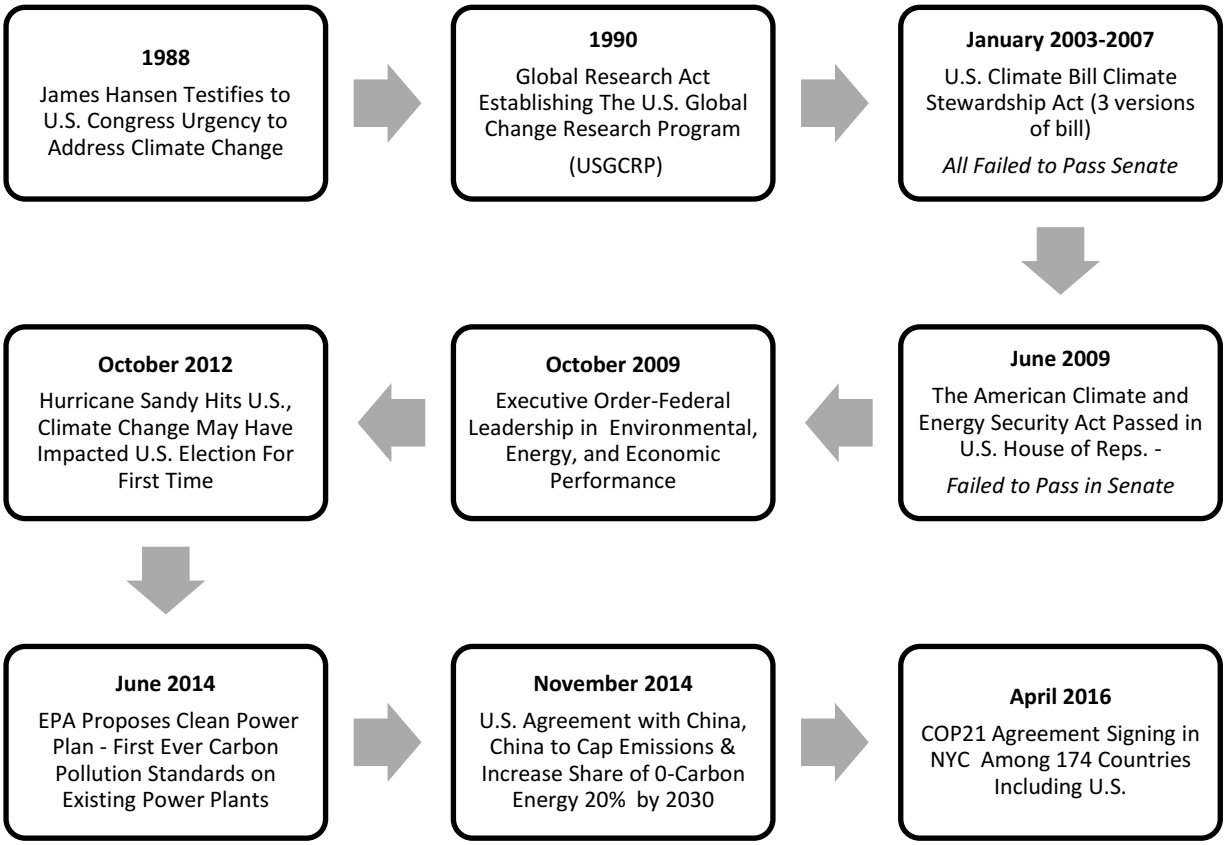

Figure 6: U.S. Federal Policy to Address Climate Change
(Source: Author's Illustration based on Congress, 2003; Terry-Cobo, 2010; U.S. Global Change Research Program, 2012; United Nations Framework Convention on Climate Change, 2016c)

In the 1960's concern for the environment began to surface among the public. Concern arose due to a culmination of influences. A literary work written by Rachael Carson, Silent Spring, resulted in a heightened environmental awareness among the U.S. public at the time. Additionally, poor environmental conditions such as air and water pollution also heightened public concern, for example the catching on fire of the polluted Cuyahoga River in Ohio (Environmental Protection Agency, 2012a).

In 1970 U.S. President Richard Nixon signed the National Environmental Policy Act (NEPA) establishing The United States Environmental Protection Agency (EPA) and the Council on Environmental Quality (CEQ) (Environmental Protection Agency, 2012a). For the first time in U.S. history federal agencies were required to consider the impact their projects could have on the environment. NEPA put into motion the requirement for federal agencies to conduct Environmental Impact Statements (EIS's) identifying possible environmental impacts before implementing large projects (Environmental Protection Agency, 2012b). The CEQ was created to review

Environmental Impact Statements of federal agencies and provide environmentally related advice to the president (Environmental Protection Agency, 2012b). At this time of general awakening to environmental issues in the U.S. scientists were already discussing climate change, but discussions at the federal level did not begin until the next decade.

Discussions regarding climate change began in 1988 when NASA scientist James Hansen was invited to speak about his research findings at a congressional hearing. Hansen testified he had found evidence of the relationship between greenhouse gases and climate change and urged the need for action (Block, 2012). Hansen's testimony in conjunction with extreme weather conditions in the U.S. at the time, such as heat waves, severe drought and forest fires, caused a growing interest in climate change among policy makers - thus, resulting in a number of climate change related bills being introduced into Congress (Block, 2012).

Establishment of the Global Change Research Act

In 1990 the Global Change Research Act passed legislation, resulting in the creation of the United States Global Change Research Program (USGCRP). The USGCRP was passed with the purpose of "understanding and responding to global change, including the cumulative effects of human activities and natural process on the environment, to promote discussions toward international protocols in global change research, and for other purposes" (1990, p. 1).

The passing of the Global Research Act might have been the beginning of solid legislation at the federal level to address climate change in the U.S. and abroad. From the stated purpose of the USGCRP it was meant to significantly impact the ability to respond both nationally and internationally to climate change. What is more, a large number of important federal agencies were involved in meeting the objectives of the USGCRP as active members on the USGCRP Council, including:

- The National Science Foundation
- The National Aeronautics and Space Administration
- The National Oceanic and Atmospheric Administration of the Department of Commerce
- The Environmental Protection Agency
- The Department of Energy
- The Department of State
- The Department of Defense
- The Department of Interior
- The Department of Agriculture

- The Department of Transportation
- The Office of Management and Budget
- The Office of Sciences and Technology Policy
- The Council of Environmental Policy
- The Council on Environmental Quality
- The National Institute of Environmental Health Services of National Institutes of Health

The USGCRP Council was charged with numerous responsibilities both nationally and internationally including planning and coordinating the program, improving cooperation among federal agencies and coordinating federal activities with other nations. In addition, the council was charged with creating a National Global Change Research Plan containing recommendations for national global change research (1990). The USGCRP has not been able to live up to initial expectations.

Congress expected and sought after concrete recommendations from the USGCRP through 1995. While congress awaited climate policy advice, the federal administration at the time led by Republican President George H.W. Bush prioritized research activities limiting the influence of the USGCRP to scientific progress rather than policy development (Pielke A. Jr. 1995, 2000a). The original draft of the Global Change Research Act required an annual report to Congress including USGCRP's activities, achievements and priorities for the global change research program "Global Change Research Act of 1990". Subsequently, in 1995 section 107 of the act was omitted thus eliminating the requirement for submission of an annual report (U.S. Global Change Research Information Office 2004). However, after considerable pressure from Congress and other policy makers adjustments were made to the USGCRP to present scientific information regarding climate change in a form more understandable to policy makers, resulting in climate predictions being presented in shorter timespans and guidance to conduct climate change workshops (Pielke A. Jr., 2000b).

After roughly two decades - according to the USGCRP webpage - the major contributions of the program have been: "observing and understanding short- and long-term changes in climate, the ozone layer, and land cover; identifying the impacts of these changes on ecosystems and society; estimating future changes in the physical environment as well as vulnerabilities and risks associated with those changes; and providing scientific information to enable effective decision making to address the threats and opportunities posed by climate global change" (U.S. Global Change Research Program, 2012).

The contributions listed here make it clear the attempts to restructure the USGCRP to provide mostly scientific information rather than guide decision making or coordinate national and international mitigation and adaptation efforts have been successful. There has been talk of modifying the USGCRP to include an Adaptation Research Program for the purpose of identifying adaptation research needs and serve to inform integration and coordination offices as part of a national adaptation strategy, should one be created (see: Smith et al., 2010). The need for more aggressive climate change legislation has been present at the federal level as has been made apparent by the number of attempts to pass additional climate change legislation.

Attempted Climate Change Legislation

Since the implementation of the Global Change Research Act numerous attempts have been made at the federal level to pass more effective climate change legislation. For example, Senators Joseph Lieberman, Democrat and John McCain, Republican made a concerted effort in the 2000's to place climate change on the policy agenda at the federal level.

In 2003 the Climate Stewardship Act was introduced into the U.S. Senate but was unable to pass legislation resulting in two more attempts to introduce the bill to the Senate in 2005 and 2007. Even with modifications the Climate Stewardship Act was unable to pass in 2005 and 2007. The first version of the Climate Stewardship bill was intended to provide funding for additional climate change research including an impact report of the Kyoto Protocol on the U.S. and methods to enhance measures to reduce greenhouse gas emissions (Congress, 2003). In 2005 the bill was modified to include large subsidies for nuclear energy and the last version of the bill, known as the Climate Stewardship and Innovation Act of 2007 was modified to establish a national cap and trade program. Revenues gained from the cap and trade program would have been used to support climate technologies and consumer benefits (Congress, 2007-2009). Following the efforts of Senators Lieberman and McCain further attempts to place climate change on the federal agenda have been made.

In 2008 the topic of climate change surfaced at the federal level during the presidential campaign. Presidential candidate Barack Obama (Democrat) made promises of addressing climate change. Following his election victory in 2009 President Barack Obama referred to climate change and marked this time period as the period when action to address climate change would finally begin, he said: "We will be able to look back and tell our children that this was the moment when we began to provide care for the sick, when the rise of the oceans began to slow and our planet began to heal" (Lizza, 2011). The May following President Barack Obama's inauguration one of the most comprehensive House Bills was introduced, sponsored by U.S. Congress Representative Henry Waxman, called the American Clean Energy

and Security Act (ACES) or the “Waxman-Markey Bill”. However, as seen in the past, political opposition primarily from the Republican Party resulted in failure of the ACES bill to pass legislation. Had the ACES bill been implemented it would have meant major progress toward developing renewable energy, reducing and recording greenhouse gases and adapting to climate change especially related to health and community vulnerability both nationally and internationally (Congress, 2009a).

Nationally, the measures addressed impacts to human health and natural resource adaptation. The bill would have required a National Strategic Action Plan within two years of its enactment to aid healthcare professionals in preparing and responding to climate change impacts. The National Strategic Action Plan intended to address vulnerabilities to public health and actions to address these vulnerabilities both within the United States and abroad with a particular focus on developing countries. The plan would have had to be completed by July 1, 2014 and updated every four years. In addition to reducing vulnerability to human health domestically and worldwide the ACES bill was meant to expand upon the resources available to monitor and predict changes in climate and improve warning systems to communicate public health, weather and disaster risks within the U.S. Additionally, the ACES bill would have put into place measures to identify the communities most vulnerable to climate change impacts and recommendations to improve responses. Internationally, the bill would have established a climate change adaptation program to support development and implementation of climate change adaptation programs and other activities to reduce vulnerability to climate change (Congress, 2009a).

The failure of the ACES bill to pass legislation has meant a major loss in terms of moving the U.S. forward in preparing to adapt to changes in climate. Whereas the three versions of the Climate Stewardship Act included measures related to energy and measures to reduce and record greenhouse gases, the ACES bill included measures to reduce vulnerability to climate change. Even if the ACES bill was not able to pass legislation it did pass in the House of Representatives, which has been a first for climate change legislation thus far.

Further Actions under the Obama Administration to Address Climate Change

Regardless of the failure of the ACES bill to pass legislation, the Obama Administration has been able to provide some additional support nationally either indirectly or through measures not requiring the approval of the House or the Senate. An example of one such measure has been the American Recovery and Reinvestment Act.

Passed in February 2009 to address the economic recession in the U.S., the economic package included $787 billion in federal tax cuts, other social benefits and

funds for domestic infrastructure projects to improve the economy and create jobs. At first glance it is not obvious the American Recovery and Reinvestment Act included measures to address climate change as the words “climate change” appeared only once in the 407-page document (Congress, 2009b). However, with further examination of funds allocated it becomes more obvious the potential the act had to support climate change incentives nationally.

Seven-hundred and eighty-seven billion dollars were provided altogether. Sixty-three billion dollars allocated to energy, transportation and climate change research and another $21 billion in climate-energy incentives (Pew Center on Global Climate Change, 2009). These funds were allocated to a number of federal agencies such as the National Oceanic and Atmospheric Administration (NOAA). NOAA received $830 million dollars in stimulus funds and was then able to decide how those funds would be used. NOAA allotted from the $830 million dollars $170 million to climate change related research such as climate modeling (National Oceanic and Atmospheric Administration, 2009). Between the years 2008-2013 direct federal funding to address climate change was $77 billion. Most of the funding (75%) was aimed at technology development and implementation (DOE) and was included in the American Recovery and Investment Act. Planned spending for the fiscal year 2014 by the Obama Administration of the $11.6 billion dollars included 23% for research, 68% on energy technology development, 8% on international assistance and just 1% ($110 million) toward climate change adaptation. For the years 2001-2014 The U.S. federal government has allocated most of climate change program funding to support clean energy technologies (research, development and deployment of) and to the U.S. Global Change Research Program. Even though funding geared toward adaptation increased for the years 2010-2014 it was still only a fraction of the funding in comparison of funds allocated toward technology development (Leggett, 2013).

In addition to providing funding for climate change research through the American Recovery and Reinvestment Act an executive order instructing federal agencies to take specified measures to address climate change was issued on October 5, 2009.

Executive Order 13514, also known as the Federal Leadership in Environmental, Energy, and Economic Performance instructed federal agencies to create greenhouse gas reduction goals, increase energy efficiency, reduce energy waste, and conserve water as well as to support sustainability type measures within their communities.

Federal agencies were instructed to measure their greenhouse gas emissions and reduce emissions according to their reduction goals. In addition to reducing greenhouse gas emissions, federal agencies were instructed to take other measures to aid in adapting to climate change, such as reducing vehicle petroleum usage,

improving water efficiency, implementing sustainability requirements and improving storm water infrastructure (The White House Office of the Press Secretary, 2009). The issuance of Executive Order 13514 has resulted in a number of actions to address climate change adaptation by federal agencies. For example, the U.S. Department of Transportation (DOT) has created a Climate Adaptation Plan as an attempt to integrate climate change into policies, programs and operations. The DOT has identified climate change adaptation to be an important part to ensuring the objectives of the department are fulfilled (U.S. Department of Transportation, 2013).

A number of actions have been taken by other federal agencies as well since the implementation of the Federal Leadership in Environmental, Energy and Economic Performance Executive Order. Some examples of actions taken by federal agencies to address climate change adaptation include: creation of an adaptation plan by the Department of Agriculture, provision of community planning guidance and capacity building assistance by the Department of Commerce, promotion of clean energy by the Department of Energy, protection of health from climate change impacts by the Department of Health, community assistance to reduce vulnerability to climate change by the Department of Housing and reduction of vulnerability to water sources via creation of a National Water Program by the Environmental Protection Agency (Center for Climate and Energy Solutions, 2012b). Beyond requiring federal agencies to reduce greenhouse gas emissions and conserve resources the executive order issued by President Obama resulted in the creation of the Federal Climate Change Adaptation Task Force.

The Climate Change Adaptation Task Force was charged with developing a report including recommendations for federal government to improve policies and programs to aid the country in adapting to climate change impacts. The Climate Change Adaptation Task Force has since produced two progress reports - one in 2010 identifying key components of national strategy to address climate change adaptation and the other in 2011 reviewing the Federal Government's progress and recommendations to build adaptive capacity to deal with climate change (Council on Environmental Quality, 2011). Although the creation of the two progress reports produced by the Climate Change Adaptation Task Force are a step in the right direction the thoroughness of these documents is questionable. The first progress report produced by the Climate Adaptation Task Force in 2010 consisted of only 70 pages and the second progress report produced in 2011 consisted of just 30 pages.

Thus far the measures taken by the Obama Administration to address climate change, such as the Federal Leadership in Environment, Energy, and Economic Performance Executive Order and support for climate change measures in the Economic Stimulus Bill, directly impacted the federal level. Although it has not yet taken effect, one measure which may have direct impacts in the private sector has

been the enforcement of more efficient passenger and commercial vehicles. By 2025 all commercial trucks, vans and buses manufactured between 2014 and 2015 in the U.S. are required to have a fuel economy of at least 54.5 miles per gallon. Furthermore, the Obama Administration has aided in doubling the amount of renewable energy in the U.S. between 2008 and 2011 and recording greenhouse gas emissions among a large number of industrial sectors (The White House, 2011b). In the early years of the President Obama's presidency many were left disappointed by the progress made to address climate change both domestically and internationally (Schindler, 2012).

Policy with the Potential to Effect Local Level Government

Actions by the Obama Administration to address climate change have been focused on providing decision-making support at local levels. One such example includes the creation of climate.data.gov and tooklit.climate.gov which was developed with the purpose to act as "technological and cognitive bridges" to make it easier for individuals including local governments to find and use climate-related data. Examples of information provided by the federal government include: the third U.S. National Climate Assessment (NCA), the creation of a guide on best practices in healthcare facilities and the delivery of science-based knowledge to farmers, ranchers and forest landowners based on regional hubs, for example the Northeast Hub. Efforts have been made to guide decision-makers more concretely via the Climate Data Initiative and Climate Resilience Toolkit. However, the Climate Resilience Toolkit is similar to ICLEI and other rational decision-making models. That is, it includes a 5-step process beginning with identifying the problem, continuing with determining vulnerabilities, investigating options, evaluating risk and costs and ending with taking action, which offers nothing new to local governments.

The implementation of federal financial and expertise support to address climate change vulnerability is still in its infancy. Federal agencies are still in the early stages of adaptation planning and implementation themselves (Leggett, 2013). As part of the Federal Climate Resilience Toolkit local governments are referred to "governmental entities and other organizations" for financial support (e.g. NOAA, FEMA, USDA, Wildlife Conservation Fund). Much of the funding for climate change mitigation and adaptation is funneled from the federal government through federal agencies such as United States Department of Energy (DOE). Eligibility for grants tends to be limited to specific entities to address specific problems. One such example is a grant offered by the DOE to local governments to support smart grid technologies and tools to improve climate preparedness and resiliency of electricity delivery infrastructure (U.S. Department of Energy, 2015). Another example specifically relating to climate change adaptation includes a grant available to public educational institutions for $8 million

dollars from the EPA Environmental Finance Center to provide multi-media finance expertise and outreach to aid in meeting environmental requirements such as reducing greenhouse gas emissions, developing decision tools, financial strategies for adaptation and extreme weather or wastewater related and energy conservation (United States Environmental Protection Agency, 2015). In terms of improving expertise, local governments have access to free online and in-person courses on topics ranging from climate variability, downscaled climate and hydrology projections, extreme weather and coastal and regional impacts. Lastly, local governments are able to locate climate change experts within their states via the U.S. Climate Resilience Toolkit website; however, sometimes search results show only a small number of experts. What is currently offered by the U.S. Federal Government requires much effort by local government decision-makers, for example searching for, analyzing and creating climate change data, gaining climate change expertise (even if free it requires time and effort), and conducting and implementing climate adaptation plans. All of which has to be funded solely or in part by municipal funds or short-term funding such as grants. More forward thinking goals by the Obama Administration have included working on removing policy barriers, modernizing programs and further development of federal policy to support local and state efforts to adapt to climate change which has not yet been accomplished (U.S. Federal Government, 2014). However, the major focus has appeared to be on mitigating greenhouse gas emissions as more recent efforts have shown. In 2015 President Obama announced a plan to introduce carbon pollution standards for power plants, a first at the national level in the U.S. The Clean Power Plan will be implemented through the EPA to establish carbon pollution standards for power plants or carbon dioxide emission performance rates. Each state has to develop and implement their own plan to meet the new standards. Compliance with these standards is planned to begin in 2022. The goal is to reduce emission by 32% from 2005 levels by 2030. It does not appear that there are measures which would specifically address adaptation to climate change. Improved grid reliability as a result of implementing other sources of power such as renewable energy and the requirement that states work with vulnerable populations while implementing measures may help further adaptation to climate change (The White House Office of the Press Secretary, 2015).

International Climate Change Policy and Future Outlook

Historically, the U.S. has failed to make binding commitments under the Kyoto Protocol which is an international agreement first adopted in 1997 between countries world-wide to reduce greenhouse gas emissions. Under the Protocol participation of developing countries is not required as the protocol is designed to place more responsibility on developed nations who have already engaged in decades of

industrial activities which contributed the most to greenhouse gas production (United Nations Framework Convention on Climate Change, 2013b). The Kyoto Protocol has said to have been successful in increasing importance of climate change in politics and to have resulted in emission reductions. However, the level of greenhouse gas emission reductions until this point has not been significant enough. The U.S. has largely taken the blame in the past for the failure of the Kyoto Protocol to have a large impact on greenhouse gas emission reductions internationally (Metz, 2013). Nonetheless, the U.S. in recent past has begun to take a more active role internationally in terms of internationally commitments to reduce greenhouse gas emissions.

In December of 2012 an amendment to the Kyoto Protocol was adopted at the Doha, Qatar talks establishing a new commitment period between January 2013 and December 2020 and avoiding the termination of the Kyoto Protocol. Furthermore, China and the U.S. (the two biggest contributions to greenhouse gas emissions) reached an agreement to reduce greenhouse gas emissions. The climate agreement includes goals to cap and reduce greenhouse gas emissions by 2030. According to the Climate Institute, the agreement reached by the U.S. and China is “a milestone in history” however, whether or not the U.S. and China are able to meet their emission reduction goals is another story. Both countries have a number of obstacles to overcome domestically in order to reach their emission reduction goals (i.e. such as political opposition in the U.S. and the complete lack of zero-emission energy in China) (Lu, 2015). In June of 2014 the U.S. EPA introduced the Clean Power Plan in an attempt to implement carbon pollution standers for existing power plants for the first time (The White House, 2014). The EPA regulations to regulate greenhouse gas emissions of coal fired power plants by President Obama have been seen as a turning point in sparking action internationally on climate change (Davenport, 2015).

The Conference of Parties (COP21)-Paris Climate Talks set to achieve for the first time in over 20 years of negotiations, a legally binding and universal agreement to keep global warming below 2°C. A record number of parties signed the agreement on April 22, 2016 in New York City. However, the $100 billion a year that was supposed to be allotted from developed to developing countries to mitigate and adapt to climate change did not make it into the legally binding portion of the agreement. Furthermore, success of the accord is still dependent on voluntary actions of future governments and global peer pressure. Each country must submit a climate plan but the level of emissions to be reduced by each country are not enforced (United Nations Framework Convention on Climate Change, 2016c: Davenport, 2015). The Obama administration has put a foot in the right direction and has even become a leader in directing climate change action world-wide. However, President Obama’s presidential term is coming to an end in 2016 and every republican presidential

candidate has questioned or denied climate change science (Davenport, 2015). The future of climate change policy is likely to be heavily dependent on whether or not the next president of the U.S. is republican or democrat.

Conclusion

This section has given an account of climate change policy development at the federal level since the 1970's up to the most recent policy actions. A number of conclusions can be drawn from this section. First, awareness of the need to address climate change has existed among the federal level and its various branches for decades. That is, a lack of action on the part of the federal level has not been due to a lack of awareness regarding climate change. Second, initial concerns regarding climate change focused primarily around reducing greenhouse gas emissions but in more recent years an awareness of the need for action to reduce vulnerability to climate change impacts or adapt has increased. Lastly, political opposition to implementation of stronger action on climate change has hindered the implementation policies which had the possibility of increasing the capacity of the U.S. and other nations to mitigate greenhouse gases as well as adapt to the impacts of climate change. Weakening of climate legislation in the past, such as with the Global Research Act of 1990, and the failure of other climate legislation to become law, such as the Climate Stewardship Act proposed in 2003, 2005 and 2007 and the American Clean Energy and Security Act of 2008, has resulted in failure of the U.S. Federal Government to lead the nation (and world) in dealing with climate change.

Had past proposed legislation been passed into law it would have meant the federal level were more involved in:

- Facilitating national and international efforts to mitigate greenhouse gases and reduce vulnerability to climate change
- Improved ability to identify and predict climate change impacts
- Improving efforts to reduce greenhouse gases
- Developing alternative energy
- Identifying adaptation options to protect human health
- Improving warning systems to better communicate with the public
- Protecting vulnerable communities such as low income, elderly and children
- Improved guidance nationally to address climate change vulnerability

Until recently, support of purely scientific research rather than programs to guide decision makers has resulted in limited support to local governments looking to adapt to climate change. There have been attempts by the Obama Administration to aid climate change decision-making at the local level, however, many of these programs

which strictly focus on adaptation are new and still require considerable effort by local governments. This section has contributed to understanding how the actions at the federal level may be affecting the decision of local governments to conduct planned adaptation to climate change. Since the early 1970`s the U.S. Federal Government has provided support for scientific programs examining climate change impacts but has been reluctant to provide programs for decision makers at state and local levels.

More recent actions taken by the Obama Administration to address climate change are commendable-and have helped to change the image of the U.S. in terms of leading on climate change action rather than hindering it. Attempts to support local government decision-makers by supporting information sharing, decision-making tools and funding opportunities have the potential to aid local governments in adapting to climate change. However, the majority of federal funding has been provided for renewable energy measures that tend to support greenhouse gas emission reductions (mitigation) rather than adaptation. Most, if not all actions taken by the Obama administration to address climate change have been the result of executive actions implemented by the president. That is, actions taken have been those of the president alone that have not needed approval from the Senate and/or the House. The fact that political action surrounding climate change has only been possible through actions needing solely the president's approval indicate opposition to action on climate change in the U.S. remains strong.

The influence of the next president elected to govern the U.S. is likely to have a strong influence on progress of climate change policies world-wide.

3.2 A Review of State Government Policy Efforts to Address Climate Change

U.S. States are granted powers not given to the federal government through the U.S. constitution. State level governments are structured similarly to the federal government consisting of an executive, legislative and judicial branch. Like the federal government each of the 50 U.S. States possesses its own constitution which they are flexible in developing. State governments then in turn grant powers to local level governments through their state constitution (whitehouse.gov, 2012). The actions of states to address either climate change mitigation or adaptation may affect the ability of local governments to respond to climate change (Meyer, 2010).

There has been no major policy created at the federal level to address climate change within the U.S. This also means states are not required to address climate change mitigation or adaptation in the U.S. It is the case in most countries that action on climate change is not required (Staden, 2010). The lack of action on the part of the federal government in the past has been seen by some to have positive aspects.

For example, historically U.S. States have played an important role as "policy laboratories" or as places where policy can be developed and tested before it is implemented nationally. States have been recognized as playing an important role as policy laboratories for the development of federal climate change policy as well (see: Rabe, 2002). At a more abstract level this bottom-up governance approach to climate change policy has been identified as valuable for nations conducting bottom-down governance (Rabe, 2006). In the presence of weak federal policies to address climate change U.S. States have taken a number of actions to address climate change.

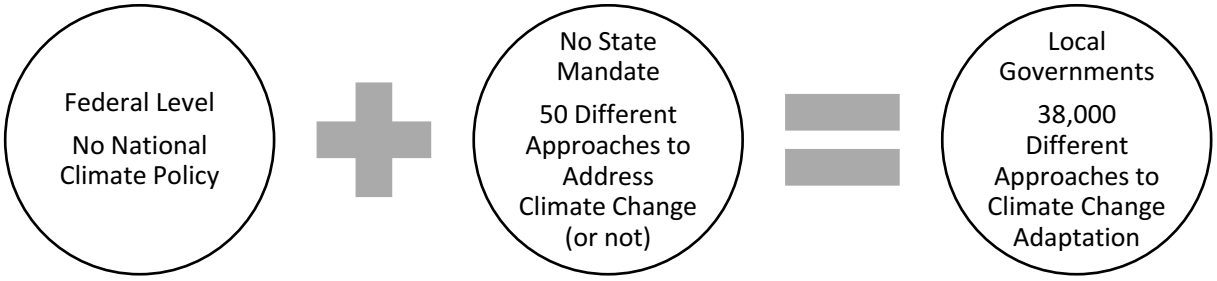

Figure 7: Multiplicity of Approaches to Climate Change Adaptation[7]
(Source: Author's Illustration)

As early as 2007 the number of actions being taken by U.S. States to address climate change - mostly mitigation actions - has been described as "striking" (Rabe, 2007). As of 2006, half of all U.S. states were characterized as actively involved in mitigation related policies (Rabe, 2006, p. 1). Actions taken by U.S. States in the past to reduce greenhouse gases have included: investments in clean energy, carbon offsetting, technology upgrading, methane collection in landfills, funding of climate change action plans and caps on greenhouse gas emissions (Bailey, 2007).

As of 2012, almost half of all U.S. States adopted greenhouse emission targets and developed active climate legislative commissions and/or executive branch advisory groups. Forty-two states have begun measuring greenhouse gas emissions through implementation of greenhouse gas reporting programs or greenhouse gas registries (Center for Climate and Energy Solutions, 2012c). In addition to taking actions to reduce and measure greenhouse gas emissions many states have come together to cap greenhouse gas emissions and trade carbon credits. In 2005, New York State established the first regional carbon cap and trade program in the U.S. called the Regional Greenhouse Gas Initiative (RGGI) with a number of other Eastern States. Thereafter, California followed suit and established a carbon cap and trade program

[7] THERE ARE APPROXIMATELY 89,004 LOCAL GOVERNMENTS IN THE U.S., 3,031 COUNTIES, 19,533 MUNICIPALITIES, AND 16,364 TOWNSHIPS (UNITED STATES CENSUS BUREAU, 2013).

(Tennis, 2009). Following the establishment of cap and trade programs in California and New York other regional cap and trade programs were established, in Western States, Mid-Western Plain States and the Northeastern States.

Historically, there have been U.S. States which have tended to be the first to adopt new policies (Walker, 1969). In terms of climate change policy at the state level California has been one of the most forward thinking.

California began addressing climate change as early as the 1980's. By passing Assembly Bill 4420 in 1988 California established the California Energy Commission (CEC) and began recording greenhouse gas emissions as well as researching the expected impacts of climate change on California. Additionally, California implemented higher vehicle emission standards to decrease air and climate pollution. The emission standards set by the State of California exceed the requirements of the federal government and have become a model for other state governments (California Department of Motor Vehicles, 2011). New York State followed the example of California and also enforced higher emission standards (Tennis, 2009). Since then, another 13 states have adopted improved vehicle emission standards as well (Center for Climate and Energy Solutions, 2012a). California has continued to act as a forerunner in climate change policies at the state level.

California has implemented an impressive number of bills to address both climate mitigation and adaptation. It has expanded renewable energy and alternative fuels and more recently has taken steps to assess the possibility of carbon sequestration (State of California, 2011-2012). Regulations implemented by California to address climate change have included implementing a cap on greenhouse gas emissions and a low carbon fuel standard for transportation vehicles (i.e. requiring emission reductions of 10% by 2020) (State of California, 2011-2012). Executive Orders issued at the state level have dealt with energy efficiency of state buildings and establishment of a climate action team to address meeting greenhouse gas emission goals, climate change impacts in California and both mitigation and adaptation planning. Many of the instructions for state agencies issued by executive order relate to coordinating California's mitigation and adaptation efforts with the California Environmental Protection Agency (State of California, 2011-2012). What is more, California passed one of the most comprehensive Assembly Bills called the Global Warming Solutions Act or Assembly Bill 32. The Global Warming Solutions Act passed in 2006 included a number of measures to reduce greenhouse gases, such as identifying cost effective methods to reduce greenhouse gases, measuring and reporting emissions, identifying enforceable regulations, establishing a cap and trade program, enforcing a cap and trade program and establishing an advisory committee. Implementation of the Global Warming Solutions Act began in 2009 and included a number of measures which are planned to be implemented through 2020. Measures

include: developing a plan to reduce and regulate greenhouse gas emissions, drafting legislation to adopt and enforce regulations and meet emission reduction goals (California Environmental Protection Agency, 2006). In addition to the many efforts of California to address climate change other states have taken actions as well.

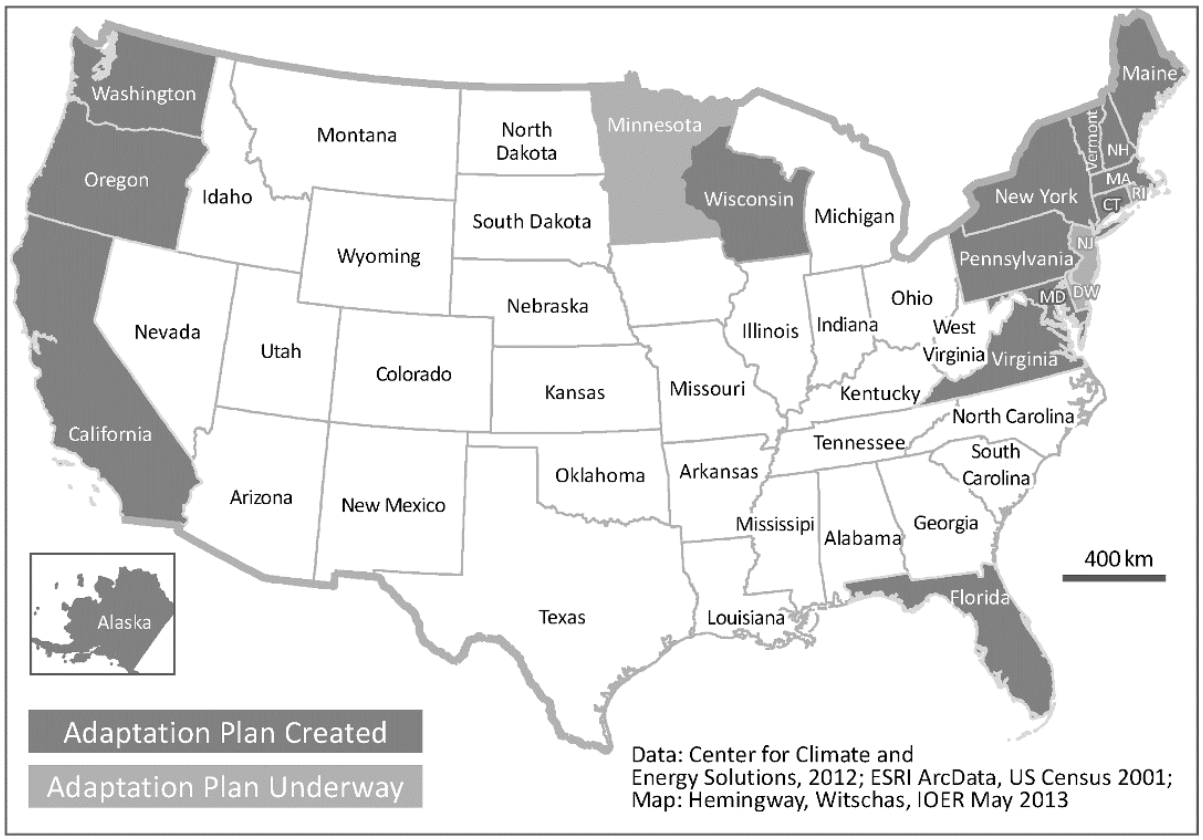

Figure 8: Adaptation Plans by U.S. State
(Source: Author's Illustration)

According to the U.S. EPA 32 States have created Climate Action Plans (Environmental Protection Agency, 2014). As of September 2012 fourteen states had completed adaptation plans developing strategies to decrease vulnerability to identified climate change impacts. Adaptation plans often include practices to reduce climate change vulnerability, such as more efficient use of resources, infrastructure changes or adjustment to regulations. A few states not having yet created an adaptation plan have identified the need to do so (Center for Climate and Energy Solutions, 2012a; Local Governments for Sustainability (ICLEI), 1995-2003; United Nations Framework Convention on Climate Change, 2013a; United States Environmental Protection Agency, 2012b).

However, these numbers taken at face value are likely to paint an overly optimistic picture of the level of action taken place at the state level to address mitigation of greenhouse gases and interest in climate change in general. As Meyer (2010) points out sometimes climate action plans are merely reports consisting of outdated

greenhouse gas emissions calculations. On the other hand, more may be taking place within the state, such as creation of additional laws to address climate change which may be missed in simply reporting which states have created what type of climate change plan. Simply examining which states have and have not created mitigation or adaptation plans may also result in drawing simplistic conclusions regarding the level of climate change action. Regardless, one can see there is a stark contrast between which states have begun to address climate change adaptation and which have not. The States located on both the West and East Coasts have been more active in adapting to climate change. There could be two possible easily recognized explanations for this: political leanings and/or proximity to sea-level rise risk.

Political Polarization of the Climate Change Issue

It has been only in recent history that environmental issues have become a politically charged issue (Dunlap, 2010; McCright, 2011). The partisan divide between Republicans and Democrats on environmental issues has grown significantly in the last two decades. Nearly 90% of Democrats believe environmental regulation in the U.S. needs to be stricter. A much smaller percentage of Republicans, 47%, support stricter environmental regulation. While support of stricter environmental laws among Democrats has slightly increased over the last two decades it has sharply decreased among Republicans.[8] An examination of liberal-conservative political positions from 1959 to 1980 in the U.S. Senate reveals political positions tend to be extreme. Poole and Rosenthal found Senator political positions within the same state tended to vary greatly where one was a conservative and the other a liberal. Political positions of liberal and conservative tend to vary a great deal. Elected officials often represent extreme coalitions rather than the interest of average voters (Poole, 1984).

In general, states located on the West and Eastern coasts tend to be democratic while the states located in the middle of the country tend to be Republican (Newman, 2012). Lyon and Yin found U.S. States with a larger number of democrats are more likely to be early adopters of renewable energy portfolio standards (Lyon, 2010).

In a study examining public opinions for the years 2001-2010 it was found that Democrats (more liberal) are more likely to believe in climate change science and possess concern over climate change as opposed to Republicans (more conservative). This political divide on climate change issues has been found among "elites" as well as among the general public. A positive effect for education attainment and self-reported understanding on the beliefs about climate change and personal

[8] IN 1992, EIGHTY-SIX PERCENT OF REPUBLICANS FAVORED STRICTER ENVIRONMENTAL LAWS THIS PERCENTAGE GREATLY DECREASED TO JUST 47% IN 2012 (PEW RESEARCH CENTER, 2012).

concern were found among liberals/Democrats. On the other hand, a weaker relationship for conservatives/Republicans was found. That is, increased education (i.e. providing additional information on climate change) and understanding regarding climate change is unlikely to convince Republicans of the need to address climate change (McCright, 2011). A number of additional differences exist between Republicans and Democrats on how they perceive climate change.

In 1997 roughly 50% of both Republicans and Democrats believed the effects of climate change had already begun. However, this percentage has steadily increased for Democrats and decreased for Republicans between the years 1997-2008. In 2008, the percentage of Democrats believing the effects of climate change had already begun had risen to 76% while it had decreased to 42% for Republicans. A similar relationship can be found for "respondents saying that the seriousness of global warming is generally exaggerated in the news". In 1997, 37% of Republicans and 27% of Democrats believed the seriousness of global warming had been exaggerated in the news, in 2008, 59% of Republicans and 17% of Democrats believed climate change to be exaggerated. Finally, while the percentage of both Republicans and Democrats believing most scientists agree climate change is occurring has increased since 1997, the percentage of Republicans is much lower (75% Democrats and 54% Republicans believed in 2008 scientists agree climate change is occurring). The percentage of belief in anthropogenic climate change since 1997-2008 among Democrats only slightly increased (70% to 72%) and decreased for Republicans (53% to 40%). The percentage of respondents from both parties increased when asked if climate change would "pose a serious threat to them or their way of life in their lifetimes" (Democrats 31% to 49% and Republicans 20% to 26%) (Dunlap, 2008, 2010). In general, Republicans are less likely than Democrats support action on climate change because Republicans are more likely to perceive climate change not taking place, believe the seriousness of climate change is exaggerated and that scientific consensus does not exist.

In a more recent study conducted in 2013, climate change beliefs among the U.S. American public were again examined. Two-thirds of those surveyed said they believed evidence of climate change existed and 44% believed climate change is manmade. On the one hand, 2/3 believe climate change exists which seems like a good basis to address climate change. On the other hand, less than half of the U.S. population believes their behavior has anything to do with causing climate change. What is more, 18% of the overall population believes climate change is a result of the earth's natural cycle. Consistent with previous public opinion surveys conducted, differences between individual opinions regarding climate change related to political affiliation was found.

As of 2013, fifty percent of Republicans and 88% of Democrats believe there is solid evidence of climate change. Sixty-six percent of Democrats and 24% of Republicans believe human activity is the cause of climate change. One sector of the political population has been extremely resistant to address climate change. Just 25% of Tea Party Republicans believe there is evidence for climate change. Again, among Republicans the effect of education did not appear to effect the belief in anthropogenic climate change. Twenty-eight percent of Republicans with college degrees and 23% of those without college degrees believe in anthropogenic climate change. Eighty-six percent of Democrats with and 57% of Democrats without a college degree believe in anthropogenic climate change. The majority of Democrats surveyed believed there is a scientific consensus on climate change while 41% of Republicans felt that way (Pew Research Center, 2013). The differences between the parties become more important when considering individuals who believed in a scientific consensus also tended to believe that climate change is manmade. Furthermore, the majority of those believing in climate change also believed it possible to mitigate climate change impacts (Pew Research Center, 2013).

In general, news reporting on climate change has been poor, failing to accurately inform the public. Journalism in the United States has been criticized as having been "transformed into a large-scale commercialized news apparatus…" (Boykoff, 2007b, p. 12). Media coverage examined between 2003 and 2006 has failed to accurately portray the existence of a scientific consensus on anthropogenic climate change among most scientists (Boykoff, 2007a). The media has tended to portray climate change as though there is some debate as to whether climate change is man-made. In the U.S. individuals who feel responsible for climate change are likely to be concerned about its impacts. The more an individual knows about climate change the less they feel responsible and concerned and the more confidence individuals have in scientists results in feeling less responsible for climate change (Kellstedt et al., 2008).

Although mitigation measures in theory address reduction of greenhouse gas for future generations, they may have in practice immediate effects relating to cost savings. The U.S. produces 42% of its electricity from coal, which is approximately 14% of coal production worldwide. The States of Wyoming, West Virginia, Kentucky, Pennsylvania and Texas are the largest producers. Coal production contributes to roughly 35% of greenhouse gases in the U.S. (Environmental and Energy Study Institute, 2014). However, renewable energy production continues to increase in the United States especially since 2007 after President Obama took office. A number of states receive over 10% of their power from wind. Some states, such as South Dakota and Kansas, generate even 20% of their electricity via wind power. Texas, one of the largest coal producers, is the largest wind producer in the U.S. behind

California, which produces just half as much wind power. Other large wind producers include Iowa, Illinois, Oregon and Oklahoma (Wiser, 2013).

Beyond facilitating mitigation and adaptation within their own departments and regionally states have the ability to facilitate mitigation and adaptation efforts at the municipal level. The State of New Jersey has been a good example of the role U.S. States could play in guiding municipal mitigation and adaptation to climate change. In 2009 a non-profit called “Sustainable New Jersey” was created for the purpose of guiding municipalities to develop sustainability programs. Two New Jersey State Departments helped develop the program including the New Jersey Public Board of Public Utilities and the New Jersey Department of Environmental Protection along with the College of New Jersey and the New Jersey League of Municipalities. Sustainable New Jersey is a voluntary program where municipalities can gain certification for their efforts. Certification is gained through actions taken by municipalities for which a specified number of credits are earned. Municipalities can choose from a large range of actions to gain their accreditation.

The types of actions municipalities can take toward gaining credit toward certification are diverse. For example, municipalities can gain credit towards certification by supporting animal companionship in the community, arts and culture or health or by supporting the local economy and management of natural resources. The program also incorporates measures to address both climate change adaptation and mitigation. Adaptation measures included as part of the accreditation program include energy tracking and management, energy audits, inventorying and upgrading of buildings, increased energy performance of buildings (both community and home) as well as the creation of a climate action plan, community and municipal carbon foot prints and wind ordnances. Municipalities are given the opportunity to gain financial and expertise related support to carry out these actions both on a competitive and non-competitive basis. Thus far, the program has appeared to have been successful in terms of gaining participation with over 400 towns having already joined the program (Sustainable New Jersey, 2012). Further, New York and Massachusetts are attempting to promote climate change actions amongst local governments by creating programs designed to support municipal mitigation and adaptation measures (Conservation, 2010).

Although the number of actions being taken by U.S. States to address greenhouse gases is commendable there are a number of drawbacks to consider. For example it is not known to what extent the measures taken by states to reduce greenhouse gases have been successful. However, what can be said as discussed previously in the introduction, the U.S. is still one of the largest contributors to greenhouse gases world-wide (Global Carbon Project, 2012). The fact that the U.S. has remained the second largest producer of greenhouse gases regardless of the actions taken thus

far by state governments to address climate change mitigation highlights the need for more action on climate change. What is more, not all U.S. States have identified the need to address climate change. Without a national mandate to address climate change the commitment nationally toward reducing greenhouse gases remains inconsistent. Secondly, the majority of the actions being taken by U.S. States to address climate change have been mitigation related. Similar to the federal level, awareness at the state level of the need to adapt to climate change is rather new. In this respect it is possible that U.S. States have followed the example of prioritizing mitigation measures over adaptation.

Some have identified the lack of guidance from the federal level as providing breathing room for state and local government to develop policy to address climate change (see: Rabe, 2007). However, too much “breathing-room” or flexibility in creating climate change policy also has its trade-offs. An example of one such trade-off is the creation of policies counterproductive toward adapting to climate change. For example the legislature of the State of North Carolina has proposed a bill to ban the consideration of accelerated sea level rise due to climate change when drafting coastal development policies and regulations (Profeta, 2012). What is more, without national policy guidance on climate change from the federal level states are left to decide for themselves whether or not they should address climate change and, if so, how. This has resulted in inconsistent approaches to address climate change.

At this point a number of policies have been tested at the state level. The “policy laboratory” stage should be sufficient for the federal government to get a good idea of what works and what does not—which relates to the limitations of bottom-up governance and what can be learned versus what can be accomplished with top-down approaches. This section has presented an account of the actions being taken by U.S. States to address both climate change mitigation and adaptation. This section has shown that a number of U.S. States have taken some sort of formal planning action to address either climate change mitigation or adaptation. The role state governments can play in moving the country forward in addressing climate change has been shown as well. As it appears, the majority of actions taken by U.S. States have been related to working with other states or even other countries to reduce greenhouse gases. However, as shown with the example of the development of the Sustainable New Jersey Program, U.S. States can play a more active role in guiding local governments to incorporate both mitigation and adaptation measures into their programming.

3.3 A Review of Local Government Policy Efforts to Address Climate Change

It is difficult to paint an accurate picture of efforts at the local level to address climate change. One major reason is the sheer volume of local governments in the United States; within each of the 50 U.S. States there are thousands of local governments. Further, all of these local governments vary greatly from one another on a number of factors making them difficult to compare directly (e.g. type, size, demographics, wealth, etc.). Although local governments have been identified by many as important in orchestrating mitigation and adaptation to climate change a comprehensive analysis of action to address climate change and the decision-making process by all local governments is lacking.

Local Government Efforts to Mitigate Climate Change

By examining climate change organization memberships one can gain some understanding of which local governments are making efforts to address climate change and what those efforts might be. In the U.S., local governments having decided to address climate change have often sought guidance from Local Governments for Sustainability or ICLEI. ICLEI is a global membership based non-profit organization which has historically supported greenhouse gas reduction and sustainability activities but has since expanded to also guide climate change adaptation decisions (Local Governments for Sustainability (ICLEI), 1995-2008b). ICLEI launched its urban CO2 Reduction Campaign in 1991 and began addressing climate change adaptation in the early 2000's with its launching of the Resilient Communities and Cities Initiative. Since the start of the Resilient Communities and Cities Initiative in 2002 an increasing number of resources for local governments relating to climate change adaptation have become available. In 2005 the Resilient Communities and Cities Initiative was created to begin an international dialogue to "mainstream disaster resilience in the planning and decision-making process of local governments" (Local Governments for Sustainability (ICLEI), 2005, p. 1).

In 1993 the City of Portland, Oregon created the first local action plan in the U.S. as a strategy to reduce greenhouse gases (Local Governments for Sustainability (ICLEI), 1995-2008a). Since then Portland has remained active in planning for climate change by implementing a Climate Action Plan and releasing progress reports highlighting efforts to reduce greenhouse gas emissions and measurements (The City of Portland Oregon, 2013). The Sierra Club's Cool Cities Program has had over 1,000 city and county members in the U.S. since 2005. Local governments are encouraged to work with members of the community, organizations and other local governments to devise solutions to "save money, create jobs, and help curb global warming". As members of

the Cool Cities Program municipal leaders are encouraged to sign the U.S. Mayors' Climate Protection Agreement. As part of this agreement municipal leaders agree to reduce their communities' greenhouse gas levels below 1990 levels by 2012 as would have occurred via the Kyoto Protocol had the U.S. federal government signed the agreement (Sierra Club, 2013). As of 2013, ICLEI has approximately 408 local government members in 46 states (counties, cities, villages and towns) (Local Governments for Sustainability (ICLEI), 2013). This is a large number of local governments however this is only a small fraction of the number of local governments in the U.S. as a whole. On the other hand, local governments with larger populations such as cities tend to be members of such organizations, therefore their potential to reduce greenhouse gases may be greater. Unfortunately, membership in a climate change organization does not directly translate to greenhouse gas reductions.

Research conducted which evaluated U.S. State and municipal governments found a large variation in emission goals and proposed actions to address climate change. Often climate change action plans contained voluntary measures which never came to be implemented (Tang et al., 2010; Wheeler, 2008). Thus, one cannot assume greenhouse gases are being reduced as a direct result of climate change organization memberships or the creation of climate actions plans. At most, by examining climate change organization memberships one can assume there is an awareness of the importance to address climate change and some degree of willingness to address it.

Local Government Efforts to Adapt to Climate Change

ICLEI has created the Climate Resilient Communities Program (CRC) aimed toward guiding local governments to decrease their vulnerability toward climate change impacts while saving money, protecting their citizens and creating healthier communities. CRC was the first national program based in the United States designed to guide local governments looking to address climate change adaptation (Local Governments for Sustainability (ICLEI), 1995-2012b). The City of Keene, New Hampshire was the first local government to develop an adaptation plan in the U.S. as part of ICLEI's Climate Resilient Communities Program (CRC).

According to the ICLEI website local government members have the opportunity to utilize various resources provided by ICLEI including information such as local government case studies, information regarding climate change impacts expected by regional location and guidance via an adaptation team. Local government members may also utilize software tools to identify climate change vulnerabilities, such as air pollution or to create climate action plans (Local Governments for Sustainability (ICLEI), 1995-2012b). It is unclear how many local governments have joined the CRC program as direct efforts at obtaining membership information from ICLEI were

unsuccessful. However, a number of local governments have been willing to voluntarily participate in a pilot adaptation planning process (e.g. Miami-Dade County, Florida, Keene, New Hampshire, Homer, Arkansas, Fort Collins, Colorado and Fairbanks, Arkansas). Another 22 local governments were willing to help in creating the CRC program as members of the CRC steering committee (Stults, 2015). While a comprehensive list of cities conducting climate change adaptation does not exist a number of cities have been identified as already having created an adaptation plan including: Seattle, Washington, Chula Vista, California, Bath, Maine, Keene, New Hampshire, New York, New York, Philadelphia, Pennsylvania, and Alexandria, Virginia. All of these cities tend to be coastal and susceptible to flooding and or sea-level rise. A few non-coastal cities were identified as already having had created a climate adaptation plan. However, all of the non-coastal cities also had water related issues. Non-coastal cities identified as having already created an adaptation plan include Greenville, Tennessee which has water shortages, Boulder, Colorado which has experienced flash floods, water quality issues and drought and Taos, New Mexico which has also experienced water quality issues (Center for Climate and Energy Solutions, 2015).

In a survey conducted by ICLEI and MIT 468 U.S. Cities, already members of ICLEI, were asked to which extent they were conducting adaptation planning. The results of the survey indicated that even among this group of climate change aware cities just 59% were conducting adaptation planning. Results of the survey indicated that U.S. cities are behind in adaptation planning in comparison to other cities such as those in Latin America and Canada, where over 90% of cities are engaged in some form of adaptation planning (Carmin, 2012).

In addition to the CRC program a campaign to promote climate change adaptation among U.S. local governments was launched in June 2013. Elected officials who sign the Resilient Communities Agreement commit to address extreme weather, energy security, faltering infrastructure and economic uncertainty. The purpose of the campaign is to increase awareness among local governments and the public, bring local governments together to garner state and federal financial and other support, facilitate resource sharing and learning from one another. This campaign is focused on including a wide range of local governments including small and rural. Members are provided with access to information resources and an online platform intended to facilitate collaboration and sharing of resources between members (Resilient Communities for America, 2015). As part of the campaign a goal was created to acquire support from 1,000 members by 2015. As of early 2015, approximately 180 members from Cities, towns and counties across the U.S. have signed the Resilient Communities for America agreement (sometimes multiple elected officials from each municipal government). This equates to approximately 173 memberships from

various governments. As it appears the goal to acquire 1,000 members as part of the Resilient Cities Agreement has not been reached, it is not certain what the reasoning is behind the failure to meet this goal is.

In short, the Resilient Communities Program operated by ICLEI member information is not currently available; however, over 20 local governments were willing to participate in the pilot project to test adaptation planning. This shows there is at least some concern and interest in adaptation to climate change. Nonetheless, even among climate active local governments there is not overwhelming action to adapt to climate change as witnessed in the survey conducted by ICLEI and MIT which found 59% of U.S. ICLEI members were conducting adaptation planning. What is more, the Climate Resilient Cities Campaign failed dramatically to meet their goal of 1,000 U.S. members by. This overview provides a limited view of what is happening among local governments active in climate change organizations. While the actions by local governments in the absence of a federal mandate are commendable they are not overwhelming. There are approximately, 89,004 local governments in the U.S. : 3,031 counties, 19,533 municipal governments and 16,364 townships (United States Census Bureau, 2013). A better understanding of what the general population of local governments are doing to address climate change impacts (if anything) is needed as well as the influences on their decision to adapt or not. The focus of research and practice has tended to be on those governments which have been forerunners in climate mitigation and adaptation policies. It is the contention here that the experience and opinions of small local governments with lesser resources is needed as well.

4 Developing A Framework to Examine Influences on the Decision to Conduct Planned Adaptation to Climate Change

Practitioners in the field have experienced firsthand how difficult it is for change to occur within local governments especially as it relates to climate change adaptation as demonstrated by this quote by Gregg (Oelofse, 2011), the acting manager for environmental policy at the City of Cape Town, South Africa: “Governments, and particularly local governments, are not renowned for being progressive institutions, open to change with long term planning horizons. By their very nature local governments focus on short term planning (3-5 year horizons), often tend towards reactive approaches as opposed to proactive management (i.e. deal with the crisis when it happens) and struggle with adapting to change or creating change”. It must be stated however that there are local governments that have decided to prepare for the long-term and take a pro-active role in addressing climate change (e.g. New York City, Portland, Oregon, the City of Keene, New Hampshire and King County, Washington). It is important to understand from a research perspective what hinders and motivates local governments to conduct planned adaptation. Local governments are capable of change. There is a need to more thoroughly examine what influences the decision to conduct planned adaptation by local governments in both rural and urban landscapes.

In the United States since the 1960’s local governments have modernized state constitutions to increase salaries for legislators, increase staff levels and simplify legislative processes. More recently, local governments have expanded and updated the services they provide. Some examples include implementation of e-government and homeland security measures following September 11, 2001 as well as updating political and fiscal processes to better deal with 21st century issues (Katz, 2003). Local governments, like other organizations, can and do adopt new policies. Some new practices are enforced by the federal government. However, others are not. As there is no federal or state mandate to conduct climate change adaptation, adaptation is considered voluntary. A number of local governments in the U.S. and world-wide have chosen to reduce greenhouse gas emissions and/or adapt to climate change on a voluntary basis. Local governments to some extent are capable of adapting voluntarily to climate change. Which types of local governments and which conditions are necessary for the decision to be made to voluntarily decide to conduct planned adaptation? It is a goal of this study to examine climate change adaptation not just among large cities but among the broader population of local governments including small local governments. In order to develop hypotheses concerning the

influences on the decision of local governments to adopt new policies or practices previous research studies are examined.

Short Overview of Innovation Theory

Innovation theory originated in Europe in the early 1900's (see: De Tarde, 1903) since then it has been used broadly across many disciplines to examine adoption of innovations. Among innovation researchers various definitions of innovation can be found. However, the term innovation can simply be defined as: a new idea, device or method or the act or process of introducing new ideas, devices, or methods (Merriam-Webster Dictionary, 2015). This definition has also been used by a number of innovation researchers. According to a definition provided by Rogers (2003, p. 12), innovations can be defined as "an idea, practice, or object that is perceived as new by an individual or other unit of adoption" (See also: Rogers, 1996; Mohr, 1969; Walker, 1969, p. 410). In this dissertation innovation is understood as defined here as a new idea or practice, with planned adaptation to climate change as the new practice being examined. Innovation theorists have been criticized in the past for blaming decision-makers for inaction to address social problems. Failure to consider the role of society in decision-making has also been a common mistake among research studies conducted. It is also important to not assume an innovation is best for society as a new practice or policy may have consequences for the adopters and society as a whole (Meyer, 2004). It is easy to only focus on what is happening within local governments to address climate change. However, the decision of elected officials to address climate change impacts may be influenced by actions at state and federal levels and by voters within their districts as well.

Beyond Spatial Diffusion

Early diffusionists focused on the adoption of innovations solely as it related to spatial diffusion (Hägerstrand, 1965). Diffusionist is a noun or adjective related to diffusionism or the theory or principle that diffusion is the main force in cultural innovation and change (Dictionary.com, 2016). The focus on spatial diffusion alone has become outdated as technology has developed and physical space in terms of communication has lost its importance. In the 1930's spatial isolation in rural U.S. communities began to matter less (regarding the spread of information) due to expansion of transportation systems and the use of cable television (Rogers et al., 1988). Today the internet and other modern technologies have further contributed to lessening the influence of physical space on the decision to adopt an innovation. In short, the focus of innovation research has shifted from earliness of innovation adoption to examining the tendency to adopt innovations (Berry, 1999). Modern innovation researchers tend to focus on societal influences on the decision to adopt a

new idea or practice rather than the influence of physical space alone (Hatimi, 2003; Ormrod, 1990). Therefore, the influence of spatial as well as societal influences will be examined in this study.

Innovation theory has been applied in a number of contexts such as farming, health departments, but also to examine adoption of new polices by local governments. Innovation theorists have examined the adoption as well as the failure to adopt new policies among various government types (i.e. states, municipalities), organizational sizes (i.e. small and large) and within and across states. Innovation theory, especially research stemming from Mohr's seminal article "Determinants of innovation in organizations", has been useful in understanding influences on the decision of governments to address climate change mitigation. This study will expand on the work of Mohr and others by examining the tendency of local governments to adopt climate change adaptation policies using general principles of innovation theory.

Influences on Innovation Adoption - Early Lessons in the U.S.

In the early 1940's one of the most influential innovation studies in the United States was conducted. Ryan and Gross examined the adoption (or lack of) adoption of hybrid corn seed by agriculturists in the State of Iowa. Ryan and Gross were puzzled as to why the agriculturalists had not adopted the use of hybrid corn seed which could have increased their crop yields (i.e. increasing resistance to drought), and ultimately found a number of explanations. Importantly, adoption of hybrid corn seed did not take place overnight. It was found on average from awareness to implementation it took seven years (Rogers, 1996; Ryan, 1943). Implementation was found to be difficult for a number of reasons. Adoption of hybrid corn seed required farmers to change their behavior. Farmers had to cease their old agricultural practices related to traditional corn seed and learn new practices related to hybrid corn seed (i.e. hybrid corn seed does not reproduce it must be replanted annually). In addition to changing their behavior agriculturalists need to pay out of pocket costs of switching to hybrid corn seed, which is an annual expense (i.e. hybrid corn seed must be purchased yearly) (Ryan, 1943).

Ryan and Gross found change to be difficult and to require considerable effort by the adopter(s). The effort related to adoption of a new product may be in the form of behavior change or financial cost. As a parallel, adaptation to climate change undoubtedly requires behavior change (e.g. planning for the future, conducting vulnerability assessments, creation of action plans) and results in financial costs (e.g. hiring or training climate change experts, creating plans, implementing adaptation measures: flood protections, public outreach, providing cooling centers during high temperature days). In this respect, it can be seen that the basics of innovation theory

as well as Mohr's hypothesis offer a useful tool to address weakness of current adaptation research.

4.1 Identifying Research Gaps within Adaptation Research Field

According to Massey et al. (2014) and Waters et al. (2014) there is a need for research that offers a more "comprehensive, structured and nuanced" understanding of barriers and potential drivers of climate change adaptation. The identification of barriers in adaptation research has been criticized as context-specific and non-generalizable (Biesbroek et al., 2013; Eisenack, 2014). However, most barriers found toward climate adaptation are not adaptation-specific but barriers found whenever new policies are being implemented. Some exceptions exist, such as the long-term nature of climate change in the reality of short-term politics, a high dependency on climate science and the general level of uncertainty surrounding climate change (Biesbroek et al., 2013). Despite this, previous research examining barriers and drivers of new policies can be useful in understanding adaptation. This is good news as the wheel does not need to be reinvented. As previously discussed, innovation theory has been found to consistently predict adoption of new policies in a diversity of contexts.

An additional weakness of past adaptation studies has been the failure to examine how to overcome barriers toward adaptation in both urban and rural contexts (Eisenack, 2014; Waters et al., 2014; Biesbroek et al., 2013; Lal, 2011;). Research examining climate change adaptation within rural communities has been lacking. More specifically, research examining the differences experienced when dealing with adaptation between urban and rural communities are needed (Lal, 2011). Therefore, rural as well as urban local governments are examined in this study *(*research question 1: *Are local governments in New York State adapting to climate change?).* Examining adaptation among local governments in both urban and rural New York presents the opportunity to also examine the influence local government size has on the decision to adopt planned adaptation. The impact of organizational size has been well researched within innovation studies and correlates well with the urban-rural context. Furthermore, innovation research has provided insights on easing adoption of innovations which has the potential to be applied to climate change adaptation.

Burch (2010) has stressed that local governments in developed countries are at a great advantage in comparison to developing countries in terms of financial, monetary and other resources. She also points out that obstacles toward climate change adaptation tend to be regulatory, structural, behavioral and cultural and tend to include other contextual factors. Despite Burch's claim that local governments in developed countries are at a great advantage when it comes to address climate

change impacts, a lack of financial as well as other resources are often given as barriers toward planned adaptation among local governments within developed nations.

Adaptation research has tended to be centered on identification of barriers toward climate change adaptation. For example, Biesbroek (2013) conducted a review of the adaptation literature and identified more than 200 “context specific barriers”. Institutional and social barriers were the most commonly mentioned. Waters et al. (2014) identified 50 distinct barriers and divided them into five groups including: governance, policy, information, resources and psycho-social barriers. Waters et al. (2014) acknowledged institutional barriers as well as social and cognitive aspects of adaptation, uncertainty and costs of adaptation to be the most prevalent barriers experienced. Furthermore, Moser and Ekstrom identified four categories of barriers toward adaptation including again, institutional, as well as attitudinal, financial and political barriers (Moser, 2010). A study examining the propensity among U.S. cities to take action on climate change looked at three elements: inhibitors, swing factors and resource catalysts. Inhibitors are ways of thinking and framing climate change adaptation such as scientific uncertainty and climate politicization; they delay adaptation but do not necessarily stop it. Swing factors affect climate change adaptation, they can be characteristics of communities which promote or deter adaptation action such as extreme weather events and political culture. Resource catalysts are types of information and moral grounding which provide a basis to motivate adaptation planning, such as local academic resources and advocacy and political engagement (Carlson, 2015).

It has been suggested that categorization of barriers are rather arbitrary but are however useful as a heuristic to “guide scientific inquiry” (Biesbroek et al., 2013). In this dissertation Mohr’s hypothesis is used as a heuristic to guide scientific inquiry and examination of the influences on the decision of New York State local governments to conduct planned adaptation to climate change.

The theoretical framework is based on Mohr’s hypothesis that “Innovation to be 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. 111). This hypothesis applies in the context of the current study as follows: adoption of planned adaptation is influenced by the local government official motivation, obstacles present which are in opposition to planned adaptation and the availability of resources to overcome obstacles to planned adaptation. Mohr’s hypothesis has also been used to examine the decision of cities to join Mayors for Climate Protection (MCPA) (See: Krause, 2010). This study expands upon previous research by applying Mohr’s hypothesis to examine

barriers and drivers of climate change adaptation among both rural and urban local governments in New York State.

4.2 The Use of Mohr's Hypothesis to Examine Influences on the Decision to Conduct Planned Adaptation

Here a brief overview of the three elements of Mohr's hypothesis is provided and an effort is made to show that it can be applied to examine adoption of planned adaptation by local governments. Mohr examined motivation to innovate, availability of resources and the strength of obstacles toward innovation.

The first element Mohr measured was motivation. He measured this as attitude and ideology of the decision maker, in his study, toward health services. He examined the willingness of health officers to encourage implementation of non-traditional programs and interact with outside organizations in order to learn about new ideas and gain support. Resources for their health departments were also examined. Similarly, one could examine the motivation of local elected officials to adapt to climate change by examining their attitudes toward climate change (concern about extreme weather and other impacts) and whether or not they are members of climate change organizations.

The second element examined by Mohr was resources. These were measured as internal "competence" and "wealth". Competence can be understood as expertise or skills possessed by health departments and wealth can be understood as budgetary funds and/or number of employees. Mohr found resource constraints, such as lack of staff, expertise, specialized training and financial resources, to be the strongest predictors of innovation adoption (Mohr, 1969, p. 114). In order to create and implement climate adaptation plans local governments also need specific resources such as: climate change expertise, excess staff to work on adaptation plans as well as financial resources.

Mohr found organizational size to be the strongest predictor of innovation adoption as it relates to resources. Specifically, he found larger health departments were more likely to possess excess resources. This is partially because larger health departments gain more revenue than smaller through taxation. In addition, larger health departments are more often eligible for competitive federal grants and other funds than smaller health departments (Mohr, 1969, p. 63). The effect of size on availability of resources and obstacles experienced has been found in a number of research studies. Only a minority of research studies have found size to not affect adoption of innovation (see: Boyne, 2005; Knoke, 1982). Mohr found the only variable influencing adoption was size and that it had a "striking" impact on the likelihood and degree of innovation (Bingham, 1976, p. 213). Fagerberg (2006, 2009)

found smaller organizations needed to do more networking to make up for fewer resources. Lastly, Mohr measured the strength of obstacles toward adoption of an innovation. This could be seen as unwillingness to change that is motivated by the desire to maintain current norms. Resistance toward adoption of new policies may originate internally for example from local government employees or externally from the community or from state and federal governments. Mohr suggested resources are needed to overcome these obstacles toward innovation.

Applicability to Examine Local Governments

As innovation theory has traditionally been used to examine larger organizations, questions may exist as to whether or not innovation theory can be used to examine smaller organizations. However, some evidence exists which supports the use of innovation theory to examine smaller local governments. Brudney (1995) successfully applied traditional models of innovation theory to examine adoption of innovation among small local governments. He examined populations of 50,000 or less and the factors affecting the adoption of computer technology. He studied the impact of community size, demand for governmental services, degree of expertise and resources as well as employment of a full versus part-time manager on the decision to adopt new computer technology. In line with Mohr (1969) population size and level of services provided were found to have the highest influence on the decision to adopt computer technology. The degree of expertise and resources as well as whether or not the local government employed a full or part time manager did not appear to affect the decision to adopt computer technology. However, degree of expertise was found to affect the degree of implementation (Brudney, 1995). That is, some degree of expertise is needed to implement measures once the decision is made to adopt an innovation.

Some evidence also exists to suggest that Mohr's hypothesis also applies toward adoption of climate change polices. Research conducted in the U.S. examining adoption of energy and climate mitigation policies among cities found that large cities were more likely to adopt energy and climate change mitigation policies than smaller cities and smaller cities needed substantial technical, financial and planning assistance (Vasi, 2006). Innovation theory, in addition to being applicable among smaller local governments, has been found to predict the decision to adopt a new policy or practice among different types of government as well. Governments irrelevant of type have been found to adopt innovations for the same reasons (Bingham, 1976, p. 220).

The applicability of innovation theory to both small and large municipalities as well as different municipality types (e.g. cities vs. towns) make it suitable to examine climate change adaptation among local governments as research questions examine

adaptation among various local government types and sizes. The following section provides a more in-depth look at possible motivations, the influence of resources and strength of obstacles of local governments to adopt new policies. Each element is discussed as related to Mohr's results and in the realm of local government adoption of climate change policies. Here, hypotheses are developed to examine the influences on the decision to adopt planned adaptation to climate change.

The Influence of Local Government Decision Maker Motivation on the Adoption of Adaptation Policies (RQ 2)

Mohr suggested that adoption of new policies or practices are influenced by the decision-maker's motivation. Research conducted at both the state and local levels have found the perceived need for a new policy by decision makers to affect innovation adoption (Damanpour, 2008; Fagerberg, 2006, 2009; Walker, 1969). Decision makers' perceptions that a new practice or policy requires too much effort or presents too much risk are less likely to adopt. Routine and staff roles must be altered to implement new practices (Newman et al., 2000). For local elected officials it is often a safer option to provide a stable environment rather than implementing change. Implementation of new policies can be risky for decision makers who may experience backlash from the media or public if measures are seen as wasteful (Newman et al., 2000).

Among general policy research the approaches and goals of local governments themselves have also been found to constrain or drive innovation. Major internal drivers have included existence of a champion as well as management and professional leadership (Newman et al., 2000). The willingness or unwillingness of decision-makers to take a leadership role has been found to influence adoption of climate change adaptation policies as well (Archie, 2014; Waters et al., 2014; Mozumder et al., 2011; Moser, 2010; Adger et al., 2009). Adoption of new policies by city to state governments has been found to be possible only where decision makers have been open to doing so (Shipan, 2006). Decision makers taking a socially active role regionally have been found to be more likely to be aware of new policies and therefore more likely to promote adoption of a new policy within their local governments (Walker, 1969). U.S. cities holding memberships within international climate change networks have indeed been found to be more likely to adopt climate mitigation policies (Vasi, 2006) as well as local governments holding membership within a local climate change networks (Krause, 2010).

Research conducted at both state and local levels have found the perceived need for a new policy by decision makers to affect innovation adoption (Damanpour, 2008; Fagerberg, 2006, 2009; Walker, 1969). Uncertainty in climate science has often been

cited as a barrier toward implementation of adaptation policies (Archie, 2014). Burch (2010) suggests a culture of collaboration and mutual respect in addition to well informed leaders are important in facilitating adaptation to climate change. On the contrary, some have suggested that an understanding of climate change causes is not necessary to take action on climate change (Brugger, 2013). Where the adoption of a new policy or practice is perceived to address a current or perceived problem and aid in maintaining the status quo (resources permitting), adoption is more likely to take place within local governments (Bingham, 1976, p. 222). Motivation to conduct planned adaptation has been linked to past extreme events and extreme weather at local (Field et al., 2012) as well as national levels (Massey et al., 2014). Extreme weather disasters such as flooding may increase the desire to adapt. It must be noted that this type of adaptation is often reactive rather than planned. In the UK flooding which took place in 2014 may have had an effect on how the issue of climate change was perceived (Press Association, 2014). Twenty-eight of 30 countries in Europe have cited extreme weather, such as flooding and extreme heat, as influencing their decision to address climate change (Association, 2014). Many researchers have found local governments to focus on and react to extreme conditions such as flooding and extreme precipitation (Amundsen et al., 2007; Biesbroek et al., 2013). In an ethnographic study conducted in the rural American Southwest among residents in arid conditions, water was the most frequently mentioned weather and climate related topic in the discussions as well as water conservation (Brugger, 2013). However there are conflicting findings regarding the influence of extreme events on the decision to adapt. Key events and crises have also been found to not influence innovation adoption but rather manager skills, perceived need for change among staff, clear vision and manager skills (Newman et al., 2000).

The Influence of Resource Availability on Adoption of Adaptation Policies

Mohr suggested adoption of new policies or practices to be directly related to resources available to overcome obstacles to said innovation. Support for this hypothesis has been found among both climate change mitigation and adaptation research. For example, Betsill (2001) found availability of resources such as funding, equipment and expertise from state and federal levels to affect the decision of local governments in the U.S. to adopt mitigation measures.

Information availability

Availability of information on climate change has been found to be a major barrier toward climate change adaptation. A survey conducted in 2011 among county

governments in the Colorado Mountains found the most common barriers toward adaptation to be information related. For example, a lack of locally-specific information on climate change as well as information at relevant scales and a lack of useful information were given as the most common barriers toward adaption planning (Archie, 2014; see also: Waters et al., 2014). A survey conducted among European Union countries found a lack of access to adaptation knowledge and information from other EU countries hindered climate change adaptation suggesting information exchange between peers to be important (Massey et al., 2014). Contrary to this, a survey study conducted in rural southeastern Arizona found the provision of additional information to agriculturists to not improve adaptation decision-making, even in the face of adequate financial resources (Coles, 2009). This may suggest that agriculturalists do not find the provision of information from outside sources to be important in their decision making processes.

Financial Resources

The presence or absence of financial resources has been found to have a strong impact on the decision to conduct planned adaptation to climate change. Budget constraints both in the Colorado Mountains and Florida Keys have been identified as the most significant barrier toward climate change adaptation at the local government level (Archie, 2012; Mozumder et al., 2011). Perceived financial and economic consequences of climate change adaptation policy implementation have been found to hinder adaptation (Waters et al., 2014). Among European Union countries a lack of resources and institutional capacity were cited as major barriers toward climate change adaptation; notably, a lack of resources was ranked as a larger barrier by countries with lower GDP's (Massey et al., 2014). Krause (2010) also found that larger local governments (who presumably would have access to greater financial resources) were more likely to join climate change mitigation organizations. Lubell et al. (2009) found a greater likelihood of environmentally sustainable policies to exist within communities with financial resources and again a higher social-economic status. Smaller cities were found to need substantial technical, financial and planning assistance. Contrarily, a study conducted in Cologne, Germany found that the individual decision to adapt to climate change was better predicted by perceived adaptive capacity than by socio-economic factors such as wealth (Grothmann, 2005). This may point to differences in individual rather than government decision-making. However, research findings in general suggest that the findings of Mohr and other innovation researchers that size is often related to monetary and other resources also applies to climate change adaptation.

Combining Mohr's Hypothesis with Diffusion Models

Berry and Berry (1990) took a unique approach to examine the adoption of lottery systems by U.S. States. Instead of simply focusing on either spatial diffusion or internal characteristics (internal determinants), they examined both. They tested both innovation based on spatial aspects (i.e. within and across states) and internal characteristics using Mohr's hypothesis regarding motivation, obstacles and resources. The influence of the number of previous lottery adopters on the adoption of a lottery system in neighboring states was also examined. Support for both diffusion and internal determinant models were found. In line with Mohr's hypothesis, Berry and Berry (1999) found the effect of proximity to other adopters was not as strong when resources were lacking. This tells us that spatial diffusion is limited where internal resources are lacking. That is, even where potential adopters may be interested in adopting a new innovation they are limited by the availability of internal resources. What is more, the impact of neighboring states was greater when the potential adopter possessed motivation to adopt a lottery system. The researchers highlighted the possibility of explaining adoption of innovation even where few have adopted (i.e. the majority of their sample had not yet adopted a state lottery program).

Research findings from Berry and Berry's study may be applicable to state and local levels. For example, much of the adaptation and mitigation planning has been concentrated in the West and East coastal states. Perhaps the decision of states to adapt is the result of the existence of motivation (i.e. in the form of flood risk) and proximity of previous adopters (states to North or South). States bordering other western coastal states for example are at lower risk for flooding and therefore less motivated to adapt. Berry and Berry's results, if applied to local governments, could help explain patterns of climate change adaptation. Perhaps larger local governments with motivation and resources are only capable of influencing adaptation of neighboring governments where resources and motivation to adapt are both present; hence smaller local governments with lesser resources (staff, expertise, financial) may not adopt climate change adaptation measures even if motivation is present (e.g. risk, concern).

Proximity to Previous Adopters

The effect of proximity on innovation adoption has been found at the local government level both in the UK and U.S. A study conducted in the UK found local governments are more likely to adopt municipal reform where a higher percentage of surrounding local governments had already done so (Knoke, 1982). This relationship has also been found in the U.S. among local governments having adopted climate mitigation policies and joined global climate change programs (Krause, 2010; Vasi,

2006). The effect of spatial proximity to previous adopters could be due to the fact that local governments in proximity to one another have similar experiences such as societal pressure to adapt or not or similar economic conditions. As suggested by Vasi (2006) local governments located near one another may adopt mitigation policies based on similar experiences such as pressures from local environmental activists or the community.

The proximity of potential adopters to those already having adopted a policy is one such example. This relationship has been found at both state and local levels of government. States in proximity to adopter states are more likely to adopt an innovation than states surrounded by non-adopter states. This relationship has been found to be stronger where potential adopters are similar to those that have already adopted (Walker, 1969). This may point to the difficulty in having mostly large, financially well-off governments adopting climate change mitigation and adaptation measures. If adoption of measures to adapt to climate change only spreads to local governments with similar characteristics to say, New York City, then few local governments are likely to adapt as there are few local governments that are similar to New York City in the U.S., particularly within New York State. One small local government has conducted planned adaptation to climate change, Keene, New Hampshire. However, Keene is atypical in regards to wealth, which may suggest exceptions do exist concerning the size-resource relationship. Local governments in the U.S. are diverse, therefore diversity is needed among those conducting climate change adaptation. Successful adaptation and mitigation planning by smaller local governments with limited resources is important if small local governments are expected to also prepare for climate change.

Climate Change Expertise

Mohr found resource constraints such as expertise and specialized training to be the strongest predictors of innovation adoption (Mohr, 1969). The degree of expertise has also been found to affect the degree of implementation of new policies (Brudney, 1995). Support for these findings has been found among adaptation research. A lack of expertise and competence has been cited as a barrier toward planned adaptation (Amundsen et al., 2007; Baker, 2012; Mozumder, 2011). A survey conducted among Canada's local governments found that larger cities with populations of 500,000 or above were either planning for climate change adaptation or discussing adaptation (15 communities were identified as having an adaptation plan or strategy in place). Only 5 % of local governments had an adaptation plan in place, 15% were either developing or incorporating adaptation plans into existing plans, 20% indicated they were beginning to discuss climate change, 45% indicated they do not have an adaptation plan and are not considering adaptation. Approximately 65% of local

governments with populations fewer than 5,000 did not have an adaptation plan in place. In addition, they were not considering implementing a plan and no serious discussion is taking place. Approximately half of these small local governments had experienced either or both significant flooding and high rainfall which caused damage. Large local governments indicated that local funding was the most important source to support adaptation activities. Smaller local governments cited provincial and local financial sources as the most important factor where federal financial sources were found to be less important – possibly as a result of federal funding to be largely temporary (The University of British Columbia, 2014).

Certain resources and skills are required for implementation of innovations to occur (Moser, 2010) but can also effect whether or not the decision is made to implement adaptation measures (Grothmann, 2005). Resources such as technical expertise have been identified as being important at all stages of implementation (Moser, 2010). Large cities have been found to be more likely to adopt energy and climate change mitigation policies than smaller cities as smaller cities often require substantial technical, financial and planning assistance (Vasi, 2006).

Potential External Obstacles toward Planned Adaptation

Mohr suggested innovation to be inversely related to the strength of present obstacles. Entities external to local governments, such as the community, state and federal governments can hinder adoption of new policies. Historically, community demands and actions of state and federal governments have been found to influence the adoption of new policies at the local government level. According to Bingham (1976) for local political innovation to take place action by all levels of government is necessary. Some evidence for this statement can be found among climate change policy research. For instance Betsill (2001) found local governments were uncertain of how they could contribute to mitigate greenhouse gases in the absence of a federal mandate. Local governments faced a number of issues while attempting to implement greenhouse gas reduction policies, such as absence of an “institutional home” for climate change related issues, a lack of administrative capacity and financial resources as well as difficulties collaborating between governments and governmental departments (Betsill, 2001).

Bingham (1976) postulated in his “Adoption of Innovation by Local Government” model that the environment (i.e. education, race, sex, residence, income, ethnicity, political culture, religion and the power structure) is crucial in influencing public attitudes. Public attitudes result in leader attitude change and vice versa. The influence of public attitudes on leadership attitudes are said to affect the federal, state and local political system. That is, characteristics of the environment shape

public attitudes, public attitudes influence elected official attitudes and elected official attitudes affect public policy and political innovation overall. The adoption of new policies may result in a need for changes in bureaucracy. Demand for changes in policy may also be a result in an increase or decrease of resources. Finally, political innovation may take place through the actions of federal and state governments; examples given by Bingham include improvements to public housing, police departments and public schools. The output of public services acts as a feedback loop in the demand for change in the bureaucracy, leadership perception of public attitudes and in the environment which results in a continuous process (Bingham, 1976, p. 218).

Community

Recent evidence suggests that the absence or presence of community support to address climate change impacts influences actions of decision makers on climate change. Archie (2012) found a lack of perceived public importance and public awareness as well as demand to take action to be the biggest challenges toward implementation of adaptation measures. Mozumder et al. (2011) found opposition from the community as well as other stakeholders to stifle implementation of adaptation plans.

Community attitudes may affect the level of funding and priority that certain measures receive. Community demands can have a large impact on the decision of local governments as to what new policies or programs are implemented (Bingham, 1976). Communities with lower socio-economic statuses have been found to adopt "efficiency innovations" while high status communities tended to adopt "amenity-type" innovations (Bingham, 1976). For example a local government with a low socio-economic status may be more willing to adopt measures to reduce greenhouse gases because reduction of greenhouse gases often result in energy cost savings, whereas construction of floodwalls to prevent forecasted increases in sea-level rise may be seen as a wasteful use of scare resources. Lorenzoni et al. (2007) found a lack of public support to address climate change was related to uncertainty and mistrust regarding scientific information. As previously discussed the media in the U.S. has typically failed to accurately report on climate change. The media has failed to inform the public that the majority of scientists agree that climate change exists and is manmade. Extreme polarization of the climate change topic between political parties has also made it difficult to properly inform the public in the U.S.

Adaptation has been proposed to be limited by society and ethics rather than technological or economic thresholds. "More often, adaption to climate change [within societies] is limited by the values, perceptions, processes and power structures within society…rather than by exogenous forces outside its control" (Adger et al., 2009, p.

349). A number of new policies by local governments in the UK were found to have been adopted due to pressure from local businesses, service users, citizens and other groups (Newman, 2000). In a qualitative study conducted among U.S. cities Tampa, Florida was found to be one of the least prepared cities even though it is at the highest risk for hurricanes. The public and political climate are said to have impeded action in this case. Los Angeles is also at high risk for weather extremes including wildfires and heat waves, but unlike Tampa the political climate promotes actions to adapt to these impacts and thus makes the city better prepared to deal with those impacts. In cities with conservative political parties actions to address climate change impacts were less likely to be taking place. Cities where local decision makers felt the public believed in climate change were more likely to be taking actions to prepare for climate change impacts (Carlson, 2015).

State and Federal Government

Historically, research has shown availability of resources such as financial assistance, equipment and expertise from other governmental levels influence innovation adoption at the local government level (Bingham 1976). The lack of financial, educational and administrative support for climate change measures has been shown to make it difficult for local governments to act on both climate change mitigation and adaptation (Betsill, 2001; Mozumder et al., 2011).

Policies created by overarching government levels have been found to influence the decision of local governments to act on climate change. The lack of a legal mandate, a strong and clear position and offering of potential solutions by federal and state governments have hindered adaptation to climate change by local governments (Waters et al., 2014). Among local governments in Australia one of the major barriers identified were ambiguities surrounding climate change adaptation (Waters et al., 2014). A study conducted in the Netherlands found that the majority of local governments had not yet implemented adaptation plans. To explain the lack of adaptation the researchers suggest higher tier governments have greatly influenced the decision of municipalities to conduct both mitigation and adaptation. Nationally, mitigation has been framed as an energy issue, whereas climate change adaptation has been framed as a water issue. In the Netherlands climate change adaptation has not been properly supported financially nor has it been the focus of policy-makers (Hoppe et al., 2014). At the same time, state and national environmental policies have been found to restrict adaptation actions by rural residents in Arizona (Brugger, 2013).

A variety of factors have been discussed which may influence the tendency of local governments to adapt to climate change. Factors discussed have included the three

areas provided by Mohr's hypothesis: the strength of obstacles to innovate, motivation to innovate and resources to overcome obstacles. As already discussed, Mohr found resources to be the strongest predictor of innovation. As Mohr and a number of other researchers have found, size tends to have the largest impact on the level of resources (e.g. slack resources, expertise or what Mohr referred to as competence and wealth). Additional and subsequent research to that of Mohr has been useful in identifying factors which influence the strength of obstacles (e.g. approaches and goals of local governments, existence of a champion/management leadership), level of resources (size of organizations/local governments) and motivation to innovate (e.g. community attitudes, pressure from local businesses, service users and others, perceived adaptive capacity and perceived need). The national context was identified as having a strong role in influencing all three (e.g. motivation, obstacles and resources). The attitudes of politicians at federal and state levels may influence the attitudes of both elected officials and communities at the local level, thus influencing motivation to adapt. Furthermore, federal and state governments impact resources available to local governments, such as financial assistance, equipment, expertise and administrative support.

Easing Adoption of New Policies or Practices

Some innovations are unlikely to be adopted due to characteristics of the innovation itself, characteristics of the potential adopter or other external conditions. According to previous research, adoption of an innovation can be eased or encouraged. Some conditions are difficult to change in the short-term, such as the community environment and attitudes as well as the demand for an innovation (Bingham, 1976). However, expertise and financial resources can be altered in the short-term. Service providers for example can ease adoption of innovations in at least two ways: they can provide instant expertise and offer adopters the ability to implement innovations on a short-term basis (Bingham, 1976).

Service providers have the possibility of offering "instant expertise" and/or "expert assistance" to local governments. The service provider delivers expertise to local governments who would otherwise have to cultivate expertise independently. In addition to providing instant expertise, service providers afford adopters the possibility to discontinue an innovation. Without the assistance of service providers it would be necessary for local governments to develop the resources and expertise required to implement an innovation. If local governments invest fewer resources in an innovation they can be more flexible in their use of an innovation. Service providers give local governments the ability to "trial process innovations". Local governments can implement an innovation short-term rather than long-term. As

previously discussed, innovations that can be tested and then discontinued, if necessary, are more likely to be adopted. What is more, local governments have the possibility of learning from the service innovators during the time they pay for the service and then opting out of paying for the service and continuing the innovation independent of the service provider (Bingham, 1976, p. 224).

In the context of climate change and local governments so called “service providers” could be considered those providing guidance and expertise to local governments, such as: ICLEI, the Sierra Cool Cities Program, the Climate Alliance and the C40 Cities Climate Leadership organizations. An example of a service provider in climate change adaptation is the Climate Resilient Communities Program provided under ICLEI. As members of ICLEI local governments acquire instant expertise. ICLEI offers a method with which to approach climate change adaptation in the form of a five-step program (e.g. Five Milestones for Climate Change Adaptation). ICLEI also provides expert assistance in the form of computer software and an adaptation team. Here the climate change organization has supplied the finances, time and effort to develop tools and a method to approach climate change adaptation. The local government is able to avoid the effort of developing a basic approach and tools toward adaptation. A local government also has the opportunity to learn from the membership organization or other local government members. Local governments have the possibility of discontinuing their membership if they are dissatisfied. It is not clear however, whether or not the financial aspect of membership would deter local governments from seeking guidance from ICLEI. Membership fees appear to be reasonable. Yearly fees may be as low as $100 per year for smaller local governments (populations 0-50,000) or as high as $8,000 per year for larger local governments (over 4,000,001 residents) (Local Governments for Sustainability (ICLEI), 1995-2008b). According to Brugger (2015), the U.S. Cooperative Extension System (CES) also has the potential to play an important role in implementation of a national adaptation strategy within the United States. The CES has the potential to aid in implementing adaptation plans at the local level in both urban and rural communities. This may be accomplished by connecting research and local culture, providing knowledge at the local level, evaluating and monitoring and bringing different actors together. A study conducted among counties in rural Arizona found CES to have the potential to mainstream adaptation through a variety of programs operating in rural communities.

In addition to easing adoption of innovations through expertise and assistance of service providers the provision of financial resources can be used to encourage innovation adoption. Limited funding, such as grants, is unlikely to result in long-term changes. However, provision of long-term financial resources has been shown to significantly impact innovation adoption. When financial incentives are committed,

local governments often act in response over a relatively short period of time (Bingham, 1976, p. 223). Moreover, adoption of political innovation may take place as a result of a larger overlapping local government has adopted it free of cost to the lower level governments.

Total resources refer to the resources which a local government possesses. Federal and state governments have the ability to increase or decrease the resources local governments possess in the long-term. If state and federal governments provide financial resources to support a specific innovation in the long-term then local governments are more likely to carry out said innovation. Spillover resources affect whether or not an innovation is adopted as well (Bingham, 1976, p. 225). For example, if a state government were to cultivate climate change expertise and other resources which were made available to local governments, then local governments would be more likely to adopt adaptation measures. In addition to providing professional expertise and resources other obstacles to innovation adoption can be prevented, such as easing bureaucratic processes, suggesting incremental innovations and easing access to information.

When implementing environmental policies local governments often experience bottlenecks at state and federal levels. Policy makers need to consider this problem (Fagerberg, 2006, 2009, p. 14). Where adaptation to climate change is difficult, strategies can be recommended which enable incremental and flexible adaptations within sectors, among communities, and across time (Rosenzwieg et al., 2011a). A survey conducted by the U.S. Government Accountability Office found broad scientific data as opposed to localized data made it difficult for decision makers at federal, state and local levels to justify spending on climate change. Over 50% of respondents believed that the creation of a federal service charged with generating and delivering information to decision makers to inform their adaptation decisions would be helpful (U.S. Government Accountability Office, 2011). Local governments themselves have the ability to work together to overcome barriers. Lubell et al. (2002) found that local government partnerships are likely to occur where few resources exist and that this is an ever increasing problem. Furthermore, local governments similar to one another were more likely to form partnerships. Partnerships are more likely to form among similar units especially where resources are available (e.g. human, social and financial capital from both internal and external sources). However, in order for partnerships to form, opposition must not be too strong (Lubell et al., 2002).

4.3 Development of Hypotheses

As could be gathered from the review of previous research in this chapter, the number of possible influences on the decision conduct planned adaptation to climate change is large. As already discussed, Mohr, 1969's hypothesis relating to motivation (of decision maker), availability of resources and presence of obstacles is used as a heuristic to examine the influence on the decision of local government to conduct planned adaptation to climate change in this study. Simply put it is used as a way to organize hypotheses and scientific inquiry to examine research questions. Krause, 2010 also used this hypothesis to examine the decision of U.S. cities to join MCPA.

Thus, hypotheses are organized by category motivation, resources and obstacles. Specific variables measured for each category were chosen based on previous empirical studies examining adoption of innovations and adoption of climate change policies by local governments. Variables measured were narrowed down based on their ability to be measured and tested in the field and to answer research questions. An online survey is used to collect data in order to measure specific variables; this is described in greater detail in chapter 5 (Methodology). In chapter 5 an additional table is provided describing research questions and corresponding survey questions as well as hypotheses. Results of hypothesis testing are presented in detail in chapters 7 and 8 and synthesized in chapter 9. Beyond discussion of hypotheses general observations are also discussed in the conclusion chapter 9. For example, general observations are discussed such as the level of planned adaptation taking place and how this relates to effort generally required to adopt a new policy, the influence of local government understanding of climate change and local government perception of their role in planned adaptation, and the effect of proximity to of those already conducting planned adaptation on those not yet conducting planned adaptation.

Origin of Hypotheses Tested

RESEARCH QUESTION 1 **"Are local governments in New York State adapting to climate change?"**	**How were hypotheses derived for research question 1?**
HYPOTHESIS I: The majority of local governments are not conducting planned adaptation to climate change.	This hypothesis is based on a review of federal and state actions to encourage climate change adaptation. As discussed in chapter 3, federal legislation and funding has largely been

	focused on mitigating greenhouse gases rather than adapting to climate change. Strong climate change legislation requiring congressional approval i.e. more than approval from the president has remained impossible. Climate change policies at the state level have also been focused on mitigation greenhouse gas emissions, and in addition vary greatly across the U.S. indicating that a lack of support for local governments to conduct planned adaptation exits in the U.S. Finally, field work conducted in New York State before the survey was conducted indicated there was little to no planned adaptation taking place outside of New York City (lack of discussion concerning adaptation, lack of programs focused on adaptation, lack of adaptation plans originating from local governments).
HYPOTHESIS II: Local governments with large populations are more likely to conduct planned adaptation than local governments with small populations	Influence of Size on Decision to Adapt: This hypothesis was derived based on previous research conducted which found organizational size to be strongly related to availability of resources and thus the likelihood of adopting a new policy or practice discussed in chapter 4 (Mohr, 1969; Brudney, 1995; Fagerberg 2006 & 2009). The effect of size on the likelihood of adoption of greenhouse gas mitigation policies has also been found in the U.S. among cities (Vasi, 2006). Krause (2010) also found that larger local governments (who presumably would have access to greater financial resources) were more likely to join climate change mitigation organizations. (Specific variables measured in online survey: population, urban vs. rural)

RESEARCH QUESTION 2 **"What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?"**	**How were hypotheses derived for research question 2?** Mohr, 1969 developed a hypothesis to examine innovation adoption. Krause, 2010 used this hypothesis to examine the decision of U.S. cities to join MCPA. In this dissertation it is used as a heuristic to examine the decision of local governments to adopt planned adaptation to climate change and adapted as such, "adoption of planned adaptation is influenced by motivation of local elected official, obstacles present which are in opposition to planned adaptation and the availability of resources to overcome obstacles to planned adaptation". Where applicable additional empirical studies were used to identify specific variables which were measured using the online survey.
HYPOTHESIS I: Local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments spontaneously adapting	Decision-Maker/Elected Official Motivation to Conduct Planned Adaptation: Mohr, 1969 found adoption of new policies or practices are influenced by decision-maker motivation. Mohr's suggestion has been corroborated by further research conducted at both the state and local levels, which found the perceived need for adoption of a new policy by decision makers to affect innovation adoption (Damanpour 2008; Fagerberg 2006, 2009; Walker, 1969). In terms of climate change adaptation, motivation to conduct planned adaptation has been linked to extreme weather at local (Field et al., 2012) as well as national levels (Massey et al., 2014; Amundsen et al., 2007; Biesbroek et al., 2013) (Specific variables measured in online survey: extreme weather, ecosystem changes).

HYPOTHESIS II: Local governments perceiving existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change than local governments spontaneously adapting	Availability of Resources to Conduct Planned Adaptation: Mohr, 1969 found availability of resources affects the decision to adopt a new innovation. Mohr found resource constraints such as expertise and specialized training to be the strongest predictors of innovation adoption (Mohr, 1969). A lack of expertise and competence has been cited as a barrier toward planned adaptation (Amundsen et al., 2007; Baker et al., 2012; Mozumder et al., 2011). Certain resources and skills are required for implementation of innovations to occur (Moser, 2010) but can also effect whether or not the decision is made to implement adaptation measures (Grothmann, 2005). This hypothesis is used to measure the resources available within a local government to conduct planned adaptation. Lubell et al. (2009) found a greater likelihood of environmentally sustainable policies to exist within communities with financial resources and a higher social-economic status. Large cities have been found to be more likely to adopt energy and climate change mitigation policies than smaller cities as smaller cities often require substantial technical, financial and planning assistance (Vasi, 2006). (Specific variables measures in online survey: budget, staff, climate change expertise).
HYPOTHESIS III: Local governments perceiving the existence of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change	Presence of Obstacles toward Planned Adaptation: Mohr, 1969 found the presence of obstacles external to organizations to inhibit innovation adoption. Historically, research has shown availability of resources such as financial assistance, equipment and expertise from other

	governmental levels influence innovation adoption at the local government level (Bingham, 1976). The lack of financial, educational and administrative support for climate change measures has been shown to make it difficult for local governments to act on both climate change mitigation and adaptation (Betsill 2001; Mozumder et al., 2011). A lack of external support to conduct planned adaptation may be seen as a barrier for local governments interested in adapting to climate change. Betsill (2001) found availability of resources such as funding, equipment and expertise from state and federal levels to affect the decision of local governments in the U.S. to adopt mitigation measures. This dissertation expands on the work of Mohr and Betsill by examining whether or not the perception of external support effects the decision of local governments to conduct planned adaptation to climate change. (Specific variables measured in online survey: state financial, federal financial, general public, state informational and federal informational support).

Table 1: Origin of Hypotheses and Specific Variables Tested
(Source: Author's Illustration, Specific Sources of Hypotheses Listed in Table)

5 Research Methodology

In this chapter, the research and study design used to address research questions and test hypotheses are presented. More specifically, the rationale for choosing the research design, data collection/survey design, measurement of research concepts (i.e. planned and spontaneous adaptation, influences on adaptation decision making), quality of survey questions (i.e. clarity, understandability) and strengths and weaknesses of research design are discussed. Lastly, the sample is defined and the process of data collection and analysis are described.

5.1 Use of a Traditional Deductive Research Design

The main research design in terms of the online survey conducted is a traditional deductive approach. Explicitly, hypotheses are generated based on theory and previous research and tested resulting in theory revision (in the case of this research expansion) (Bryman, 2004). Here, previous research on the decision of local governments to adopt a new practice or policy was examined resulting in hypotheses which were tested using the data collected. A cross-sectional research design was employed to collect data. That is, local government opinions were collected at the end of 2011 (one period in time) in order to "understand behavior and the meaning of that behavior within its specific social context" (Bryman, 2004, p. 27). In this research study, data was collected to examine local government official opinions to better understand the decision of local governments to conduct planned adaptation to climate change (or not). As with many cross-sectional research designs, survey research was used to examine variation among the sample. Typically quantitative data or quantifiable data is used to create a systematic or standardized method to identify this variation among the sample (Bryman, 2004, p. 42). Patterns of association are identified using cross-sectional research because it is not possible to identify models of causation as variables are collected at one period of time (Bryman, 2004). Cross-sectional research has been criticized because it is limited in examining how variables change overtime (See: Berry, 1999) but still remains one of the most practical methodologies in terms of resource and time constraints (it should be noted that longitudinal approaches pose their own limitations that threaten internal validity, due to the very nature of evaluating variable over time, including changes in history/social/cultural factors, tracking participants, and self-selection biases through attrition). The primary tool employed to address research questions in the present study was an online survey. However, other supplementary methods of data collection were employed, such as informant discussions and document analysis. Even though the survey data was collected at one period of time, subsequent informant discussions occurred at various points in time between 2010 and 2015. Efforts to establish and maintain contact in the field of study (New York State) were

taken early on in the research process. Informant discussions were conducted via telephone, e-mail and in-person and used as a means to aid in answering research questions, generating hypotheses, obtaining research materials and to better understand the study area and survey results. Furthermore, contact with New York States' Climate Smart Communities Program[9] (CSC) has been useful to gauge how conditions for local governments have changed since the survey was conducted (i.e. end of 2011 vs. 2015).

Research Design Rationale

The research methods are based on consideration of the research needs as recommended by Bryman (2004). Firstly, the limited in-person data collection time (1 year) and the challenge of conducting research on New York State from Germany presented a need to collect data in a time efficient manner making the option to conduct longitudinal research or to collect data multiple times difficult. Secondly, the nature of the research questions, such as the inclusion of all local governments and local government types in New York State in order to identify variation among the sample, presented the need to collect many responses. The best way to employ this research method was found to be an online survey.

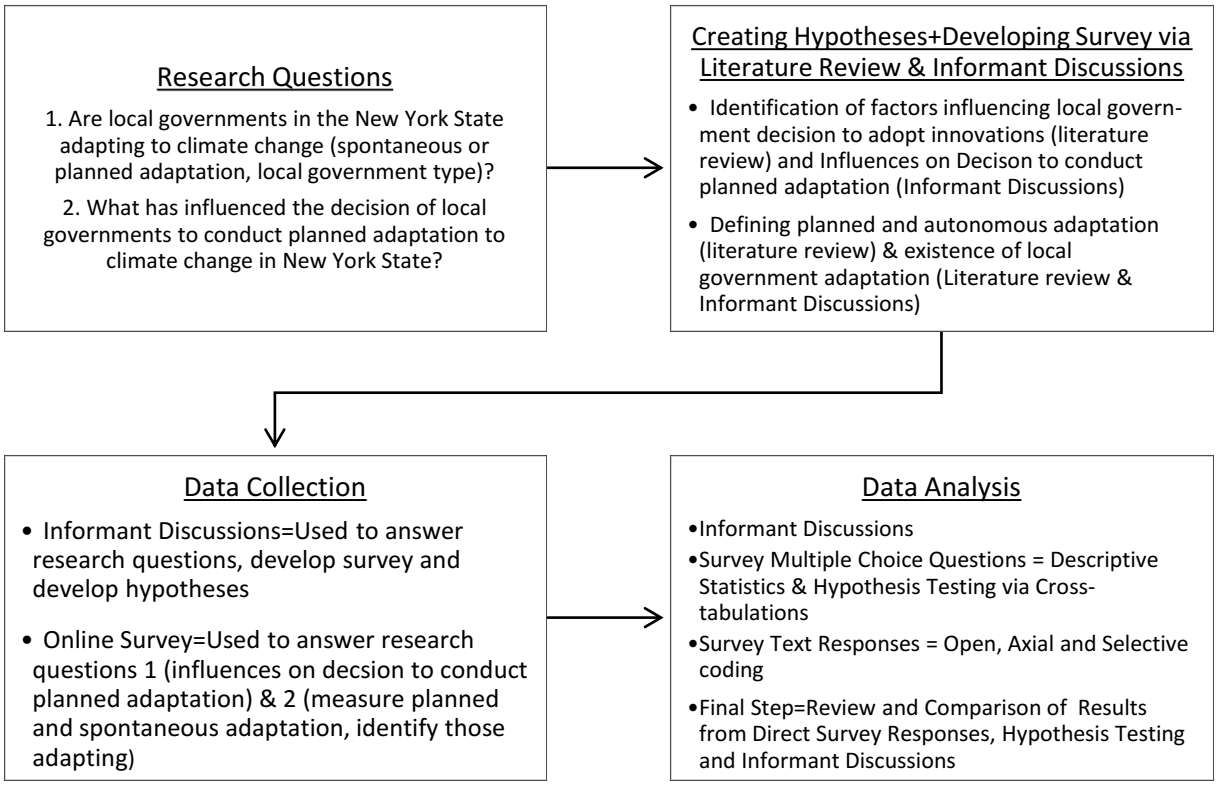

Figure 9: Study Design
(Source: Author's Illustration)

[9] CLIMATE SMART COMMUNITIES IS A VOLUNTARY PROGRAM OPERATED BY NEW YORK STATE AND DESIGNED TO GUIDE LOCAL GOVERNMENTS IN MITIGATING AND ADAPTING TO CLIMATE CHANGE , THE PROGRAM IS DISCUSSED IN MORE DETAIL IN CHAPTER 6.

5.1.1 Data Collection via Survey (and supplementary methods)

Survey Data

The main instrument used to collect data was an online survey. The process of creating the survey was based on the work of Dunn (2009)[10] where sequential steps are taken until a final draft is completed. After solidifying the topic and determining the instrument type, the initial draft of the survey was created. Survey questions were designed to answer all research questions and hypotheses (see chart at the end of this section). The survey was improved based on two rounds of feedback provided by advisors, peers and experts in the field. The design of the survey took place from early-2011 until mid-2011.

Informant Discussions

In addition to conducting the survey a series of informant discussions via telephone, e-mail, or in-person took place. Results of the discussions were recorded via paper pencil during discussions and digitally recorded. In addition to the survey and informant discussions one focus group was conducted in Albany, New York. Data at that point was recorded and notes were taken as well. Unfortunately, there was a malfunction with the recording device and the data from audio file was lost. The hand-written notes were used in this case.

Telephone discussions were conducted with individuals both in New York State and in the Northeast United States with sustainability and climate experts. This proved to be extremely valuable throughout the research process in terms of gaining access to local government e-mail addresses, gaining further contacts and climate change reports as well as understanding the general political atmosphere in terms of climate change adaptation in the U.S. and Northeast.

Four individual pair or individual discussions were conducted to get a realistic perspective of what, if anything was being done in the State of New York to adapt to climate change. As previous attempts to find significant action in the state toward climate change action (other than New York City) was difficult to determine via web searches. Telephone calls, web searches and networking resulted in meeting with individuals from the New York State Division of Coastal Resources as well as individuals from a university-based program, Sea Grant New York, a cooperative program with the State University of New York and Cornell University. Furthermore,

[10] He identified 6 steps in executing a questionnaire or survey study including identify topic and, if necessary, define a sample, determine type of instrument, draft initial survey and ask peers and professionals to critique it, pilot test the survey a few people, use their feedback to improve question clarity and revise survey, administer survey to intended group or sample (s) and code and analyze data.

in an attempt to further understand the environment that local governments are working in, further discussions with an Environmental Policy Professor (telephone), a city Sustainability Coordinator (telephone) and a Fisheries Specialist (in-person) in New York State were conducted.

A variety of input was given, including suggestions for the survey introduction, re-wording of questions, expansion of response options and question order. Additionally, informants suggested further contacts in the state and additional sources of climate change information. Informants provided insight into the level of local government climate change adaptation, whether or not spontaneous or planned adaptation was taking place and possible factors influencing the decision of New York State governments to conduct planned adaptation to climate change.

Focus groups are often used as a way to gain a more realistic perspective of the research field, generate hypotheses based on informant insights and aid in development of the survey (Flick, 2009). For that reason, a focus group was carried out on August 18, 2011 at the New York State Department of Environmental Conservation in Albany, New York. In the focus group a paper copy of the survey was reviewed again for content and wording. In addition, participants were asked questions relating to adaption taking place in New York State and their experience with local governments and climate change.

Measuring Influences on Decision to Conduct Planned Adaptation

In order to examine the influences on the decision of local governments to conduct planned adaptation to climate change in New York State (i.e. motivation, deterrents) certain variables had to be measured based on the literature review and hypotheses. Local government opinions regarding climate change concern (e.g. extreme weather, ecosystem changes) and availability of internal and external resources needed to be measured.

To identify influences on the decision to conduct planned adaptation among the entire sample respondents were asked whether or not support existed for local governments looking to address climate change impacts from the public, state and federal levels (i.e. both financial and informational). Additionally, respondents were asked regardless of their current or future plans to address climate change if their local government had the internal resources to address climate change impacts (i.e. budget, staff, and expertise). Lastly, both respondents indicating they were addressing climate change impacts and those that said they were not addressing climate change impacts were asked directly what motivated their decision.

Research conducted examining adoption of environmental policies, new polices or practices in general among local governments were used to identify the possible

factors influencing local government decision makers. A few studies were available which examined adoption of mitigation policies among local governments in the U.S. These were used to develop the survey as well. Response options for survey questions dealing with drivers or deterrents of adaptation were based on mitigation research from Betsill (2007, 2001), Vasi (2006) and Warden (2007). This section, thus, describes the concepts that were utilized to measure the key research questions (spontaneous adaptation, planned adaptation and influences on the decision to conduct planned adaptation) in the survey. The next section reviews other aspects considered in the survey design.

Measuring Planned and Spontaneous Adaptation

The second research question was as follows: "*Are local governments in the New York State adapting to climate change?"* A. Is adaptation to climate change taking place? If so, then…B. What types of governments are adapting (e.g. towns, villages, cities/large or small)? C. Is adaptation taking place intentionally or spontaneously (planned vs. spontaneous adaptation)?

Dealing with adaptation was a challenge to measure because the concept of climate change adaptation is complex. In this dissertation it was decided to examine both planned and spontaneous adaptation. These terms needed to be operationalized and then measured within the survey. Measuring planned adaptation in the survey was not as difficult as measuring spontaneous adaptation. With planned adaptation respondents could be asked directly if they were taking measures to adapt to climate change because it was assumed they were aware of the concept of climate change. Asking respondents about spontaneous adaptation was more of a challenge because it was assumed respondents were not consciously addressing climate change in this case. Because there has been very little research examining climate change adaptation among local governments in the U.S. there were few resources to guide adaptation measurement in the survey. Surveys conducted in the Northeastern U.S and New York State was used as a guide where possible to create the survey (see: Clean Air-Cool Planet, 2011; Institute, 2011).

Spontaneous adaptation was measured in the survey by considering adaptation actions local governments could be taking to reduce their vulnerability toward current and future climate change impacts. Due to the fact that New York is a "home rule" state, local governments have a wide range of actions available to them which could be used to spontaneously react to climate change. Current and future climate change impacts in New York State were considered in conjunction with possible local government actions to address those impacts. Climate change reports specific to the Northeast and New York State were used to identify the climate change impacts expected in New York State as well as actions available to local governments to

reduce vulnerability (see: Authority, 2010; Thoman et al., 2010; Field et al., 2007). Respondents were asked if they were taking the identified measures. The measures were not identified in the survey as aiding in reducing climate change vulnerability instead they were paired with impacts such as flooding, heat waves and wildfires.

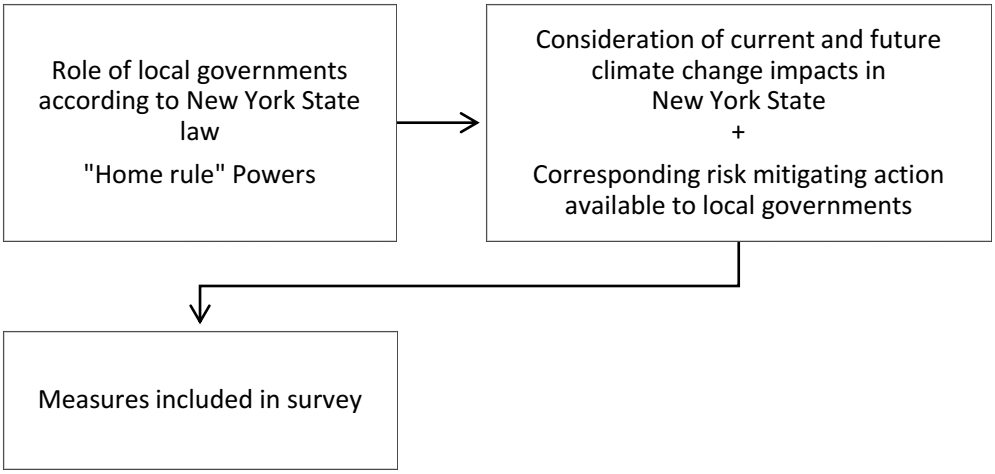

Figure 10: Measuring Spontaneous Adaptation in Online Survey
(Source: Author's Illustration)

For example, respondents were asked whether or not their local government was taking actions to upgrade storm water infrastructure and to promote healthy forests and functional watersheds to decrease flooding damage. Additionally, respondents were asked if their local government conducted community outreach by providing wildfire, heat wave, flooding and infectious borne disease education. Lastly, respondents were asked whether or not they were addressing public health through provision of access to cooling centers during high temperature day, healthcare access during storm emergencies and managing the spread of disease and air quality. Responses to these questions provide an overview of the actions already being taken by New York local governments which may aid in reducing current and future climate change impacts.

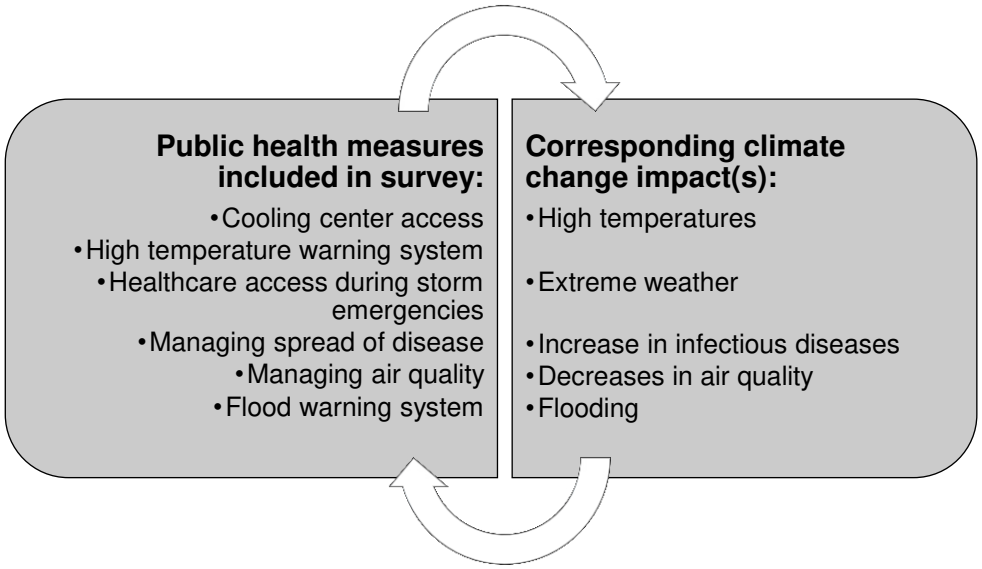

Figure 11: Sample Pairing of Possible Adaptation Actions with Corresponding Climate Change Impacts
(Source: Author's Illustration)

Measuring Planned Adaptation

RQ 1: Beyond measuring spontaneous adaptation among the sample planned adaptation was measured as well. That is, local government were asked explicitly whether or not they were taking actions to address climate change impacts and asked to elaborate on those actions.

As previously discussed a simplified model of the adaptation process is used in this study to measure local government stage of planned adaptation based on Moser (2010) and the Five Milestones for Adaptation developed by ICLEI (1995-2012b). The "monitor option" or "monitor re-evaluate resiliency" phases included in both previous models are not included as it is beyond the scope of this study in terms of time. The four stages measured in the survey (i.e. 1. detect climate change as a problem, 2. identify vulnerability and possible benefits to climate change, 3. create a climate preparedness plan, and 4. implement a climate preparedness plan) were intended to span Moser's phases of understanding, planning and the beginning stage of managing.

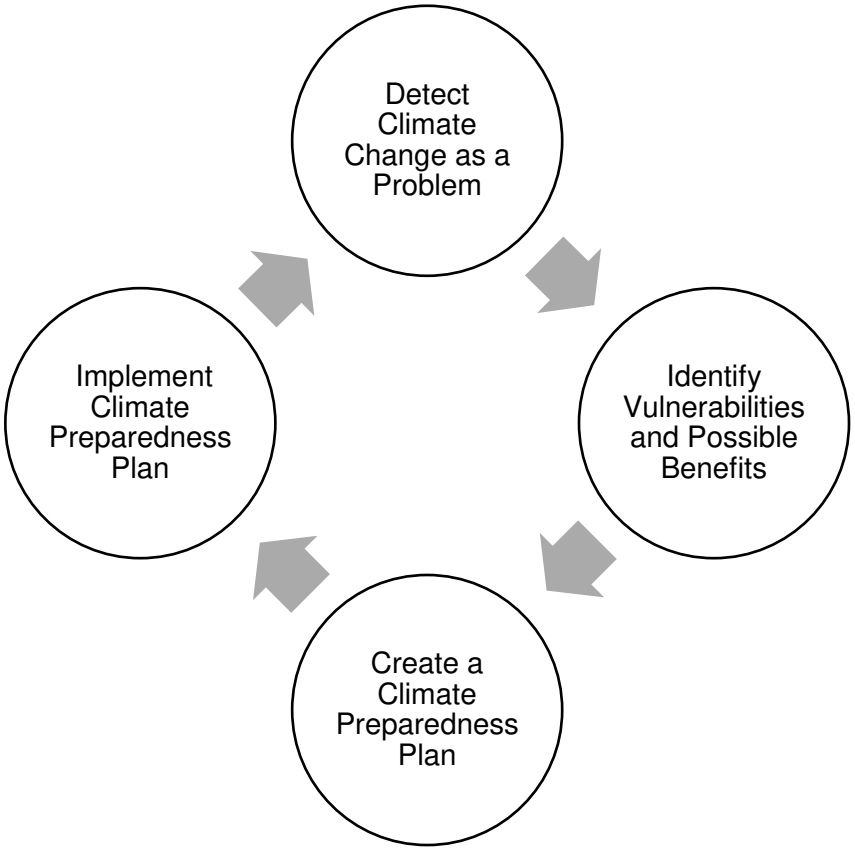

Figure 12: Modified Adaptation Process
(Source: Author's Illustration Adapted from: Moser, 2010 and ICLEI, 1995-2012b)

Respondents were asked a series of questions in order to identify the adaptation stage of their local government. In order to identify whether or not local governments had detected climate change as a problem respondents were asked whether or not formal discussions had taken place regarding climate change impacts. This is considered the first step in the adaptation process and is within the understanding phase of the adaptation process (Moser, 2010). To identify whether or not local governments had taken steps to identify vulnerabilities and possible benefits due to changes in climate respondents were asked another series of questions. First, respondents were asked directly whether or not their local government was explicitly taking actions to address climate change impacts. Then, where respondents indicated yes, they were asked questions relating to identification of vulnerability (i.e. climate impact assessment, infrastructure vulnerability assessment, invasive species, floodplain map updates) and anticipated benefits (i.e. increases in summer recreation, tourism or increases in certain fish populations or agriculture). Here, the intent was to understand whether or not local governments are attempting to gather and use information in order to define the problem of climate change for their local government. Finally, the planning stage was measured. In this phase local governments develop, assess and select options to address their vulnerabilities to

climate change (Moser, 2010). Respondents were asked whether or not their local government was in the process of creating, finishing or implementing a climate preparedness plan. Respondents were also asked if instead of creating a separate climate preparedness plan they were integrating preparedness measures into other plans. After discussing the measurement of both spontaneous and planned adaptation in the survey, in the following section measurement of influences on the decision to conduct planned adaptation will be discussed.

Research Question	Corresponding Survey Question (See Survey in Appendix)	Corresponding Hypotheses
1) Are local governments in the New York State adapting to climate change?		
A. **Is adaptation to climate change taking place?**	**6*,7*,8*** Identifying spontaneous adaptation, **9*** Identifying formal or informal discussion of climate change, **10*** Identifying planned adaptation,**14*** Identifying stage of adaptation planning and **15*** Identifying measures conducted to gauge vulnerabilities	**Hypothesis I:** The majority of local governments are not conducting planned adaptation to climate change
B. **What types of governments are adapting (e.g. towns, villages, cities/ large or small, etc.)?**	**4** coastal versus in-land, **18** climate change organization membership, **20** county, **21** urban, rural or suburban, **22** responsible individual for climate change, **23** government type, **24** population	**Hypothesis II:** Local governments with large populations are more likely to conduct planned adaptation than local governments with small populations (Specific variables population, urban versus rural).
C. **Is adaptation planned or spontaneous?**	**6*,7*,8*** Identifying spontaneous adaptation, **9*** Identifying formal or informal discussion of climate change, **10*** Identifying planned adaptation,**14*** Identifying stage of adaptation planning and **15*** Identifying measures conducted to gauge vulnerabilities	

2) What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?		
A. **What has motivated local governments to conduct planned adaptation to climate change?**	**1,2,3,5**-ranking concern climate change impacts, **12** Directly asking why conducting planned adaptation, **13** External influences, **16** Identifying perceived benefits to climate change, **17*** Perception of public, state and federal support to conduct adaptation measures, **19*** Internal resources and **27*** open response	**Hypothesis I:** Local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments spontaneously adapting. **Hypothesis II:** Local governments perceiving existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change than local governments spontaneously adapting. (specific variables: budget, staff, expertise) **Hypothesis III:** Local governments perceiving the existence of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change (specific variables: state financial, federal financial, general public, state informational and federal informational support).
B. **What has deterred local governments to conduct planned adaptation to climate change?**	**11** directly asking why no planned adaptation **17*** Perception of public, state and federal support to conduct adaptation measures, **19*** internal resources, **27*** open response	**Hypotheses I & II** also apply here.

Table 2: Research Questions with Corresponding Survey Questions and Hypotheses (Source: Author's Illustration)

Further Survey Design Considerations

After considering research design and measurement of research concepts, survey questions and the overall survey design were reviewed. A number of aspects were considered, such as content, clarity, shared meaning, question length and phrasing, question order, flexibility of the survey and survey length. The purpose here was to increase the chances of high quality responses to address research questions.

As recommended by Dunn (2009), care was taken to ensure content, clarity and shared meaning within the survey. The content of the survey was reviewed to make certain research questions were being addressed and any unnecessary questions were removed. Survey questions were also reviewed for clarity[11] and shared meaning[12]; this meant examining questions for local government understandability. This was accomplished by examining first drafts of the survey to identify scientific or field specific jargon and replace them with terms more familiar to local governments. Two terms could not be avoided - adaptation and mitigation were defined in the introduction to the survey. Feedback on survey drafts was especially helpful in identifying unclear wording or questions especially from New York State. Finally, consideration of question order[13] and its possible influence on survey responses took place.

One example of where question order could have impacted responses is in presenting questions regarding the actions being taken to address flooding, heat waves, heavy winds and other extreme conditions before questions regarding concern about specific climate change impacts. This was avoided by placing concern related questions toward the beginning of the survey. It has also been recommended to guide into sensitive subjects slowly (Dunn, 2009).

As climate change is a politically polarized topic, especially in the United States, an effort was made not to immediately start with it as a topic at the beginning of the survey; this was done in order to avoid question reactivity. The survey begins with questions about concern of the current and predicted climate changes in New York State (without calling them climate change impacts) and then moves toward questions addressing the types of measures local governments are already taking to address flooding, public outreach and public health, which are considered actions of spontaneous adaptation in this study. In the climate adaptation survey respondents were not directly asked about climate change until they had reached the 9th survey question where they were asked whether or not their local government was taking measures to address climate change impacts.

[11] CLARITY REFERS TO SURVEY QUESTIONS WRITTEN IN SIMPLE, PLAIN AND FAMILIAR TERMS (DUNN, 2009).

[12] SHARED MEANING REFERS TO RESPONDENT INTERPRETATION OF SURVEY QUESTIONS AS INTENTED BY RESEARCHER (DUNN, 2009).

[13] QUESTION ORDER MAY RESULT IN "LITERAL" AND "CONTEXTUAL" EFFECTS ON RESPONSES (DUNN, 2009).

Survey Content Order

- Concern regarding severe weather, ecological change and other impacts
- Measures taken to address flooding, public health, public outreach
- Drivers & resisters toward adaptation
- More detailed planning questions (for respondents indicating local government conducting planned adaptation)
- Internal and external drivers/resisters
- Structural/demographic
- Consent
- Participant option to obtain survey results
- Further comments

As well as consideration of question understandability and contextual effects of question order, boredom of respondents was considered as one factor with the possibility to decrease response rates. For instance, the placement of demographic questions at the beginning of a survey has been found to bore respondents and result in fewer response rates (Dunn, 2009). To avoid this, demographic type questions were placed at the end of the survey. To further reduce the likelihood of respondent drop-out, survey questions were eliminated where uncertainty existed as to whether or not respondents would know the answer. For example, a group of questions examining experience with extreme weather impacts within the last 10 years was removed because it was not clear whether or not - either because of memory or length of employment with the municipality - participants would be able to recall their experiences. Survey questions were examined based on their importance in answering research questions and were removed where appropriate. A final consideration of the survey design was flexibility of the instrument in terms of the range of responses.

Further steps were taken in order to ensure the survey was not too inflexible. In light of the fact response options provided in the survey could be geared more toward mitigation and lack adaptation related response options an effort was taken towards a “flexible” instrument. To ensure respondents were not forced to answer one way or the other, most survey questions were not required. In addition, almost all survey questions contained an “I don’t know”, “not applicable” or “other” response option. This gave respondents the opportunity to show they were uncertain if they were, to indicate a specific question did not apply to their situation or to provide a response that was not included in the survey question. There were just a few exceptions where respondents were forced to respond in order to proceed through the survey. For

instance questions used to measure dependent variables and gain informed consent were required. One of the final considerations before administering the survey concerned its length and completion time. Each of these is important to minimize response biases found when surveys are too long.

5.1.2 Strengths and Weaknesses of Research Design

As this study is conducted in the "real world" as opposed to a laboratory or simulated setting, the external validity is said to be good. On the other hand, as research is conducted in the "real world" controlling variables is more challenging than in laboratory settings which can threaten internal validity. One additional concern with this study is measurement validity or the quality of the instrument used to measure research concepts. While care has been taken to measure concepts in the survey, because the research topic is relatively novel, the measurement of these concepts has not been rigorously tested (Bryman, 2004). Although the concepts such as planned and spontaneous adaptation as measurements have not been rigorously tested, in this study the design of the survey has been strengthened via informant discussions both in and outside the State of New York, which at least provides an element of face validity.

Defining the sample

New York State includes 723 towns, 62 cities, 554 villages and 62 counties. Because the opinions of each of these geographical distinctions are important to understanding the research questions, attempts were made to include as many as possible in this study. The method chosen to distribute the online survey was via elected official e-mail addresses. The introduction to the survey was addressed to the local elected official explaining the purpose of the research and what was being asked of them. Local elected officials were selected as the contact person because climate initiatives are often initiated by them (Pitt, 2009). An e-mail was sent to the highest ranking elected official on October 13, 2011. The highest ranking elected official varied according to municipality type, for example, sometimes the survey was distributed to a town supervisor, village supervisor, city mayor or county supervisor. According to one informant discussion there is a large number of small local governments (200-300) with no viable e-mail addresses (Telephone Informant Discussion /Policy Analyst, New York State, March, 2011). Thus, where local governments had no viable e-mail address they had no chance of participating in the survey.

Participation Incentives

As monetary or other types of incentives were not deemed appropriate for local government officials, along the fact they could potentially create a response bias, they were not provided to participants. The opportunity to obtain results of the study as a participant was the sole incentive offered to participants, in addition to the satisfaction of contributing to the furthering of science and potentially improving climate change policies aimed toward local governments.

Informed consent

Before beginning the survey participants were informed about survey content and their consent would be needed to use their responses as part of a research study. As suggested by Dunn (2009) consent was placed at the end of the survey. This was done to allow participants to consent to their responses being used only after being fully aware of the types of responses they were providing.

Conducting the Online Survey

A number of available online survey software programs were reviewed for their practicality, usability, price, use in sciences, and exportability to SPSS or excel. Survey Monkey was chosen as the program of choice and purchased for one year from March 2011 until March 2012.

Survey Monkey was chosen as the best software option because of its export capabilities, data analysis tools, unlimited invitations to take the survey and because it was available in English unlike some of the popular survey programs used in Germany. Use of this program made it easy to collect data in New York State from Germany. Respondent e-mail addresses were uploaded to survey monkey and all correspondence took place there. Data was collected and stored using survey monkey and exported regularly as an excel spreadsheet or statistics for the social sciences file.

The survey was administered on October 13, 2011 and followed by a series of reminders on October 26, November 21, and November 30. There is a larger time lapse between the first distribution of the survey and the first reminder as a result of the U.S. local elections on November 9, 2011. It was thought local governments would not have time to respond to the survey during this time period. A final reminder was sent December 12 to participants indicating the survey would end December 16, 2011.

5.2 Analysis of Survey (And Other Data)

Online Survey

Much of the data collected from the survey was used in a descriptive way to address research questions. Simple percentages and sums were used to describe planned and spontaneous adaptation of the sample. The survey data was also used to describe the opinions of respondents concerning the obstacles and resources available to address climate change impacts. In the case that respondents indicated they were addressing climate change impacts the actions they were taking to plan for adaptation and assess vulnerabilities toward climate change were also described. The survey data was used to describe the opinions from the sample on what influenced their decision to address climate change impacts or not. Finally, characteristics of the respondents and the local government they work for were described. Beyond describing responses using percentages and sums cross-tabulation tables were used to test hypotheses.

Cross tabulations are used to examine the dependent variable and its relationship to some independent variable (De Vaus, 2007). Two dependent variables were measured in the survey: (1) planned adaptation and (2) discussion of climate change. In most cases both dependent variables were used to test hypotheses (described more in chapter 9). Independent variables measured were, for example, concern regarding climate change impacts, perception of resources and obstacles to climate change adaptation.

The survey data collected was stored by the online survey program, survey monkey. The data was then exported to SPSS for recoding and data analysis. Before hypotheses could be tested, a considerable amount of recoding was needed. Recoding entailed reversing Likert scales that had been reverse-keyed (5-1 instead of 1-5). Where there were not enough responses to analyze data, response categories had to be collapsed. For example, respondents were asked whether or not their local government had the budget to address climate change impacts and given three response options: “yes”, “no” and “some”. In some cases there were too few responses in each category to use cross-tabulations. Therefore, the categories “yes” and “some” were collapsed resulting in just two response categories, “yes” or “no”, and enough responses to analyze the data. In other cases there were missing values, for example zeros were not in place where they should have been and had to be added afterwards.

Statistical significance for the cross-tabulation tables was tested using either the Fisher’s exact test or the Chi-square depending on the resulting cross-tabulation cell sizes. Relationships were considered to be significant or likely to be occurring in the population at all levels below .05. This means, where relationships between variables

are deemed to be significant, there is a 95% (1-.05=.95, 95%) chance the relationship exists among the population and a 5% chance of not being true. Significance levels are reported along with cross-tabulations in the results section. In addition to using simple percentages and sums to describe data and cross-tabulations to test hypotheses, open-ended and other response options were analyzed using qualitative data approaches.

Survey Text Responses

There were many opportunities for respondents to add to the response options provided to them. Most survey questions contained a response option “other” where respondents could type a response that was not provided. An opportunity was also provided at the end of the survey for respondents to comment. These “other” and open-ended survey questions resulted in a good deal of text which needed to be analyzed. The approach taken to analyze these questions, as suggested by Gaunt (2012), is qualitative.

The coding of qualitative data involves three steps: open-coding, axial coding and selective coding (Burnett, 2009, p. 191). Open-coding entails identifying categories interactions or topics. To do this, a table was created for each survey question. The text responses were added to the table in one column and topics identified in another column. The second and the third step in coding of qualitative data is axial coding (i.e. making connections between various coding categories) and selective coding (i.e. revisiting original data and reviewing) to identify the most useful pieces of data which are selected for further work (Burnett, 2009, p. 191). The last two steps were conducted by creating a summary of the topics identified in a separate cell. A sample of the qualitative data coding is shown below. The final step in the process included reviewing the response categories and number of responses in each category and providing a written summary.

Open-ended Responses	**Topic Identified**
Investigate 'rip-rap' along river and streams	Other measure: addressing river and stream erosion
Not allowed. State Tax Cap.	Jurisdictional conflict
replacement of lines	Other measure: updating infrastructure
joint effort with NYCDEP and NYSDEC on Esopus Creek	Other measure: Networking to address flooding
Summary of Open-ended Responses:	3 other measures 1 jurisdictional conflict

Table 3: Sample of Qualitative Data Coding of Open-Ended Survey Questions (Source: Author’s Illustration)

Informant Discussions

Hand written notes were taken during informant discussions. Following informant discussion the text was separated into categories based on the research question(s) addressed. The text was sorted according to research question address and then sorted further into subcategories. For example, text associated with research question two examining the influences on the decision to adapt was sorted based on specific area address: resources, obstacles and motivation. Finally, the text was broken down into further subcategories (e.g. resources=staff, budget, expertise, obstacles=, motivation=). After examining the informant data a written summary of responses was completed.

6 Overview of Study Area: New York State

New York State is an interesting and important study area as it has been a leader in addressing climate change both at the state and local levels. As related to climate change mitigation, New York State has been the first U.S. State to develop an emissions trading program. At the local government level New York City has been a leader in climate change adaptation both nationally and internationally. New York City, located in New York State, is one of the most progressive cities world-wide having gained national and international attention for their city-wide comprehensive plan addressing both mitigation and adaptation to climate change. However, New York City is the city with the largest population in the United States and represents almost half of the population of the State of New York. It is sometimes overlooked that, at the same time, there is a large number of local governments located throughout New York State in which very little is known about their experiences with climate change. They are sharing a state with New York City but how do their experiences differ? What kinds of challenges do other types of municipalities face (e.g. towns, villages, counties)? How do local governments with limited staff and budgets perceive their ability to adapt to climate change? The experiences that have occurred in New York State attempting to address climate change may be interesting to others trying to implement climate change policies on a broad scale, such as state and federal governments.

Figure 13: Physical Features of New York State
(Source: Author's Illustration)

General Overview of New York State

Historically, New York State has been considered to be an innovator in policy adoption which has been said to be explained by its good relations to New England, Mid-Atlantic and Great Lakes States (Walker, 1969, p. 893). The geographic location and physical size of New York State are what makes it unique in comparison to other U.S. States and what may explain the states' tendency to be a leader in policy development. New York is located in the Northeastern United States and has a number of neighboring entities. Neighbors include domestically the states of Connecticut, Massachusetts, New Jersey, Pennsylvania, Rhode Island and Vermont and one international neighboring country, Canada. The state is vast, encompassing 127,515 square kilometers (47,126.4 square miles) and containing 19,378,102 inhabitants (United States Census Bureau, 2010a). These characteristics make New York an important player in bringing the region together to tackle the problem of climate change. The experiences that have occurred in New York State attempting to address climate change may be interesting to others trying to implement climate change policies. The vast majority of voters in New York City are democrats indicating that other areas of the state tend to be more republican which is likely to impact on interest and acceptance of addressing climate change. New York State as a whole contained 5,649,934 registered Democrats and 2,654,481 registered Republicans, while New York City as of April 2012 had 2,979,896 registered Democrat and 485,872 Republican voters (New York State Board of Elections, 2012).

New York City could be seen as an exemplar in addressing climate change for both national and international local governments. However, as New York City is atypical in terms of population size and resources, the experiences there in addressing climate change may not transfer well to smaller local governments. There is a stark dissimilarity between New York City and the remainder of New York State.

Rural New York State

Population growth in the state has been isolated to New York City and neighboring (i.e. Long Island and Mid-Hudson) regions. On the other hand, the majority of the state, specifically western New York and the Mohawk Valley regions, have lost population. As of 2000, 16 of 61 cities in New York State had larger populations than in 1960. The majority of cities in New York State have experienced a 30% decline in population (Division of Local Government Services & Economic Development, Date Unknown). What is more, unlike New York City, much of the state is rural and experiencing growing poverty. Forty-four of New York State's 62 counties are rural with almost 15% of the population living in poverty (New York State Office for the Aging, Date unknown, p. 4).

The actual number of people living in rural areas in New York State is 1,508,228 as compared to 16,049,937 in urban areas (Economic Research Service, 2011). Equitable or fair adaptation to climate change throughout New York State will undoubtedly depend on the ability of local governments to protect their citizens from negative climate change impacts. The vulnerability of citizens to climate change as well as the ability of local governments to adapt to climate change varies throughout New York State. Rural regions are often some of the most vulnerable to climate change and possess fewer resources compared to urban counterparts.

Image 1: Mobile Home Housing in New York State
(Source: Photo Taken by Author, New York State, 2015)

Half of the counties in New York State are rural comprising 92% of the land area and 22% of the population. That is, over four million New Yorkers live in rural counties. These rural areas often face lower income levels, ageing infrastructure and higher home ownership rates (due more to a lack of rental options than a sign of high income), with approximately 9% of the housing stock comprised of mobile homes (New York State Rural Advocates, 2006). According to the New York Rural Advocates, the state's rural communities lack technical expertise in addition to financial resources to employ urban planners, foster community development or create housing departments. What is more, their communities are often highly dependent on current climate conditions.

Image 2: Signage for a Local "Farmers Market" Where Local Produce Is Sold
Here hours of operation are shown as well as the products offered, patrons can pay for goods with their financial governmental assistance-offered to low income residents
(Source: Photo Taken by Author, New York State, 2015)

Image 3: Local Business Selling Locally Grown Plants and Flowers
(Source: Photo Taken by Author, New York State, 2015)

Image 4: Local Business Selling Fire Wood Often Purchased by Tourists Camping in the Area (Source: Photo Taken by Author, New York State, 2015)

Those living in rural communities tend to earn their incomes from industries such as agriculture and dairy, which are highly sensitive to changes in climate. Individuals living in rural New York State also tend to rely on tourism industries such as skiing, camping and other recreational activities, which are also climate sensitive industries (Scientists, 2006). Rural communities often depend on locally grown produce which may increase in cost due to climate change. New York State water supplies in rural areas are often small scale, making the threat of water scarcity in rural areas very real. What is more, the spread of infectious diseases, such as the West Nile Virus, is also a threat to rural areas of New York (Rosenzwieg et al., 2011a).

Currently, as opposed to in the past, rural areas receive less attention among legislatures as compared to urban areas. Before 1962 many legislatures were dominated by rural interests mostly of white male representatives. That is, urban and suburban interests were underrepresented. A 1962 U.S. Supreme Court decision ruled this to be a violation of the equal protection clause of the 14th amendment and, thereafter, legislative districts had to be redrawn. This resulted in increased attention on urban and suburban ills and addressing those problems and less on urban areas (Katz, 2003, p. 8).

6.1 Climate Change in New York State

What does climate change look like in New York State? What types of climate change impacts are local governments predicted to experience? Some of the changes include increases in temperatures and precipitation which affect a number of sectors including health, the economy and agriculture. At the local level changes in climate mean disruptions in provision of public services such as energy, water and transportation, often provided by local governments. Without adaptation to climate change serious risks to health and the economy are eminent and potentially costly in numerous ways. Despite the adaptability of New Yorkers to severe weather conditions, planned adaptation to climate change will be needed to minimize the negative impacts to climate change.

Typical Weather Conditions in New York State

The weather experienced in New York State is extreme and climate change is expected to result in even more extreme weather conditions. Throughout the year a fair amount of precipitation occurs as well as drought and flooding. Across the state heavy snowfall is experienced especially in mountainous and lake areas. Extreme high and low temperatures are also typical throughout the state, although this varies by region. Often due to thunderstorms, heavy winds, lightning and hail are experienced. Freezing rain is also not uncommon (Rosenzwieg et al., 2011b). Although New Yorkers are used to dealing with adverse weather conditions, these conditions are expected to increase in frequency and intensity due to changes in climate and are likely to require adaptation to minimize negative impacts on health and the economy. Climate changes in New York State are already being documented and are reviewed below.

Climate Change Impacts Expected in New York State

In general there has been a warming trend detected in all seasons. Increases in annual temperature, precipitation and sea level rise have already been witnessed and are predicted to continue into the future at an even faster pace than experienced in the past. Climate projections were calculated for New York State as part of the ClimAID report released in 2011 by NYSERDA. The ClimAID report outlines projected climate changes expected in New York State.

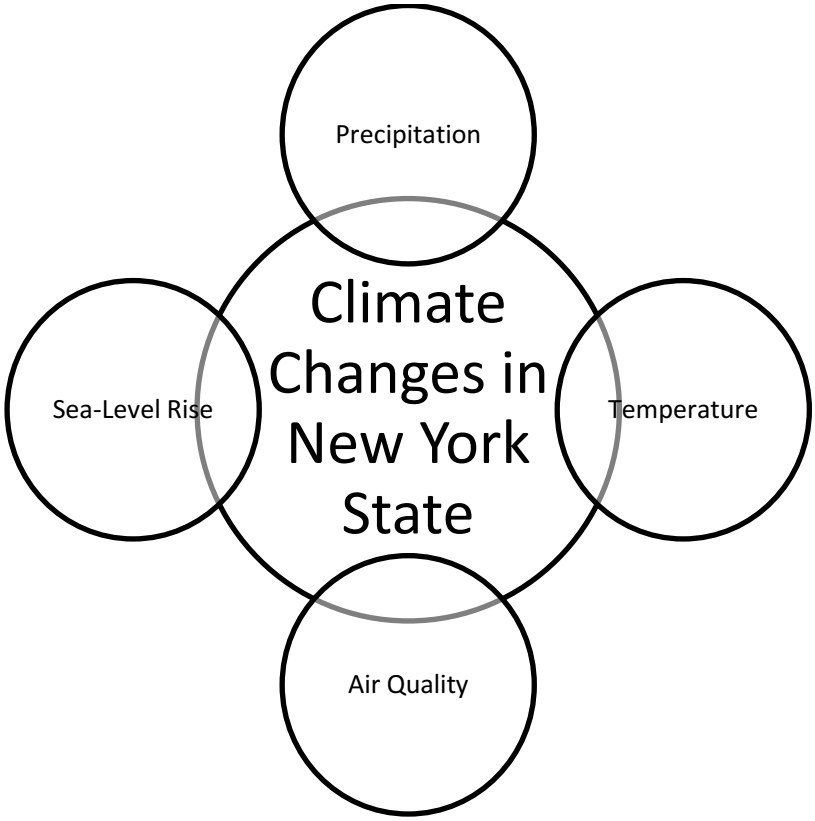

Figure 14: Expected Climate Change Impacts by Sector for New York State (Source: Author's Illustration based on Rosenzwieg et al., 2011b)

Temperature Changes

At the current pace, average annual temperature is projected to increase by 1.5 to 5.5° F in the 2020's, 3.0 to 5.5°F in the 2050's and 4.0 to 9.0°F in the 2080's. Climate projections indicate it is extremely likely the Northern part of New York State will experience higher temperatures. This also means snowpack will be reduced and the length of the growing season will be longer. In addition to increases in temperature the number of extremely warm days - those over 90°F (32°C) are expected to increase in occurrence and duration. The increase in frequency of drought is also predicted to occur within New York State including summer drought. Besides an increase in temperature, longer growing seasons and a larger number of extremely warm days precipitation is expected to increase in New York State in the coming decades.

Increases in Precipitation, Sea-Level Rise and Flooding

Precipitation in New York State is predicted to increase by 0% to 5% by the 2020's, 0% to 10% by the 2050's and 5% to 15% by the 2080's. Increases in precipitation are expected to be accompanied by sea level rise. Projections provided in the ClimAID report predict sea level rise in coastal areas and the Hudson River Area to increase

by one to five inches in the 2020's, five to 12 inches in the 2050's, and eight to 23 inches in the 2080's. This is of particular concern for coastal communities, many of which are just 10 feet above sea level and have already experienced a one foot rise in sea level in the last three decades. In addition to flooding, coastal communities can expect to experience coastal storms more often and at a greater intensity than in the past. That is, coastal floods and storms are predicted to occur once every one to three years instead of once per decade on average (Rosenzwieg et al., 2011b, p. 32-34). Increases in sea level rise and the occurrence of coastal flooding and storms are likely to have a number of negative impacts on coastal communities.

According to the ClimAID report, without adaptation coastal communities are to experience serious negative impacts to their communities. Perhaps most shocking is the fact that by 2050 a small portion of coastal areas are expected to be permanently inundated, necessitating an evacuation of housing and other properties. Other possible impacts to coastal communities include disruptions to transportation systems due to flooding of bridge and tunnel entrances and highways, disruption or failure of water treatment and sewer systems as well as wear and tear due to increased salinity of water taken into wastewater pollution control plants and other infrastructure. Changes in climate are expected to have a number of negative effects not just in coastal areas but throughout New York State.

Negative Impacts of Climate Change

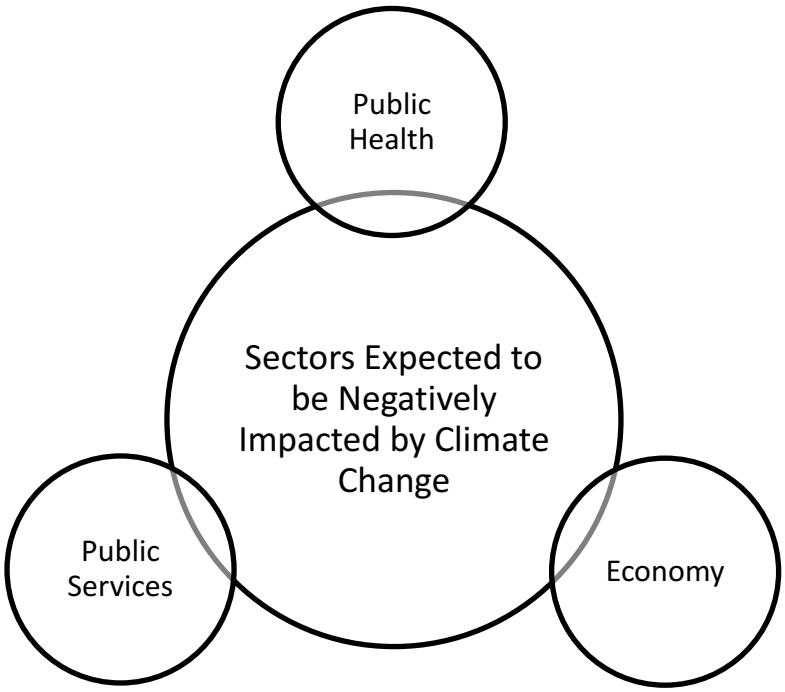

Figure 15: Sectors Expected to Be Negatively Impacted by Climate Change (Source: Author's Illustration based on Rosenzwieg et al., 2011b)

Negative Impacts to Public Health

Climate change is expected to have negative influences on public health in three main areas: decreased air quality, the increased spread of infectious diseases and death or illness caused by extreme weather conditions such as extreme heat. Those already suffering from cardiovascular diseases, respiratory diseases or allergies are particularly vulnerable to increases in air pollution, pollen and mold caused by climate change. The cities of Buffalo and New York are predicted to experience the most severe worsening of air quality in New York State putting those with respiratory illnesses at further risk (Union of Concerned Scientists, 2006). Moreover, occurrences of West Nile Virus and other similar viruses are expected to increase among New York State residents as warmer temperatures promote insect reproduction. Finally, extremely high temperatures in summer months pose risks to health as well, especially among the elderly (Rosenzwieg et al., 2011a).

Image 5: Local Newspapers and Brochures Meant for the General Public Show Evidence of Negative Impacts of Climate Change Already Being Experienced in New York State (Source: Photo Taken by Author of Materials Gathered in 2012)

Image 6: Public Announcement Encouraging Boat Owners/Users to "Clean. Drain. Dry" Their Boats in Order to Prevent the Spread of Invasive Species
(Source: Photo Taken by Author, New York State, 2015)

Negative Impacts to the Economy

Much of the economic activity in New York State is dependent on current climate conditions. Changes in climate pose economic risks to the agricultural sector, specifically in crop, wine and dairy production. In addition to agricultural production, changes in climate pose economic risk to the tourism sector. Considering predicted climate change impacts and the New York State economy there is reason to be concerned about the future damages that climate change poses (State of New York Comptroller, 2010).

The agricultural industry is a four billion dollar industry in New York State. Twenty-five percent of New York State land is comprised of agricultural land. New York State is among the top 10 states in terms of crop production (e.g. grain, corn, potatoes, and cabbage). New York State is also the second largest wine producer in the U.S., behind only California (State of New York Comptroller, 2010). Furthermore, New York State is the third largest dairy producer in the U.S. resulting in 1.9 billion in revenue per year (Scientists, 2006). Outside of agricultural production, the geography of New York State makes it an ideal destination for outdoor recreation. New York State is comprised of mountainous and lake areas making it suitable for skiing and the fishing industry, also big industries in the state. Variations in climate due to climate change are expected to jeopardize these economic sectors.

High temperatures result in revenue losses for dairy production as dairy cattle decrease milk production during high temperature periods (Rosenzwieg et al., 2011a). In 2005 high temperatures in New York State resulted in a decrease in dairy production and a 24 million dollar revenue loss (Union of Concerned Scientists,

2006). Just as higher temperatures have implications for dairy farmers, they do as well for fisheries. Warming waters due to increases in temperature are expected to result in a decrease of cold-water fish and important changes to the fishing industry (e.g. fishing limits due to altered migration or life cycle patterns of existing fish populations). Further, warmer temperatures interrupt conditions that promote skiing such as a loss of snow cover. Ski resort operators may decide to produce more artificial snow at a cost to their revenues and smaller ski resorts which cannot afford to produce artificial snow may be forced to close operations (Rosenzwieg et al., 2011b).

Negative Impacts to Public Services

Changes in climate are predicted to alter environmental conditions and the stability of public services. Disturbances to delivery of public services such as water, energy and infrastructure damages are expected in New York State as a result of climate change. Local governments, charged with ensuring delivery of public services, will be put under increased pressure to restore delivery of public services. The challenge of maintaining consistent water delivery and quality of water is expected to increase as. Energy delivery in the face of extreme weather and climate events and increased energy demand are also expected to be a challenge. Maintaining infrastructure in extreme weather conditions will be another challenge local governments have to face.

Water Delivery and Quality

Climate change is expected to complicate the provision of water services. Many of the outcomes of climate change, such as extreme precipitation, the occurrence of flooding and extreme temperatures, will challenge the ability of local governments to provide water. Extremely warm temperatures increase the demand for water and at the same time slow down the recharge of drinking water. Extreme precipitation and flooding hinder water treatment practices. Increases in water runoff result in soil erosion and decreased filtration of water (Rosenzwieg et al., 2011b). In short, climate change is expected to decrease the availability and quality of water. Water and waste water infrastructure is ageing and in need of repair. This in conjunction with climate change impacts will make uninterrupted delivery of water to citizens a challenge (New York State Water Resources Institute, 2015).

Energy Delivery

Changes in temperature, precipitation and extreme events may affect the ability to produce renewable energy such as hydropower, biomass and solar. Increases in temperatures and sea level rise are very likely to reduce water cooling capacity and damage coastal power plants resulting in reduced power generation and, in the case

of nuclear power generation, increased risk of overheating. Increases in temperature and precipitation such as snow and ice storms may cause damages to equipment used to transmit electricity resulting in increased occurrences of power outages. What is more, increases in mean annual temperatures are likely to cause an increase in demand for electricity causing the number of instances when electricity demand is equal to or greater than the amount of electricity available. Disturbances in electricity services may result in blackouts, brownouts and threats to the general reliability of electricity service. The downstate regions (areas in and around New York City) are particularly vulnerable to disruptions in delivery of electricity (Rosenzwieg et al., 2011b).

Infrastructure maintenance

Climate change is expected to result in damages to transportation, communication and infrastructure. For many local governments charged with maintenance of roads, communication and transportation infrastructure this means increased repair and maintenance costs and challenges when it comes to providing their citizens with uninterrupted services.

Conditions such as extremely high or low temperatures can create wear and tear of roads, bridges, railroads and bridges resulting in traffic delays or closures altogether. Extreme temperatures, sea level rise and other extreme events, such as snow storms, hurricanes and ice storms, may interrupt telephone and other services relying on cables (damage caused by flooding, fallen trees, utility lines, power failures and failure of other electrical equipment). Additionally, extreme events such as hurricanes, extreme winds, and increased extreme precipitation may push buildings to the limits of durability (Rosenzwieg et al., 2011b).

What does climate change mean for New York State Local Governments?

It is evident to most that climate change poses risks; some have been predicted and some have not. Local governments have the option to prepare for the predicted risks of climate change in New York State. Local governments may decide to take intentional steps to prepare for climate change impacts by conducting planned adaptation. On the other hand, local governments may decide to react to climate change impacts as they come or autonomously adapt to climate change. Planned adaptation to climate change impacts is more likely to increase adaptive capacity to climate change impacts and resilience in general.

New York State local governments can increase their adaptive capacity to minimize the impacts of climate change on health, the economy, service delivery and infrastructure by adapting their current practices. Some climate change experts believe New York State as a whole will not be successful in adapting to climate

change if local governments are not part of the process (Tryhorn, 2010). New York State local governments have the ability to play a major role in climate change adaptation. As part of a “home rule” state, New York State local governments regulate quality of life and provide direct services to their citizens (Paterson, 2009). They are also in a position to guide comprehensive planning and make use of a number of land-use controls to incorporate climate change impacts into their planning. As part of comprehensive planning local governments may implement land-use controls to minimize climate change impacts, for example the implementation of open-space preservation addressing issues of flooding, air quality and extremely high temperature. Additionally, land-use controls that can aid in managing climate change impacts, such as flooding, air quality, water quality and extreme temperatures, are floodplain management, wetland protection, water resource protection and erosion and sedimentation control (Paterson, 2009; Rosenzwieg et al., 2011b).

Land-Use Control Available to New York Local Governments	Climate Impact Addressed
Open-space preservation	Flooding, air quality, extremely high temperatures
Floodplain management	Flooding
Wetland protection	Flooding, water scarcity, water quality
Water resource protection	Temperature changes, drought
Erosion and sedimentation control	Flooding, extreme precipitation, water quality

Table 4: Land-Use Controls Paired with Climate Impact to be Potentially Addressed (Source: Author’s Illustration based on Paterson (2009) and Rosenzwieg (2011b)

As permitted by the federal and New York State constitutions local governments are in a position to utilize their “home rule” powers to address vulnerability to climate change. New York City leadership has taken advantage of this position to address both mitigation and adaptation to climate change (Sussman, 2010). It is uncertain to what degree other New York local governments are able or willing to adapt.

6.2 New York City, New York: A Leader in Climate Change Adaptation

New York City is the most heavily populated city in the U.S. with 8,244,910 inhabitants; it is also one of the most economically successful cities in the world (McKinsey Global Institute, 2011; U.S. Census Bureau, 2000). New York City is also

among the world's top 10 cities at risk of flooding due to climate change (The World Bank 2013). Fifteen of New York City's towns and cities (approximately half of the population) are at risk to flooding. Sea level is expected to rise by 13 inches (33 centimeters) by 2050, putting at risk 423,000 inhabitants, 186,000 homes and 62,000 acres of land (Climate Central 2012). As one of the largest economies and population centers with some of the highest risks for flooding it is no wonder that New York City has been a leader in climate change adaptation planning.

The City of New York began addressing climate change within their city-wide comprehensive plan called PlaNYC. PlaNYC was created as part of an initiative to address projected increases in population and improvements to the economy in New York City. Climate change was selected as one of the factors expected to impact New York City economically, therefore, measures to address climate change were included among several other initiatives (Office Long Term Planning and Sustainability, 2007). In comparison to other U.S. cities and cities world-wide, New York City is ahead in climate change planning, especially adaptation.

In a survey conducted by ICLEI and the Massachusetts Institute of Technology (MIT) 468 U.S. cities (already members of ICLEI) were asked to which extent they were conducting adaptation planning. The results of the survey indicated, even among this group of climate change aware cities, just 59% were conducting adaptation planning. Results of the survey indicated U.S. cities are behind in adaptation planning in comparison to other cities, such as those in Latin America and Canada where over 90% of cities are engaged in some form of adaptation planning (Carmin, 2012). As indicated by the results of this survey conducted, New York City has been able to advance further in adaptation planning in comparison to other U.S. cities. What is more, as the majority of ICLEI members world-wide, including the U.S., are only in the preparatory stages of adaptation planning, that is, just 18% of ICLEI members world-wide have implemented a plan (Carmin, 2012), New York City is at the forefront of climate change planning world-wide by having already implemented an adaptation plan.

Since the release of PlaNYC, a number of measures designed to address climate change adaptation have been implemented. The creation of a climate change task force consisting of city, state and federal agencies as well as private companies and other professionals has been one such measure (Lowe et al., 2009). The Climate Task Force was charged with protecting infrastructure, outlining collaboration with neighbor-hoods vulnerable to climate change, establishing site specific strategies to protect against climate change impacts and incorporating climate change related concerns into the planning process city-wide (Office Long Term Planning and Sustainability, 2007).

Within PlaNYC a number of initiatives with accompanying milestones were proposed. The City Planning department has made considerable effort to provide updates to the public on the progress made thus far to accomplish pre-established milestones. According to the Office of Long Term Planning website, the majority of the 127 initiatives in PlaNYC were begun within the first year of the plan's release (The Office of Long Term Planning, 2012). Between the years 2008-2010 a number of initiatives were completed relating to mitigation and adaptation. Measures implemented include: creation of a sustainable storm water management plan and energy efficiency plan, completion of the first official climate change projections for New York City, replacement of police vehicles with hybrid vehicles, planting of 250,000 trees, expansion of parkland and repainting of rooftops to reduce inside building temperatures. The city also made efforts to collect information such as obtaining high resolution mapping and elevation data in order to identify climate change risks. New York City planners have also identified building code and land use modifications which could be modified to decrease vulnerability to flooding (New York State Sea Level Rise Task Force, 2010).

As a result of PlaNYC greenhouse gas emissions in New York City have been reduced 13% below 2005 levels (The Office of Long Term Planning and Sustainability, 2011).

Image 7: View of Manhattan, New York City, from Liberty Island
New York City has been one of the most progressive cities world-wide in terms climate change planning (Source: Photo Taken by Author, New York State, 2015)

Climate Adaptation Measures Implemented by New York City

As opposed to many comprehensive plans which are seldom implemented, updated, or even monitored, PlaNYC has been updated with new initiatives and milestones. Additional milestones were added to PlaNYC in 2009. According to The New York City Office of Long Term Planning, two-thirds of milestones have been met. In 2011 the PlaNYC was again updated to include 132 initiatives with 400 milestones set to be accomplished by the end of 2013 (The Office of Long Term Planning, 2012). The efforts of New York City and Mayor Bloomberg have gained world-wide recognition and in 2010 Mayor Bloomberg was chosen to chair the C40Cities Climate Leadership Group - a network of megacities addressing climate change (C40 Cities, 2011; The Office of Long Term Planning and Sustainability, 2011).

The impact Mayor Bloomberg has had on the efforts being taken by the City of New York to address climate change adaptation is a good example of the impact elected officials can have on local government preparedness to deal with climate change. In having identified climate change as a real problem affecting the City of New York, officials have been able to gain support from federal and state level government in order to identify climate change vulnerabilities and implement a number of measures. At minimum, the Bloomberg administration has increased awareness of climate change impacts. As previously discussed, this awareness of climate change in New York City has resulted in implementation of specific measures to reduce climate change vulnerability and monitoring of specific measures to reduce vulnerability to climate change impacts. At the very least, New York City is now better prepared than in the past to deal with future climate change impacts, although it is still far from being invulnerable.

As a result of the hurricane that reached the U.S. East Coast on October 29, 2012, the City of New York was unable to provide many vital services to its citizens.

The city was left with flooding, submerged transportation tunnels and subway lines, damaged electricity substations and power outages. What is more, thousands of homes were destroyed; millions of citizens were without electricity and in some cases access to food and water. The impacts on New York City caused by Hurricane Sandy resulted in a heightened awareness not enough is being done to address climate change impacts (Tollefson, 2012). However, the Bloomberg administration has taken the opportunity to learn from the impacts of Hurricane Sandy on New York City and improve the city's adaptation efforts.

In 2012, Mayor Bloomberg introduced an additional initiative to rebuild in the aftermath of Hurricane Sandy as well as to increase resiliency to future natural disasters. The Special Initiative for Rebuilding and Resiliency (SIRR) is a program designed to identify and explain the impacts of Hurricane Sandy while examining the extent of

future threats expected for New York City. The goal of the SIRR program is to identify actions likely to increase infrastructure resiliency and neighborhoods already damaged by Hurricane Sandy. The SIRR program has resulted in an additional comprehensive plan called “A Stronger, More Resilient New York” outlining actions to address increased resilience city-wide.

Infrastructure addressed within the comprehensive plan includes a broad range of areas including coastal protection, services such as utilities, healthcare, telecommunications and transport, and waste water but also touches upon broader areas, such as economic recovery, parks and environmental protection. Community resilience plans were also created as part of the comprehensive plan for five neighborhoods identified as in high risk (Office of the Mayor New York City, 2013). PlaNYC could be seen as the first stepping stone in a series of plans to address climate change in New York City.

Obstacles Faced by New York City

The example of New York City shows that even when interest in addressing climate change exists within a municipality, challenges still exist when implementing measures to reduce vulnerability which may reduce the level of future preparedness. There must also be resources and effective collaboration at various governmental levels as identified in an updated version of the PlaNYC of 2011. The New York City Office of Long-Term Planning and Sustainability identified a number of challenges while attempting to implement PlaNYC adaptation initiatives.

Challenges included a lack of monetary support especially related to collapse of the housing market in 2007 which caused an economic downturn also referred to as The Great Recession (WebFinance, 2013). In addition to the trial of the city independently funding initiatives, it was also a challenge to gain financial support from state and federal governments as well as permission to implement projects (The Office of Long Term Planning and Sustainability, 2011, p. 13).

Regardless of the challenges incurred while attempting to implement measures to reduce vulnerability to climate change impacts, the City of New York has accomplished a great deal. As previously discussed, New York City is far ahead of most cities world-wide which have not yet begun to implement their adaptation plans. In comparison to most local governments in the U.S. which have not yet begun to plan for climate change adaptation New York City is a pioneer of climate change planning by already having created, implemented and updated adaptation plans. The advancement of climate adaptation planning appears to be largely attributed to the mayor’s willingness and persistence in addressing the vulnerability of New York City to climate change, and to learn from past weather events.

With the success New York City has had thus far in planning for climate change adaptation one might ask why the State of New York does not enforce adaptation planning among all New York State local governments. To start with, New York State is “home rule” meaning the state has given via the state constitution to local governments the right to decide if and how they conduct comprehensive planning. That is, New York State local governments are largely independent of the state and it would be uncharacteristic for the state to enforce climate change adaptation planning. What is more, state=enforced adaptation among all New York State governments based on the successes of New York City would be unfair. Local governments in New York State are vastly different in terms of size and resources they possess.

6.3 New York State Efforts to Address Climate Change

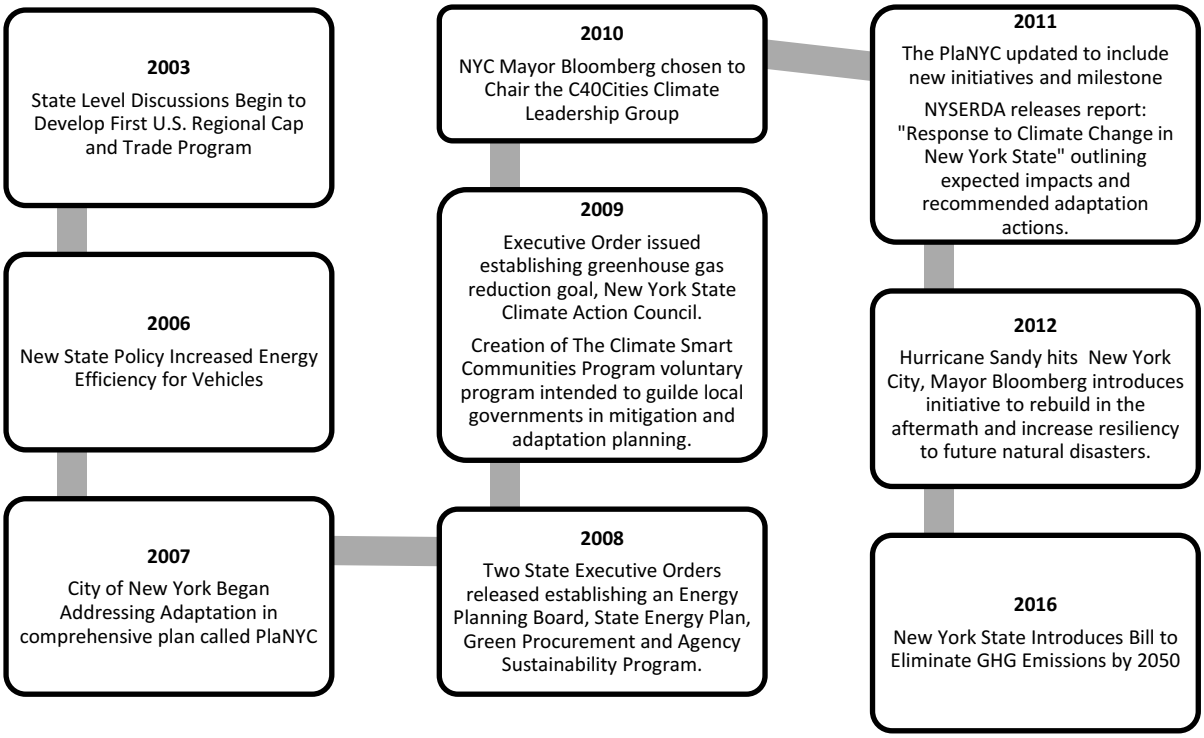

Figure 16: Milestones of New York State Efforts to Address Climate Change (Source: Author’s Illustration)

Both federal and state level governments in the U.S. have prioritized climate change mitigation rather than adaptation, especially in earlier attempts to address climate change. New York State has followed a similar path to that taken by the federal government and other state governments. The process of addressing climate change began in New York State in 2003 with the development of the first emissions trading program and has progressed from there to include improvements to auto emission standards, establishment of greenhouse gas emission goals and has evolved to

include adaptation planning. While the State level government of New York has been a leader in climate change mitigation, the City of New York has been a leader in addressing climate change adaptation.

State Efforts to Minimize Greenhouse Gas Emissions

In 2003 the Governor of New York, George E. Pataki, initiated discussions with 11 state governors to develop a regional cap and trade emissions program. These discussions resulted in the creation of the Regional Greenhouse Gas Initiative (RGGI). RGGI was formed in an effort to record regional emissions and establish a trading system for power generating facilities. By establishing RGGI, New York State succeeded in developing the first emissions trading program in the U.S. (Tennis, 2007). The establishment of RGGI showed that the development of an emission trading program in the U.S. was possible and can be established in collaboration with many state partners. Following the creation of RGGI by New York State, the idea spread and many other emission trading programs were established in the U.S.

Diffusion of emission trading programs started in California after New York and continued in other states as well. The success of RGGI in generating creation of emission trading programs among other U.S. States has been dampened due to minimal success in actually reducing greenhouse gas emissions.

The limit on greenhouse gas emissions, also referred to as the carbon cap, has not been set high enough. The failure of the carbon cap to limit emission production has been said to be due to a concern of increasing energy costs. Due to a fear of increasing energy costs, a cost safety valve limiting emission volume restrictions has been implemented in the RGGI region. The implementation of the safety valve has partially been blamed for the limited success of RGGI (The Canada Institute of the Woodrow Wilson International Center for Scholars, 2008). In addition to the implementation of a cap and trade emissions program, there have been other efforts at the state level to reduce greenhouse gas emissions.

In 2006 the State of New York implemented auto emission standards modeled after a standard implemented by the State of California requiring higher efficiency standards for all new passenger vehicles and light duty trucks (California Environmental Protection Agency, 2007; Tennis, 2007).

In 2009, in addition to establishing the Office of Climate Change, Governor Paterson implemented through executive order a greenhouse gas reduction goal of 80% of 1990 levels by 2020. The Executive Order also put into place the New York State Climate Action Council charged with drafting a climate action plan by September 30, 2010. An interim report was released November 9, 2010, and made available for public comment. The climate action plan, which would have outlined actions to

reduce greenhouse gases and address climate change adaptation, has not yet been released (New York State Department of Environmental Conservation, 2012). However, that does not mean there is no available information concerning the risks of climate change and possible adaptation actions in New York State.

The New York State Energy and Research and Development Authority (NYSERDA), a government supported research organization financed through electric and gas utilities, federal grant and voluntary contributions, has been active in assessing the risks of climate change in New York State. In 2011, NYSERDA released a climate change report outlining predicted climate change impacts and possible adaptation strategies in eight sectors in a report called a “Response to Climate Change in New York State”.

Climate change impacts in New York State were identified in a number of sectors including water resources, coastal zones, ecosystems, agriculture, energy, transportation, telecommunications, and public health (New York State Energy Research & Development Authority, 2012). One of the primary purposes of this report was to inform decision makers concerning climate change vulnerabilities specific to New York State and encourage adaptation (Rosenzwieg et al., 2011a). The report serves its purpose in so far as to identify general impacts expected in New York State. However, in order for local governments to adapt it would be necessary to conduct further impact assessments to identify more concretely vulnerabilities to individual communities.

State Programs Guiding Local Governments to Minimize Flood Risk

Beyond the recent programs and policies enacted to explicitly address climate change in New York State there are longer standing programs which tend to focus directly on flooding but inadvertently address climate change. At the state level, the New York State Sea Level Rise Task Force and the Local Waterfront Revitalization Program (LWRP) are two programs focused on guiding local governments in protecting waterfront communities. A federally supported program, the New York Sea Grant is operated within New York State and also focuses on coastal or communities located on shorelines.

New York State Sea Level Rise Task Force

In 2007 the New York State Legislature created the New York State Sea Level Rise Task Force to protect coastal systems, natural habitats and promote community resilience in New York State. The task force consisting of both private and public sectors (including local government) restricted their focus to waterfront communities in and around New York City, specifically Westchester, Nassau and Suffolk counties.

In a report submitted to the New York State Legislature in 2010 the task force provided an assessment of impacts expected in New York State due to sea level rise and their recommendations to address vulnerability of the coastal areas and ecosystems in New York State to control flooding and improve water quality (New York Department of Environmental Conservation, 2012). The task force found that New York State coastal communities have already been negatively affected by sea level rise and flooding. What is more, the risks to local governments located on the coasts were identified as high and expected to increase as a result of climate change. In general, the task force found coastal communities to be poorly poised to adapt to flooding and other impacts.

According to the task force, coastal communities in and around New York City have failed to guide development in a way as to prevent and minimize flood damage. Decision makers have not taken precaution to prevent destruction of naturally occurring features, such as wetlands, which help to protect against flooding. In addition to failing to prevent destruction of wetlands at the local level, both state and local levels have continued to allow development in areas considered “high risk” to flooding. One possible explanation found by the task force was a lack of detailed information to aid decision-makers concerning the flood risk facing their communities.

The task force found New York State flood risk maps to be outdated and not exact enough to aid decision-makers in preventing flood damage. It was recommended that decision-makers be provided access to information which could be used to reduce community vulnerability to flooding such as: updated elevation data maps, coastal erosion hazard areas, and wetland and shoreline information. Beyond providing updated information to decision makers, the task force recommended enforcing adaptation to sea level rise at both the state and local levels.

Adaptation, according to the task force, would be embedded at state and local levels through adoption of official sea level rise projections, incorporation of sea level rise into state agency planning, implementation of specific measures in areas identified as “high risk” and by way of modifications to New York State laws and regulations. However, New York City Task Force members disagreed with a number of the recommendations based on a lack of scientific, environmental and cost-benefit analysis. New York City Task Force members also felt the task force had not considered the impacts of enforced adaptation in undeveloped areas as compared to highly developed areas. Though the task force had not considered the impact enforcing consideration of flooding would have in underdeveloped areas, it did consider the importance of guiding local governments in their adaptation planning.

The tasks force recommended that New York State be highly involved in aiding communities in adapting to sea level rise by providing “financial support, guidance

and tools for community-based vulnerability assessments and ensure a high level of community representation and participation in official vulnerability assessments and post-storm recovery, redevelopment and adaptation-planning processes". In addition to the state being heavily involved in supporting community adaptation, the task force recommended improving state relations with the federal government in order to garner financial and other support in adapting to climate change (New York State Sea Level Rise Task Force, 2010).

Local Waterfront Revitalization Program (LWRP)

The LWRP operating under the Department of State already provides New York State local governments with the opportunity to take part in their Coastal Management Program (CMP). As a voluntary participant of CMP local governments are encouraged to develop their own local waterfront revitalization program with a number of objectives. One intended objective of the program is to attract development and promote cultural and natural characteristics of local communities. A second objective is to establish networks with other local governments, state and other organizations as a means to gain technical and financial assistance. However, although all villages, towns and cities in New York State are permitted to join the LWRP, not all are eligible for financial assistance. Financial assistance is restricted to those located along a long list of designated creeks, rivers and lakes (including Great Lakes Ontario and Erie) as well as the Atlantic Ocean (New York State Department of State, 2012). Again, as seen with the Sea Level Task Force restrictions to whom may participate have been made, it is unclear what kind of ramifications, if any, this may have on the preparedness of ineligible local governments to adapt to climate change.

New York Sea Grant (NYSG)

NYSG is one of 33 programs nationally operated under the National Sea Grant Program. The purpose of the National Sea Grant Program is to utilize and conserve resources which are provided by coastal waters, marine waters and the Great Lakes. The National Sea Grant Program is operated under the National Oceanic and Atmospheric Administration (NOAA) and The Department of Commerce (National Oceanic and Atmospheric Administration, 2015). The New York Sea Grant was established in 1971, has 15 staff members located in downstate and upstate regions and is operated by the State University of New York and Cornell University. Each professional has a different responsibility locally, regionally or nationally. One of the purposes of the Sea Grant is to improve resilience to specific hazards including climate change. Specifically, Sea Grant aids in climate change adaptation by

informing policy and management, helping communities prepare and supporting economic resilience (New York Sea Grant, 2015).

New York State Office of Climate Change

In 2008, the year following the release of PlaNYC two Executive Orders were released putting into place measures to address both climate mitigation and adaptation. A State Energy Planning Board State Energy Plan, a State Green Procurement and an Agency Sustainability Program were created. Additionally, the State of New York has recognized the importance of considering climate change within local government decision-making. The New York State Office of Climate Change was established with the intention to add "…a climate change element into the decision making and practices of governments, public and private institutions, businesses and individuals across the state." (New York State Department of Environmental Conservation, 2012). In addition to encouraging local governments and other public and private institutions to integrate climate change into decision making and other practices, the Office of Climate Change also aims to inform citizens concerning climate change, guide decision-making regarding the actions necessary to mitigate climate change impacts within a variety of sectors (New York State Department of Environmental Conservation, 2012).

The New York State Office of Climate Change has attempted to provide guidance to New York State local governments through creation of the Climate Smart Communities Program (CSC) in 2009. The CSC is a voluntary program open to New York State towns, villages, cities and counties. Local governments join by passing a pledge within their legislative bodies and registering with CSC officials. The CSC program is structured similarly to that of ICLEI, whereas local governments are guided through a series of steps to aid climate change decision making. Examples of recommended steps include conducting greenhouse gas inventories, developing local climate action plans as well as decreasing energy demand and renewable energy within local government operations (Conservation, 2010).

In the early stages of the program local governments were offered a limited amount of guidance focused mostly on mitigation. Since the creation of the CSC program it has been expanded to provide more service to local government looking to address climate change within their communities. CSC members have the opportunity to participate in webinars to learn from other communities and/or climate experts, join a listserv alerting them to receive funding and education opportunity alerts. The State has experimented further by implementing pilot projects to guide local governments more intensely with their climate change planning. It is expected that the CSC program will continue to expand and develop further. In 2016 New York State has continued to move forward on climate change policy by introducing a bill to eliminate

greenhouse gas emissions by 2050 primarily through the enforcement of renewable energy (Bade, 2016). Still it is unclear how this may effect adaptation to climate change at the local level. The discussion seems to still be very much focused on reduction of greenhouse gases rather than adapting to the negative impacts of climate change.

The results of this study may help to provide guidance as to what is necessary to engage local governments in adaptation planning.

7 Results

7.1 Introduction and Background to Adaptation Survey

This dissertation research was conducted as part of an international graduate school housed within the Leibniz Institute of Ecological Urban and Regional Development (IOER) in Dresden, Germany. This is relevant within the context of this research because from my perspective as a U.S. citizen and a prior student of city and regional planning in Columbus, Ohio (U.S.A). In my experience, Germany was far ahead in their actions on addressing climate change adaptation at least at the level of federal policy. The German federal government specifically the Federal Ministry of Education and Research (BMBF) and the IOER were already taking measures to develop adaptation approaches to climate change. I attended a status conference in Berlin and witnessed some of the adaptation research being conducted within our institute (Dresden) and in other regions of Germany. The IOER was competitively selected to conduct one of many regional projects funded by the federal government of Germany with the purpose to create model adaptation framework with the potential for non-model regions of Germany to adapt. The IOER conducted a project called REGKLAM—"Development and Testing of an Integrated Regional Climate Change Adaptation Program for the Model Region of Dresden". IOER researchers examined many different facets of climate change adaptation in the Dresden region, such as: city and habitats, wastewater, knowledge transfer, adaptation strategies and land-use and made suggestions as to how adaptation plans could proceed. The results of the research project were made available in 2013 as a model for other regions of Germany to adapt. As can be seen from my account of pre-and post-political conditions in the U.S. and my field work in New York State in the following section, the atmosphere within the U.S. at the time my research was conducted was rather different than that of Germany in terms of awareness of the need to adapt to climate change (for more information on the REGKLAM project See: Müller, 2012).

7.1.1 Pre- and Post-Political Conditions in the U.S. Surrounding Survey Dissemination

Here, a description of the circumstances before, during and after the online survey was conducted is given. A description of the circumstances surrounding the distribution of the survey is provided as a means to 1) Understand the conditions local governments were operating under as the survey was distributed and 2) Identify how conditions may have changed since the survey was distributed.

The online survey was conducted at the tail end of 2011 (November and December). President Obama, as presidential candidate having made promises to act on climate

change during his presidential campaign, had been in office for nearly two years at the time. In October of 2009, after failing to pass the Energy Security Act in the U.S. Senate, President Obama used his authority as President to issue the Leadership in Environmental, Energy and Economic Performance - an Executive Order requiring federal agencies to set greenhouse gas emission targets and conserve resources, and establishing the Federal Climate Change Adaptation Task Force. That is, political opposition to action on climate change prevented major legislation at the federal level requiring the president to use his executive power to force some level of action on climate change.

Eight years prior to the survey being conducted, New York State established the first greenhouse gas emissions trading program in the U.S. In 2007 (four years prior to the survey being conducted) New York City began conducting planned adaptation to climate change. In the context of 2007 and presently (2016) the creation and especially the implementation of a climate adaptation plan by New York City is considered advanced both nationally and internationally. At the time the survey was taken, there were a number of programs already in place within New York State addressing issues related to flooding and sea-level rise including the New York State Sea-Level Rise Task Force, the Local Water Revitalization Program and the New York Sea Grant. However, these programs are focused on helping coastal communities deal with flooding and sea-level rise; their main focus is not climate change.

Two years before the survey was conducted the State of New York State explicitly placed adaptation on the policy agenda (2009), by establishing the New York State Action Council and the Office of Climate Change also via executive order. The Climate Smart Communities Program, housed under the Office of Climate Change, was created to guide local government mitigation and adaptation planning. In the early years of the CSC program much of its focus was on mitigation.

Period after Survey Conducted

Roughly two years after the survey was conducted Hurricane Sandy hit the Eastern Coast of the U.S. resulting in 37,000 destroyed homes and massive power outages. New York City and New Jersey were greatly impacted (Federal Emergency Management Agency, 2013). New York City, under Mayor Bloomberg, introduced a new initiative to rebuild in the aftermath of Sandy and increase resiliency to future natural disasters. As a result of Hurricane Sandy climate change adaptation received more attention. Before and during the period the survey was conducted there had been very limited mention of adaptation at both state and federal levels. As of early 2010 it was difficult to find any mention of climate change adaptation among federal

government websites. In 2012 the topic of adaptation began to surface more and more, possibly as a result of Hurricane Sandy.

Prior to 2012, local governments seeking advice from the U.S. Environmental Protection Agency (EPA) on creating a climate action plan or something similar were encouraged to look elsewhere for guidance such as other local or state government websites both within the U.S. and abroad or to use resources such as ICLEI or university websites. Furthermore, in early 2013 information available from the EPA website was updated to include adaptation rather than just mitigation contrary to what was previously available in 2010 (United States Environmental Protection Agency, 2012a). Despite showing more concern and awareness of the need to adapt to climate change, the majority of federal climate change spending before and after the survey was conducted has been allocated to measures having the potential to reduce greenhouse gas emissions (e.g. technology development). Between the years 2008 and 2014 less than 1% of federal climate change funding has been allocated toward climate change adaptation. The federal government has continued to make mitigation a priority. In June of 2014 federal government proposed the first ever carbon pollution standards on existing power plants and made an agreement with China to reduce greenhouse gas emissions.

An Update from the New York State Climate Smart Communities Program

In order to assess the more recent situation in New York State, an informant discussion was conducted with a number of individuals working at the New York State Climate Smart Communities program in March 2015 via web cam. Pre-determined questions were used to guide the discussion and notes were taken by hand.

<u>What is happening in New York State to encourage local government adaptation to climate change (what has changed)?</u>

A certification program has been developed in order to give recognition to local governments making efforts to mitigate and/or adapt to climate change, and to provide a framework for action. There are currently 149 Climate Smart Community members which cover 1/3 of the states' population (6.4 million residents). The certification program was created in order to encourage action as in the past local governments signed the CSC pledge and then failed to act. The certification program was created in hopes of sending a signal to action. There are 13 priority actions (e.g. create a task force, hire a coordinator) that CSC members are encouraged to take. The more difficult the action, the more points can be earned. A pilot study was conducted among eight communities. Eligibility to participate in the pilot project was

based on being located in the Hudson Valley and the submission of a statement by individual communities.

Communities were selected competitively however only eight communities applied to be part of the project. The initial goal of the creators of the pilot project was to include only four communities; however, they felt it was important to include all who were interested. Outside contractors were hired to guide four of these pilot communities in gaining certification; the other four were allowed to participate but without technical assistance. Two of the communities that did not receive technical assistance dropped out of the program (they were rather small). In the end, four communities received certification (first of four levels-level four is the highest certification) and two communities received bronze certification (second of four levels). Motivation of elected officials could be related to community pride. As part of the CSC program the expertise of five coordinators is available by region. The CSC Coordinators provide assistance to any climate-smart community that is interested, without regard to the certification portion of the program. In April 2014 the certification program was launched. As of March 2015 there has not been any documentation submitted by CSC members.

In order to create interest in gaining certification more financial support from the state is needed. The development of a certification portal is in the works. The certification portal would provide the opportunity to submit certification documents as well as to gain awareness of possible action local governments can take to combat climate change.

Are local governments interested in addressing both adaptation and mitigation to climate change?

Local governments are mostly interested in addressing mitigation as it often results in cost savings (e.g. save on electricity costs). With the exception of a few local governments in the Hudson Valley there is currently very little adaptation work taking place among local governments.

What if anything has changed at the federal government level (i.e. have conditions changed for local governments in terms of mitigation and adaptation to climate change)?

Federal funding has been provided through the Governor's office to address storm recovery. Climate change has not been a part of a coordinated effort here. Local governments have not been required to consider climate change impacts as part of their future plans.

(Webcam-Telephone Informant discussion, Policy Analyst, New York State, March, 2015)

The main conclusions that can be drawn from this informant discussion are:

- Despite efforts of the CSC program, actions to address both mitigation and adaptation remain limited among New York State local governments (after joining CSC program local governments fail to act, limited interest to join the pilot certification program, documentation has not been submitted through the new certification program).
- Interest in addressing climate change is primarily concerned with mitigation as mitigation often results in cost savings. Adaptation action is focused in the Hudson Valley (according to CSC staff).
- The focus of policies toward certain geographic areas has continued (only local governments in the Hudson Valley were eligible to participate in the certification pilot program).
- Small local governments face more challenges than larger (Two small communities dropped out of the pilot program after being ineligible to receive technical assistance as part of the pilot certification program).
- More financial support is needed from the state and federal governments to support adaptation measures. (Funding obtained from state and federal governments to minimize flooding do not require consideration of climate change (according to CSC staff).

This informant discussion shows that, despite a stronger stance on climate change at the federal level, not a lot has changed at the state and local level. Action to address climate change remains low. The actions that do take place mostly revolve around mitigation, often as a means to save on energy costs. Within New York State it is likely that policies, especially those involving financial support, continue to be centered on the Hudson valley.

7.1.2 Survey Response Rate and Sample Characteristics

The circumstances surrounding dissemination of the online survey conducted as part of this dissertation have already been discussed. This section is used to provide an overview of the survey including, the response rate as well as characteristics of the sample. This entails government type, the general geographic location (i.e. county location), population size, whether or not responses originated from rural or urban areas, and proximity to bodies of water, as well as, characteristics of the individual completing the survey and whether or not the prospective local government is a member of a climate change organization.

The highest ranking elected official for the respective government type (e.g. city=city mayor, village=village supervisor, town=town supervisor) was invited to participate in the survey. To increase the chances of high quality responses, elected officials were provided the option to allow another individual to complete the survey if they felt someone other than themselves would be more knowledgeable about efforts within their local government to address climate change impacts (e.g. an environmental specialist, sustainability coordinator, etc.).

E-mail invitations were sent to 1,600 individuals working for local governments in New York State. The survey received a response rate of 9% (141/1,600 x 100)). While the sample size is not overly large it has been found to be typical of voluntary surveys conducted online. For example, in 2011 an online survey conducted in Germany examining climate change adaptation among local government officials also received a response rate of 9% (Bray, 2011). Both surveys were conducted on a voluntary basis and local governments received no incentives other than contributing to science. Local governments may be overburdened with other tasks or other research studies.

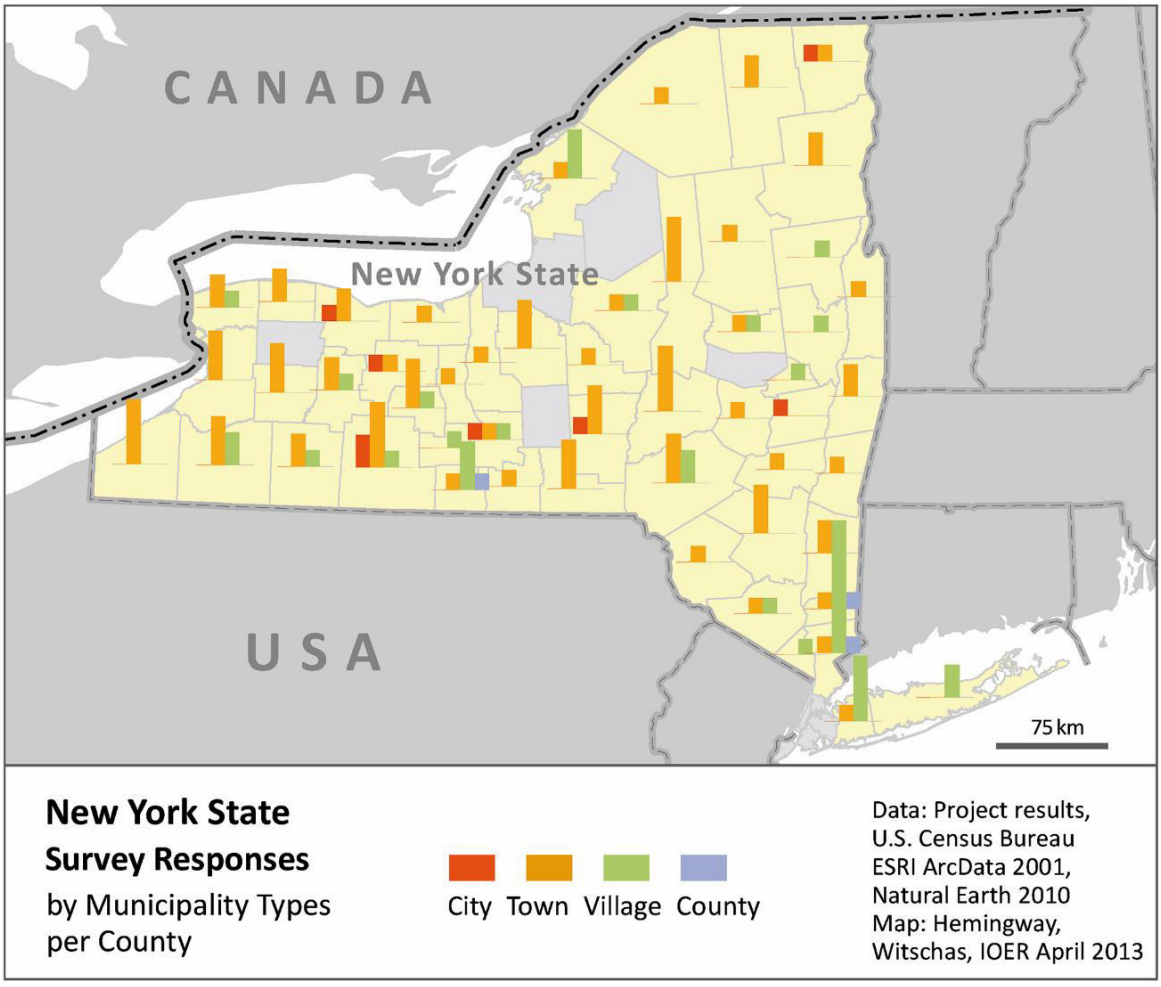

Figure 17: Survey Responses by Municipality Type
(Source: Author's Illustration)

Sample Characteristics

Municipality Type

Nearly 80% (126 of 141 responses) of survey responses were received from town (88) and village (38) governments. The remaining 20% of responses (16 responses) were received from city (8) and county (8) governments equally. A number of responses received from villages originated from the New York City and downstate areas. The further north from New York City the fewer responses to the survey were received.

There are 932 towns, 554 villages, 62 cities and counties in New York State. Thus, the proportion of responses is similar to the proportion of local government types existing in population.

Population Size

A similar pattern can be seen in terms of population. New York State local governments mostly consist of small populations. Just 35 municipalities have populations above 25,000 (United States Census Bureau, 2010b). New York City, with 8,175,133 residents, has by far the largest population. There are also a handful of larger municipalities, mostly cities, such as Buffalo, Rochester, Yonkers and Syracuse with populations between 150,000 and 270,000. Smaller cities such as Albany, New Rochelle and Cheektowaga have populations between 65,000 and 100,000 (United States Census Bureau, 2010a). The remaining municipalities consist of relatively small populations of around 10,000 residents or less (United States Census Bureau, 2010b).

Approximately 70% (100 of 141) of the survey responses were received from local governments with populations below 10,000.

The remaining responses were received from local governments with populations above 10,000 to as much as over 300,000. Fourteen local governments indicated they had populations between 10,000 to 20,000, eight local governments 20,000 to 40,000, two local governments 40,000-70,000, two local governments 70,000 to 100,000, three local governments 100,000-300,000, and finally three over 300,000. As the greater part of the sample indicated they had populations below or around 10,000, it is not surprising the majority also indicated they were located in rural areas.

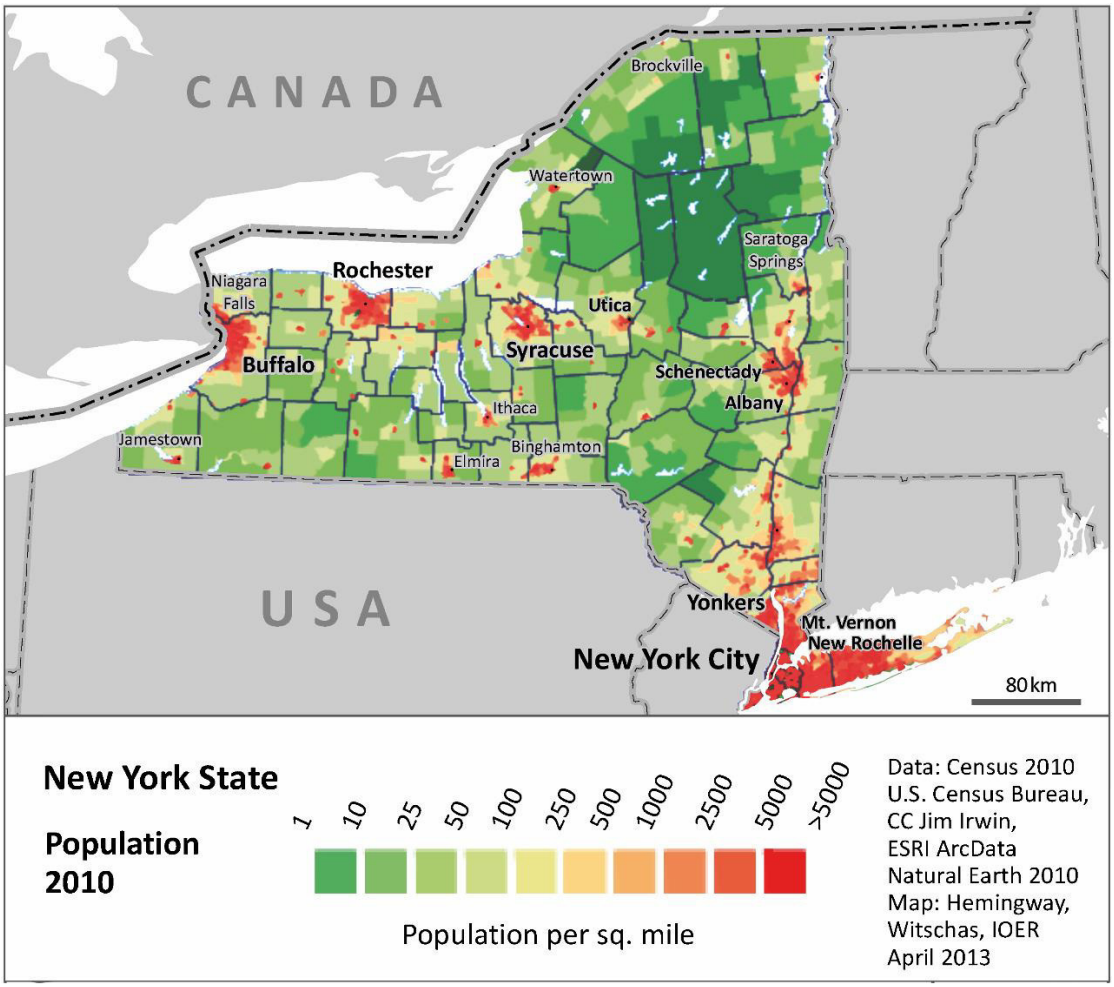

Figure 18: Population Density in New York State
(Source: Author's Illustration)

Rural versus Urban

Seventy percent of the sample indicated they were located in rural areas, 23% in suburban and 5% in urban areas. This would also be expected as the majority of New York State counties are rural (44 of 62). However, New York State counties are diverse often consisting of some combination of urban, suburban and rural areas (New York State Office for the Aging (unknown):4). The fact that counties are larger and encapsulate all other municipality types makes them unique. Counties have the possibility to effect regional efforts to address climate change. At the same time, counties have an interesting challenge ahead of them as they often contain both rural and urban areas.

The diversity of local governments has been confirmed among the survey sample, as indicated by a number of respondents in the "other" response option for this question. Thus far, it can be seen the sample is similar to the population in terms of municipality type, population, and composition of urban and suburban areas. The similarity of the sample to the population is also reflected in responses regarding local government proximity to water bodies.

Image 8: Small Local Government Located in Northern New York State
(Source: Photo Taken by Author, New York State, 2015)

Proximity to Water Bodies (Rivers, Lakes, Coastal Areas)

MULTIPLE CHOICE RESPONSES

Approximately 55% of respondents indicated their local government to be in proximity to at least one body of water. That is, over half of those who responded work for a municipality that are likely currently face or will face climate change related risks associated to bodies of water (i.e. flooding, sea-level rise, inundation, water quality issues).

Figure 19: Proximity of New York State to Water Bodies
(Source: Author's Illustration)

Twenty-eight percent of respondents indicated their local government to be on a river, 19% on a lake and 6.3% in coastal areas, whereas 59% of respondents indicated they served municipalities located in-land.[14] However, as with the categorization of rural/urban/suburban many respondents indicated their local government to be comprised of some combination of inland, lake, stream or coastal areas.

This is also expected considering the plethora of water bodies in New York State, e.g. two Great Lakes - Lake Erie and Lake Ontario as well as Lake Champlain and the Atlantic Ocean (Campbell, 2011). What is more, the state contains the Finger Lakes (a series of 11 lakes in Central New York) and three main rivers (the Hudson, Mohawk and Genesee Rivers) in addition to over 6,713 natural bodies of water of one acre or more (Development, 2010).

Is your community.....?		
Answer Options	Response Percent	Response Count
Coastal	6%	9
In-land	59%	84
On a river	29%	41
On a lake	19%	27
Other (please specify)		16
Answered question		142
Skipped question		0

Table 5: Responses to Survey Question 4: Identifying Local Government Proximity to Water (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December 2011)

WRITTEN RESPONSES

From the written responses one can observe the geographic diversity within which New York State local governments operate.

"we live in the Mohawk Valley"

"on the New York State Canal System"

Some small communities contain precious resources that other local governments depend on - such as in this example, the community contains the water supply for New York City:

[14] PERCENTAGES ADD TO MORE THAN 100 DUE TO THE FACT THAT RESPONDENTS WERE PERMITTED TO CHOOSE MORE THAN ONE RESPONSE OPTION.

"New York City water supply reservoirs are contained within our boundaries"

One can also see many communities do not just have one type of water body but often two or more or a combination of water bodies and other geographic features:

"also along the Hudson and Delaware rivers"

"between Catskill Mts [mountains] & [and] amp; Hudson River"

"Junction of the St. Lawrence River and Lake Ontario"

"Three Lakes and two dams"

"There are streams and lakes throughout our community"

"Several Creeks. Chesapeake Bay Watershed"

One respondent associated the river located within their local government with flooding:

"has a river and lake that floods in the spring"

Many local governments contain multiple bodies of water and diverse landscapes which may translate to challenges adapting to climate change, for example multiple areas susceptible to flooding.

Characteristics of Individuals Completing Survey

Do Local Governments Perceive a Responsible Entity for Climate Change Preparedness Measures?

MULTIPLE CHOICE RESPONSES

The individual completing the survey was asked whether or not their local government contained a unit, department or individual responsible for climate preparedness measures. Respondents were also asked whether or not they were the individual responsible. In addition to multiple choice responses, those completing the survey were given the option to choose "other" and freely respond. From all of those surveyed, 42 indicated there was a responsible entity (individual, department or unit) for climate change preparedness within their municipality.

Is there a unit, department or individual responsible for climate preparedness measures within your local government (Select all that apply)?		
Answer Options	Response Percent	Response Count
Individual (I am not that person)	14,3%	7
Individual (I am the individual responsible)	49,0%	24
Department	28,6%	14
Unit	8,2%	4
Other (please specify)		39
	Answered question	49
	Skipped question	93

Table 6: Responses to Survey Question 22: Identifying Responsible Party for Climate Preparedness Measures
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Twenty-four respondents indicated (using the multiple choice answer responses) they were the person responsible for climate preparedness measures within their local government. Another seven respondents indicated a person responsible for climate change measures existed, but that they were not the person. Although it is not clear why someone not responsible for climate preparedness measures would complete the survey, there are possible explanations.

For example, the mayor may have decided to complete the survey although responsibility for climate preparedness measures lies within an environmental division or with a profession. From respondent email addresses it could be seen that a number of those responding were supervisors, mayors, managers and clerks (22 supervisors, 16 mayors, 3 managers, 5 clerks). Beyond individual responsibility for climate preparedness measures, 14 respondents indicated their local government to have a department charged with addressing climate change and another four indicated a responsible unit.

WRITTEN RESPONSES

Thirty-one individuals indicated no responsible party existed within their local government to address climate preparedness measures. By examining responses more closely we can learn a great deal more about how local governments are operating and what this means for climate change adaptation.

Some were unsure of who would be responsible for climate preparedness measures or did not understand the question.

"Unknown who responsible"

"Do not understand the question. I handle Emergency Preparedness"

Others indicated within their local government they were not addressing climate preparedness measures but reacting to damages once an event has already occurred. Although this question was not intended to measure spontaneous or planned adaptation, this response already gives an indication some local governments are spontaneously adapting to climate change.

"None-React to Damage"

"I am following best practice; no formal designation taken"

Others associated responsibility with other departments or organizations or some combination.

"It's a combination of people from Public Safety, Planning and Environmental Mgmt [management]"

"unaware of anyone, likely the County Health Dept" "Emergency Services 911"

"NWEAC (North Westchester Energy Action Coalition"

Responses also showed local governments were in the process or attempting to address climate change impacts.

"Ad hoc group just forming"

"We currently have a temporary position working on these types of issues (grand funded)"

A number of those surveyed indicated there was a person, department or unit responsible for adapting to climate change (42 individuals). The written responses obtained make it clear local government in New York State are just at the beginning stages of adapting to climate change. First, to a number of local governments or employees it is unclear who - if anyone - is responsible for climate preparedness measures. Second, some local governments are currently responding to climate events as they happen as opposed to planning ahead of time. Third and lastly, temporary positions and external groups are beginning to form which attempt to address climate preparedness measures.

Local Government Climate Change Memberships

To better understand the influences of outside organizations on the decision of local governments to address climate change impacts and the networking taking place among local governments, all respondents were asked to indicate if their local government held an organizational membership to a program promoting climate change mitigation or adaptation.

Nearly all 141 respondents answered this question, 85% of respondents indicated their local government did not hold a membership to an organization promoting local government action to address climate change. Nineteen local governments indicated they were a member of such an organization. There were a number of open-ended responses to this question.

Which, if any, is your local government a member of (Select all that apply)?		
Answer Options	Response Percent	Response Count
ICLEI-Climate Resilient Communities	1%	2
ICLEI-Cities for Climate Protection	3%	4
DEC-Climate Smart Communities	7%	10
Sierra Club-Cool Cities Program	0%	0
Mayor's for Climate Protection	2%	3
None	85%	117
Other (please specify)	8%	11
	Answered question	138
	Skipped question	4

Table 7: Responses to Survey Question 18: Local Government Membership in a Climate Organization
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Again, the topic of disbelief surfaced; one respondent appeared to be personally offended by the mention of ICLEI. Two respondents indicated their local governments to be former members of ICLEI and one mentioned they found no value in the membership. Another respondent indicated their local government was currently in legislative process of joining the New York State Climate Smart Communities Program. Additionally, a handful of respondents indicated their local governments to have other types of memberships/networking activities among local organizations (e.g. The Hempstead Harbor Protection Committee, Cayuga Watershed, The Adirondack Association of Towns and Villages, and Pace University). Finally, two respondents were uncertain as to whether their local government obtained a membership to a climate change organization.

Local governments indicating they were preparing for climate change impacts were also asked whether an outside agency had influenced their decision to address climate change impacts. Just 16 of 24 respondents directed to this question decided to respond to it. Non-governmental agencies were selected as affecting the decision of local governments to address climate change the most, followed by state agencies. Universities and federal agencies appeared to have had less of an impact on the decision to adapt.

Did any of the following impact the decision to address climate change impacts?		
Answer Options	Response Percent	Response Count
Non-governmental agency	56%	9
Universities	6%	1
Federal agencies	19%	3
State agencies	44%	7
	Answered question	16
	Skipped question	126

Table 8: Responses to Survey Question 12: Influence of Outside Agency on Decision to Conduct Planned Adaptation
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

7.1.3 Strengths and Limitations of the Sample

Implications of Sampling Technique and Sample Characteristics Representativeness

Although the intended sampling technique was simple random sampling, a convenience sample is more likely to have taken place. Due to the quality of the e-mail database not all local governments had an equal chance of being included in the survey. As participation was completely voluntary, there is also a risk of non-response bias, nevertheless, this is the case with a great many research studies. Regardless of the weaknesses of this method, it was the best option available. The database used at the time had also been used by other state departments to communicate with local governments. Furthermore, obtaining the database of local government e-mails resulted in instant access to hundreds of local government officials.

Despite the use of a convenience sample, the characteristics of the sample are similar to the population of local governments in New York State. That is to say, the majority of local governments in New York State are small, rural and often located near water bodies. Since the sample is similar to the population of local governments, the responses to the survey are believed to be representative. However, the results of the survey may not be representative of some of the government types. For example, the majority of responses were received from rural local governments with populations of 10,000 or less. Few responses were received from local governments with populations of 30,000 to 50,000. What is more, the majority of the responses collected originated from rural areas as opposed to urban. Therefore, it is not certain if responses can generalize to all local governments equivalently. As a consequence,

the results of the survey generalize best to small, rural local governments. Although this is the greatest weakness of the sample, it is also its greatest strength. Small, rural local governments are a group that up until this point has been largely excluded within innovation research in general and specifically in both mitigation and adaptation climate change research.

In terms of representing the opinions of local government officials in New York State, responses were received from most parts of the state minus a few counties - not a small feat considering New York State is approximately 1/3 the size of Germany (i.e. New York State 127,515 km² vs. Germany 357,100 km²). In addition, opinions were gathered from a variety of municipality types: cities, villages, towns, and counties. Finally, in addition to covering much of the state geographically among a variety of municipal types a wide range of populations were included (e.g. ranging from under 5,000 up to over 300,000). This has been enough to compare responses across groups.[15]

7.2 Which Local Governments are Adapting and how? Examining Planned and Spontaneous Adaptation in NYS (RQ1)

As the online survey was being prepared it was difficult to find any evidence that planned adaptation to climate change was taking place in New York State other than in New York City.

The Department of Environmental Conservation implemented the Climate Smart Communities Program in 2009 and was a useful resource throughout the research process. Through staff experiences with implementing the Climate Smart Communities program an understanding of where the most interested, active and climate change aware local governments were located was possible. In 2010 the Climate Smart Communities Program had 80 local government members of which only a handful had completed local action plans (e.g. Cortland, Greenburgh, Irondequoit and the City of Ithaca). Twenty-four of the climate smart communities resided in Westchester County. Interest in the CSC program and awareness of climate change existed in downstate areas of Long Island, New York City and the lower Hudson Valley. Less interest in climate change existed in the upstate areas. Those interested tended to be concentrated around the universities in the state such as in Syracuse (Syracuse University and the State University of New York College of Environmental Science and Forestry) and Ithaca (Cornell University and Ithaca College). The CSC program in the early stages had no local government members

[15] WHEN CONDUCTING SURVEY RESEARCH AT LEAST 40 CASES ARE NEEDED FOR EACH INDEPENDENT VARIABLE THAT YOU INTEND TO ENTER INTO THE ANALYSIS (SAPSFORD, 2007).

from Western New York State. As of March 2015 the CSC program has grown to include 149 members (Climate Policy Analyst, March 2015).

One downfall of the information provided by the CSC program in 2010 was that it mostly focused on mitigation. The program has since placed more emphasis on adaptation. However, interest by local governments themselves has continued to be focused on mitigation. Furthermore, the majority of local government members have failed to implement or at least submit finished local action or adaptation plans.

Discussions with other experts outside of the CSC program also indicated interest within the state regarding climate change has mostly focused on green building, green power (e.g. wind) and reducing greenhouse gases. Small coastal communities were identified as reacting to climate change but not perceiving it as such which indicated that spontaneous adaptation was taking place. However, one informant response indicated local governments tend to focus on sea-level rise rather than an array of climate change impacts.

As part of the background for this research state programs that address climate change and adaptation were purposely sought out; however, information on programs that are available to local governments in New York State was not fully available. For example, during informant discussions the Local Waterfront Revitalization Program was mentioned. However, it took several Google searches even knowing the name of the program to locate its website. This highlights the need for the programs to be better promoted to ensure local governments are informed of the services available to them when attempting to reduce their communities' vulnerability to climate change.

7.2.1 Spontaneous Adaptation to Climate Change in New York State

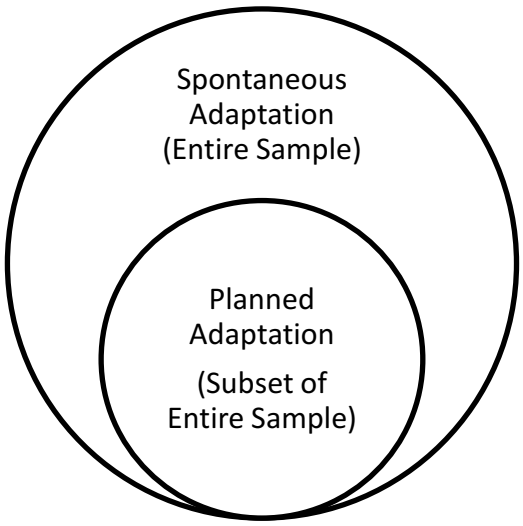

Figure 20: Identifying Planned Adaptation among the Sample
(Source: Author's Illustration)

Alternatively, an effort was made to identify actions being carried out by all local governments who responded to the survey which could help to minimize the negative effects of climate change. This was carried out by first identifying actions local governments could/or often do take to adapt to climate change and asking all respondents if they were implementing any of those measures (e.g. identifying flood plains, updating storm-water infrastructure, promoting open-space). The purpose of doing this was to identify spontaneous adaptation among local governments (i.e. unintentional, reactive adaptation). All survey respondents were asked if they were taking actions to prepare for climate change impacts (i.e. planned adaptation) in order to identify those that were implementing measures to intentionally address climate change.

Beyond examining just whether or not climate change adaptation was taking place survey questions measured how exactly local governments were conducting spontaneous and planned adaptation.

Spontaneous adaptation takes place without the actor deliberately taking actions to address climate change as such but simply reacting to environmental stimuli. Such reactive adaptation are actions local governments are taking which may be related to reducing risk to climate change impacts. These actions are not intentionally performed to address climate change impacts per se, but occur in response to already experienced impacts. Respondents may not even believe in climate change and yet conduct spontaneous adaptation. Due to time constraints and concerns about respondent fatigue, the examination of spontaneous adaptation among the sample needed to be narrowed. Based on the climate impacts expected/incurred in New York State and the actions available to local governments to reduce climate change impacts, measures included belong to three categories: flooding, public health and public outreach.

Spontaneous Adaptation to Flooding

An abundance of water bodies in New York State make it prone to flooding in many regions. Therefore, all respondents were asked whether or not their local government was taking measures to reduce vulnerability to flooding. Respondents were asked whether or not they were taking specific measures to prevent flooding damage such as upgrading storm water infrastructure, upgrading building infrastructure and promoting healthy forests to prevent flooding damage. Respondents were also given the option to select “other” and specify activities they were taking to address flooding.

Seventy-two percent of respondents indicated their local government had upgraded storm water infrastructure. A large percentage also indicated they were managing flood plains or promoting open-space and functional watersheds as a means to decrease flooding damage. Fewer respondents indicated they had upgraded building

infrastructure or promoted healthy forests as a means to reduce flooding damage. Beyond these measures respondents indicated they were taking part in other activities to reduce damages due to flooding.

Which, if any, of the following measures has your local government taken to decrease FLOODING damage (select all that apply)?		
Answer Options	Response Percent	Response Count
Upgrading storm water infrastructure	72%	84
Upgrading building infrastructure to handle large	22%	26
Promoting healthy forests	19%	22
Promoting open-space	47%	55
Promoting functional watersheds	42%	49
Managing flood plains	57%	66
Other (please specify)		4
Answered question		116
Skipped question		26

Table 9: Survey Question 8: Identifying Measures Taken to Reduce Flood Damage (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Respondents mentioned they were conducting other activities to reduce impacts due to flooding, such as prevention of erosion.

"Investigate 'rip-rap' along river and streams"

"Rip-rap" refers to the use of stones and other materials such as concrete near shoreline or river embankment areas which may serve to prevent erosion (Merriam-Webster Dictionary, 2013). Erosion may be caused by large waves, ice or flooding. Changes in climate are associated to increases in erosion along shorelines due to more frequent occurrences of conditions which cause erosion (United States Environmental Protection Agency, 2011a). The use of rip-rap as a buffer has been used in New York City to protect communities bordering the East River from storm surge (Navarro, 2012).[16]

Another respondent mentioned upgrading infrastructure or "replacement of lines" which is probably in reference to upgrading pipes of some sort.

WRITTEN RESPONSES

Responses to the "other" category for this question indicated respondents were working collaboratively with other departments in other municipalities to address flooding impacts.

[16] STORM SURGE IS AN ABNORMAL RISE OF WATER GENERATED BY A STORM, OVER AND ABOVE THE PREDICTED ASTRONOMICAL TIDE (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, 2013).

"joint effort with NYCDEP[New York City Department of Environmental Protection] and NYSDEC [New York State Department of Environmental Conservation] on (…) Creek"

In summary, the survey sample indicated local governments are doing the most to reduce flooding impacts within their communities. They by far are upgrading infrastructure which may help them to deal with the negative impacts of flooding. It can also be seen from the survey responses that many local governments are promoting open space and promoting functional watersheds as a means to address flooding. From the three categories addressed in this section relating to spontaneous adaptation respondents were far more interested in the measures related to flooding, rather than public health and public outreach. All but 26 respondents answered the questions related to flooding; hat is, the flooding question received 116 responses, whereas the questions asking about public health and outreach received responses from just half of the sample.

Spontaneous Adaptation concerning Public Health

High temperatures, extreme weather, increases in infectious diseases, decreases in air quality, and flooding were identified as the most serious impacts expected to negatively affect public health in New York State (Rosenzwieg 2011b). Considering expected impacts to public health due to climate change, respondents were asked what they were doing to protect public health. This question received far fewer responses than the questions dealing with flooding.

Of those that responded to this question, the most common response to addressing public health was providing access to healthcare during emergencies, followed by providing access to cooling centers during days of extreme temperatures. Some respondents indicated they were managing the spread of infectious diseases and had already installed a flood warning system. Few indicated they were managing air quality or had installed a high temperature warning system. A number of respondents took advantage of the opportunity to elaborate on what their local governments was doing to protect public health.

Which, if any, of the following measures has your local government taken to protect PUBLIC HEALTH (select all that apply)?		
Answer Options	Response Percent	Response Count
Access to cooling centers during high temperature	47%	35
Public access to health care during emergencies	51%	38
Managing spread of diseases (e.g. spraying for	26%	19
Managing air quality	12%	9
Installation of a high temperature warning system	4%	3
Installation of flood warning system	28%	21
Other (please specify)		10
	Answered question	74
	Skipped question	68

Table 10: Survey Question 6: Identifying Measures Taken to Protect Public Health (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

WRITTEN RESPONSES

One respondent referred to the "well developed emergency management plan at the county level" and pointed out that each town had its own emergency management plan. It is not certain from this response that the measures included in the emergency management plan would include climate change impacts.

"we have a well-developed emergency management dept at the county level and each town has its own emergency management plan"

Two respondents indicated they had taken measures to improve communication between their local government regarding weather related emergencies. One community chose to communicate via e-mail and the other via text messaging.

"[Our local government] email [s] locations of cooling centers, flood warnings, [and] air quality to residents"

"Installation of email/voice/text emergency notification system"

An additional respondent indicated providing shelter to those needing it during cold temperature days.

"open centers during extreme cold"

Two respondents indicated the existence of barriers toward protecting public health including bureaucratic hurdles between state and local government and a lack of financial resources.

"Not allowed. Incompetent State government"

"none-small town, limited budget"

Just half of those surveyed decided to respond to the question examining spontaneous adaptation to protect public health. The written responses from those completing the survey can perhaps shed some light as to why many chose to skip this question. Perhaps some local governments feel it is not their responsibility to address public health. As seen from one response to this question, local governments may associate protection of public health to county governments. Others may not have the financial resources due to the small size of their local government or feel they are being prevented from protecting public health by the state. Still, from this question we see that approximately a quarter of the entire sample is providing access to cooling centers on high temperature days and access to healthcare during emergencies. Furthermore, a number of respondents indicated they were managing the spread of infectious diseases and had installed flood warning systems.

Spontaneous Adaptation concerning Public Outreach

Based on the number of impacts expected to affect the public, outreach was identified as an important area of concern where local governments could take an active role in reducing vulnerability. Climate change impacts are expected to result in increases of incidences such as wildfires, heat-waves, flooding and infectious borne diseases. Increasing awareness of these incidences and of the appropriate actions the public can take, increase the likelihood of easing negative impacts. Local governments were asked whether or not they provided education in the aforementioned areas.

Which, if any, of the following measures has your local government taken toward PUBLIC OUTREACH (select all that apply)?		
Answer Options	Response Percent	Response Count
Wildfire safety education	17%	11
Heatwave awareness education	21%	14
Flooding awareness education	76%	50
Infectious borne illness education (e.g. lyme	39%	26
Other (please specify)		10
	Answered question	66
	Skipped question	76

Table 11: Survey Question 7: Identifying Measures Taken Toward Public Outreach (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

The question concerning local governments' public outreach measures received even fewer responses than the question dealing with public health measures. This could be interpreted in two ways. Either the majority of local governments surveyed do not

believe it is their responsibility to address public outreach or they just do not see the need for it or both. Local governments are doing the most in terms of public outreach to educate the public about flooding. Fifty respondents indicated their local governments were taking measures to educate the public about flooding. Other than providing flooding awareness education, most often respondents indicated they were educating the public concerning the spread of infectious disease. Few local governments indicated they were providing wildfire safety or heat wave awareness education. There were a number of written responses to this question.

WRITTEN RESPONSES

Some of the written responses were repeated from the previous question. For example, one local government indicated the county level government to be conducting public outreach. The topic of not having the budget due to small government also surfaced as well as being prevented from action by state level government.

"through Livingston County"

"none-small town, limited budget"

"not allowed incompetent State government"

Others indicated they were implementing other measures not included in the multiple choice question, such as public outreach to the elderly, environmental pollution in water sources and the provision of screening, clinics environmental as well as emergency information to the public.

"living conditions for poor and elderly"

"screening and clinics, environmental education"

"storm water drainage pollution, harmful effects of fertilizer runoff causing hypoxia (low oxygen) in surrounding waters"

"emergency information"

Similarly to the previous question dealing with public health, this question received a small number of responses. Again, as with public health, the low response rate for this question could be explained by a local government perception that public outreach is not the responsibility of their municipality. Furthermore, perhaps the reason many local governments did not respond to this question was because they are not attempting to conduct public outreach measures. Even among those that responded to this question - with the exception of flooding awareness education - very little is being done in terms of public outreach. This may be explained by barriers such as limited budgets and bureaucratic hurdles.

7.2.2 Planned Adaptation to Climate Change in New York State

Whereas the previous section examined spontaneous adaptation among the sample survey, this section examines planned adaptation. As previously discussed planned adaptation is adaptation to climate change that takes place deliberately as opposed to spontaneous adaptation. Planned adaptation includes deliberate actions and may include the implementation of policies by local governments. More concretely, the attempts of local governments to utilize the powers granted to them by the state and federal constitutions to reduce their communities' vulnerability to climate change were measured.

a) Identifying Adaptation Planning Stage

A small number of local governments indicated they were conducting planned adaptation to climate change. Twenty-four local governments indicated they were planning to adapt to climate change. Those that said they were conducting planned adaptation to climate change included 3 cities, 8 villages, 12 towns and 1 county, which appear to reflect the proportion of these government types among the sample (i.e. 5 cities, 30 villages, 75 towns and 7 counties said no, they are not preparing for climate change impacts). The majority or 14 of those that said they were adapting to climate change had populations below 10,000, five responses had between 10,000-20,000 residents, three respondents between 20,000-30,000 residents, one response between 100,000-300,000 residents and lastly, one response had over 300,000 residents. Local governments indicating they were adapting to climate change impacts received were approximately equally from urban and rural areas (however, percentage wise more local governments from urban areas are conducting planned adaptation). In terms of location, those that said they were adapting tended to be located either in New York City or North of the city with some scattered outliers (e.g. one response was received from west of The City of Buffalo).[17] Some New York City counties identified as having a high risk in terms of flooding seem to be some of the most active in terms of those surveyed. Five local governments in Nassau County said they were discussing climate change and four in Dutchess County. Furthermore,

[17] NUMBER OF LOCAL GOVERNMENTS CONDUCTING PLANNED ADAPTATION BY COUNTY: ALBANY 1, CAYUGA 1, CHAUTAUQUA 1, DELAWARE 3, DUTCHESS 4, ESSEX 1, MADISON 1, MONROE 1, ORANGE 1, TOMPKINS 1, ULSTER 1, WESTCHESTER 4, WYOMING 1. NUMBER OF LOCAL GOVERNMENTS DISCUSSING CLIMATE CHANGE BY COUNTY: ALBANY 1, ALLEGANY 1, BROOME 3, CATTARAUGUS 1, CHAUTAUQUA 1, CHEMUNG 1, CLINTON 1, COLUMBIA 1, DELAWARE 3, DUTCHESS 4, ERIE 2, ESSEX 2, FRANKLIN 1, FULTON 1, HAMILTON 1, JEFFERSON 2, LIVINGSTON 2, MADISON 1, MONROE 2, NASSAU 5, NIAGARA 1, ONEIDA 1, ONTARIO 1, ORANGE 2, OTSEGO 3, PUTNAM 1, ROCKLAND 1, SHOHARIE 1, SCHUYLER 1, STEUBEN 2, TOMPKINS 1, ULSTER 2, WARREN 1, WESTCHESTER 8, WYOMING 2.

four local governments from Westchester and four local governments from Dutchess County indicated they were conducting planned adaptation.[18]

However, it was difficult to identify exactly what some local governments were referring to when they indicated that they were adapting to climate change. Four local governments indicated they were currently creating a climate preparedness plan. No single local government indicated they had finished a climate preparedness plan or were able to implement a preparedness plan. Eight local governments indicated they were currently integrating climate preparedness measures into other plans. That is, from the 24 local governments that said they were planning for climate change adaptation only 12 could provide a definitive response to this survey question.

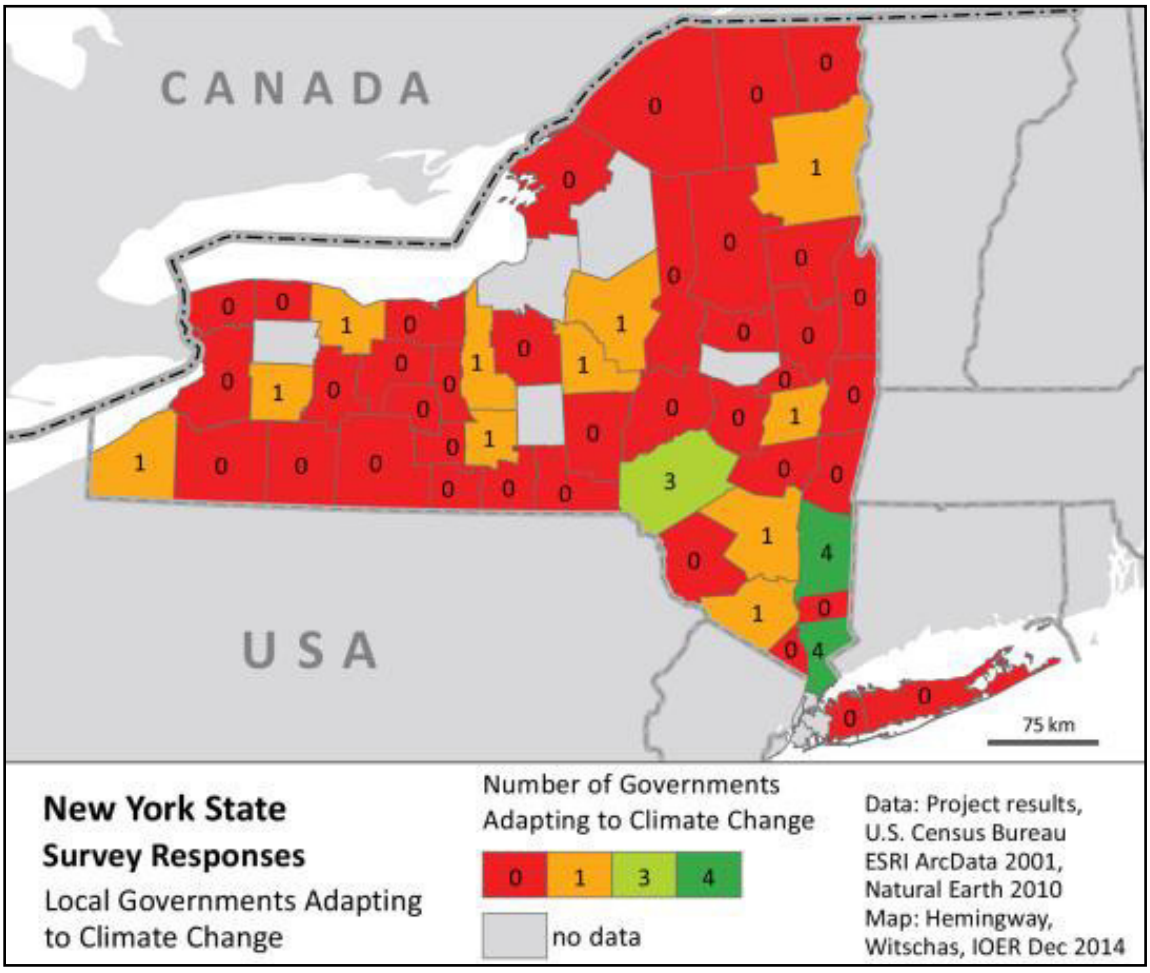

Figure 21: Local Governments in New York State Adapting to Climate Change (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

[18] NEW YORK CITY COUNTIES IDENTIFIED AT MOST RISK FOR FLOODING INCLUDE: NASSAU, KINGS, QUEENS, SUFFOLK, NEW YORK, BRONX, RICHMOND, WESTCHESTER, ROCKLAND, AND DUTCHESS (CLIMATE CENTRAL 2012. SEA LEVEL RISE, STORMS, AND GLOBAL WARMING'S THREAT TO THE U.S. COAST). AMONG THOSE PARTICIPATING IN THE SURVEY 5 LOCAL GOVERNMENTS IN NASSAU COUNTY, 1 LOCAL GOVERNMENT IN ROCKLAND COUNTY AND 4 LOCAL GOVERNMENTS IN DUTCHESS COUNTY SAID THEY WERE DISCUSSING CLIMATE CHANGE. FOUR LOCAL GOVERNMENTS FROM WESTCHESTER AND 4 LOCAL GOVERNMENTS FROM DUTCHESS COUNTY INDICATED THEY WERE CONDUCTING PLANNED ADAPTATION (24 RESPONDENTS TOTAL IDENTIFIED AS CONDUCTING PLANNED ADAPTATION FROM SAMPLE SURVEYED).

How is your local government planning for climate change adaptation?		
Answer Options	Response Percent	Response Count
Currently creating a climate preparedness plan	33%	4
Have finished a climate preparedness plan	0%	0
Implementing a climate preparedness plan	0%	0
Integrating climate preparedness measures into other	67%	8
Other (please specify)		2
Answered question		12
Skipped question		130

Table 12: Survey Question 13: Identifying Planned Adaptation Stage
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December 2011)

b) Identifying Climate Change Vulnerability

Local governments were asked whether or not they were taking steps to identify vulnerabilities to climate change in their jurisdiction. A three point scale was provided including "already implemented", "considering implementing" or "have not implemented" in terms of the following: creation of a climate change committee, map updates (e.g. flood plains, landslides), invasive species assessments, infrastructure vulnerability and infrastructure assessments. Of the 24 respondents directed to this question 14 responded. Amongst the small number of respondents directed to this question, the majority indicated they had already updated flood plain maps and there seemed to be considerable interest in conducting infrastructure vulnerability assessments. There was limited interest in the creation of a climate change committee or conducting invasive species vulnerability assessments. Seven respondents indicated interest exists within their local government to conduct a climate impact assessment. Due to input gained in a focus group conducted in the summer of 2011, landslide susceptible analysis was included as a response option. A number of respondents indicated it was not applicable for them to conduct a landslide susceptibility analysis and that they did not intend to conduct one. Although this response option is not included here it has an important implication. It is reassuring to witness the honesty and objectivity of the respondents in answering survey questions.

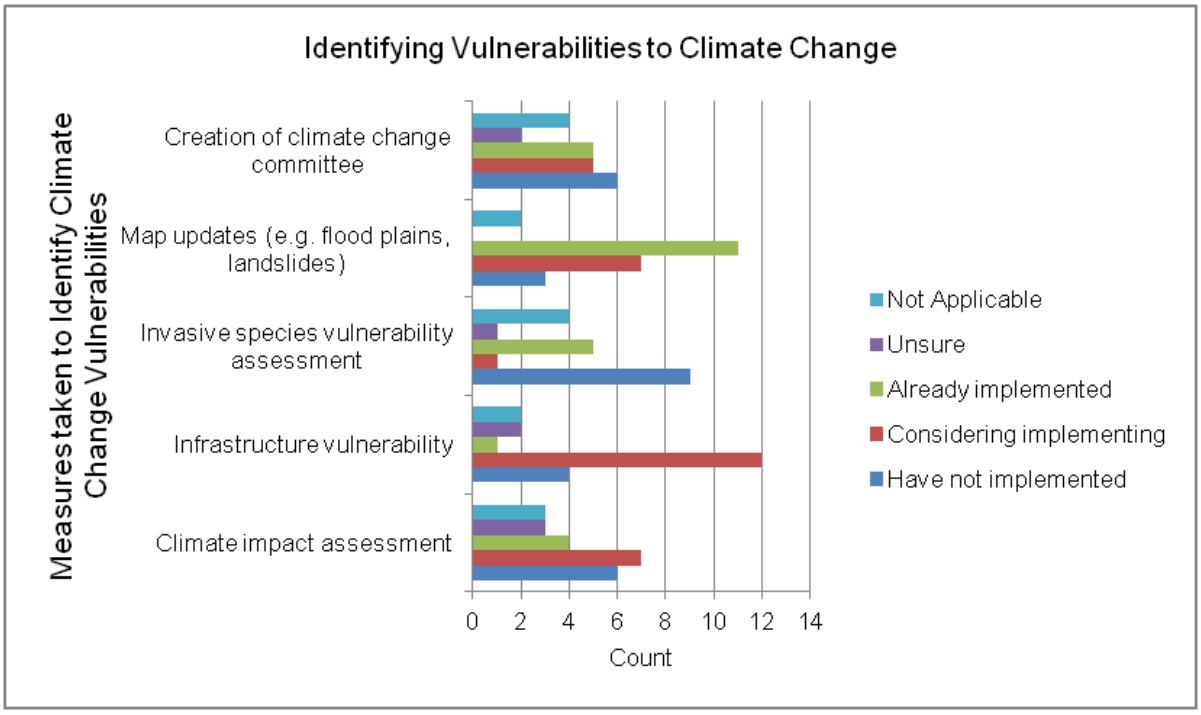

Figure 22: Identifying Vulnerabilities to Climate Change
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

c) Anticipation of Possible Climate Change Benefits Among Sample

Respondents were asked in addition to climate change planning and climate change vulnerability assessments if they were anticipating benefitting from climate change. As the vast majority of respondents indicated they were not addressing climate change impacts and those that indicated they were addressing impacts for the most part have not yet begun to plan for climate change or identify vulnerabilities, it is no surprise that the vast majority do not expect to benefit in some way from climate change.

Regardless whether or not respondents anticipated their community to benefit from climate change impacts, they appeared to be interested in the question, as all 22 respondents directed to this question responded to it. At most respondents anticipated a reduced need for snow removal and increases in agricultural production. Respondents did not appear to anticipate benefitting from increases in summer recreation, summer tourism or increases in certain fish populations. This question was in some ways too advanced for local governments that appear to just beginning to think about climate change (a possible indication of this is the absence of written responses to this question).

Does your local government anticipate any of the following benefits due to changes in climate (Select all that apply)?			
Answer Options	Yes	No	Response Count
Increases in summer recreation	4	17	21
Increases in summer tourism	3	18	21
Increases in certain fish populations	2	19	21
Increases in agricultural production	6	14	20
Reduced need for snow removal	7	15	22
Other (please specify)			0
		Answered question	22
		Skipped question	120

Table 13: Survey Question 15: Identifying Anticipated Benefits Due to Climate Change (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

7.2.3 Adaptation More Likely in Urban Areas (Hypothesis 1: Urban vs. Rural Adaptation)

Here the hypothesis is examined that local governments located in urban areas are more likely to conduct planned adaptation than rural local governments. Rural local governments tend to be smaller than urban local governments. Researchers have found larger cities to be more likely to adopt energy and climate change mitigation policies than smaller cities, as smaller cities often lack technical, financial and planning resources (Bingham, 1976; Krause, 2010; Vasi, 2006). In order to measure this hypothesis, survey respondents were asked whether or not they were conducting planned adaptation to climate change and whether or not their local government was located in a rural or urban setting. A cross-tabulation was created in order to measure the independent variable (urban/rural) and two dependent variables were examined – planned adaptation and whether or not discussion about climate change was taking place.

Hypothesis 1 (RQI): Local governments in *urban areas* are more likely to conduct planned adaptation to climate change.

Examining the Influence of an Urban vs. Rural Landscape on the Decision to Conduct Planned Adaptation

The majority of respondents indicated they were located in rural areas and that they had populations below or around 10,000. Seventy-percent of the sample indicated they were located in rural areas, 23% in suburban and 5% in urban. This would also be logically expected, as the majority of New York State counties are rural. When examining which local governments were adaptation according to population size, it

was observed that as population increased the percentage of local governments having said their local government was conducting planned adaptation also increased (i.e. 13.1% of local governments with a population below 10,000 indicated they were conducting planned adaptation, 30.8% of local governments with populations ranging from 10,000 to 100,000 indicated they were conducting planned adaptation and finally 33.3% of local governments with populations ranging from 100,000-300,000 indicated their local government was conducting planned adaptation to climate change). Examining this further, the results of the cross-tabulations table also show that local governments in urban areas (which tend to have larger populations than urban areas) are more likely to be conducting planned adaptation to climate change. A significant association was found between explicitly addressing climate change impacts and whether or not the local government serves a rural or urban area.

Test of Significance for Urban vs. Rural and Conducting Planned Adaptation:

$$\chi^2(1) = 8.950, p = .003$$

Based on the cross-tabulation table and test of significance:

Local governments located in urban/suburban areas are more likely to be preparing for climate change impacts than rural local governments.

Conducting Planned Adaptation	Urban/Suburban	Rural	Total
Yes	13	11	24
No	27	87	114
Total	40	98	138

Table 14: Cross tabulation: Conducting Planned Adaptation and Urban/Suburban versus Rural Landscape
(Source: Author's Illustration)

Results also indicate urban and suburban local governments are more likely to be discussing climate change than rural local governments.

$$\chi^2(1) = 11.761, p = .001.$$

Based on the cross-tabulation table and test of significance:

Local governments located in urban/suburban areas are more likely to be discussing climate change than rural local governments.

Discussing Climate Change	Urban/Suburban	Rural	Total
Yes	30	42	72
No	10	56	66
Total	40	98	138

Table 15: Cross tabulation: Discussing Climate Change and Urban/Suburban versus Rural Areas (Source: Author's Illustration)

Results of Hypothesis 1 (RQI):

Results indicate urban and suburban local governments are more likely to be discussing climate change than rural local governments. *Local governments located in urban/suburban areas are more likely to be preparing for climate change impacts than rural local governments.*

Hypothesis 1 (RQI): Local governments in *urban areas* are more likely to conduct planned adaptation to climate change and to be discussing climate change.

8 Identifying Influences on the Decision to Conduct Planned Adaptation (RQ 2)

In this chapter the influences affecting the decision of local governments to conduct planned adaptation to climate change are examined. One purpose of the online survey was to examine the internal and external influences on climate change decision making. Respondents were asked directly what influenced their local governments' decision to conduct planned adaptation or not. Additionally, respondents were asked more general questions about the resources available to address climate change impacts and about their connectedness to outside organizations. Respondents were probed to indicate whether or not their local government was taking steps to prepare for climate change impacts. Respondents indicating they were preparing for climate change impacts were asked additional questions concerning climate change planning, conducting of vulnerability assessments, etc. Both groups were asked directly why their local government had decided one way or the other to prepare for climate change impacts. Before survey responses are examined in more detail, the number of local governments from the sample conducting planned adaptation is discussed.

8.1 Opinions of Environmental and Climate Change Experts

According to informants, the conditions that local governments face throughout New York State vary and are likely to impact the decision to conduct planned adaptation to climate change. That is, incentives and barriers experienced vary, eligibility for grants or other funding vary depending on municipality type, size or memberships and attitudes of the voters differ depending on the community. The attitudes of citizens are likely to impact the decision of local government officials to join climate change organizations or conduct planned adaptation to climate change. One topic which was repeatedly mentioned by climate change experts in New York State is that no requirement exists for local governments to consider climate change impacts. The absence of a requirement to address climate change impacts helps to explain the low level of planned adaptation and highlight the importance of understanding motivation behind the decision of local governments to conduct planned adaptation. According to informants, many local governments do not consider climate change adaptation to be a priority for a number of reasons. In particular, there is some disbelief in climate change; some local governments are simply not convinced climate change exists. However, for those looking to conduct planned adaptation to climate change it can be a challenge. According to informants, a support system for local governments looking to address climate change impacts is not in place and nation-wide momentum on

climate change is missing. For others, especially those located in coastal areas, the risk is very real and motivation exists to adapt. New York local governments are challenged to provide basic needs of citizens and at the same time are dealing with outdated technology and infrastructure. Many local governments, especially small ones, do not have the capacity to conduct planned adaptation to climate change in terms of staff numbers, budget and other resources.

8.1.1 Motivation toward Conducting Planned Adaptation

The vast majority of respondents indicated their local government was not taking measures to address climate change impacts, with only 24 of 141 local governments indicating that measures were being taken. That is, the vast majority of survey respondents indicated they were not conducting planned adaptation to climate change.

As stated by respondents, the biggest reasons for not addressing climate change impacts have to do with resources such as budget, staff and climate change expertise. What is more, respondents are focused on dealing with current issues facing their municipalities, as one respondent said their local government is focused on “immediate survival”. Disbelief in climate change internally within local governments is also affecting the decision of local governments to conduct planned adaptation. Uncertainty regarding the causes and distrust in climate science appear to influence whether or not local governments are willing to take climate change seriously. What is more, some local governments perceived disbelief in climate change to exist within the community itself. In addition to resource constraints and cultural barriers, jurisdictional conflict has been identified as another barrier to local government adaptation to climate change. Finally, as can be seen from written responses some interest exists to conduct planned adaptation among local governments in New York State but uncertainty regarding the proper response exists.

Although the vast majority of the sample indicated they were not conducting planned adaptation, a small number indicated they were intentionally addressing climate change impacts.

What prompted the decision to address climate change impacts (Select all that apply)?		
Answer Options	Response Percent	Response Count
Presence of a climate change leader	17%	4
Severe weather concerns	58%	14
Ecosystem changes (e.g. invasive species, fish	17%	4
Economic risk	17%	4
Concern about the future	50%	12
Knowledge of climate change	67%	16
Other (please specify)		3
	Answered question	24
	Skipped question	118

Table 16: Survey Question 11: Identifying Influence on Decision to Conduct Planned Adaptation (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

The most common responses given for conducting planned adaptation included: knowledge regarding climate change, severe weather concerns and concern regarding the future. To a much lesser extent, the presence of a climate change leader, ecosystem changes, and economic risk were given as reasons for conducting planned adaptation. Written responses to this question noted other possible influences on the decision to conduct planned adaptation beyond what was provided in the multiple choice section. It appears that increased awareness of the environmental conditions influenced the adaptation decision among one local government. The respondent indicated that their local government was prompted to address climate change impacts after preparation of an open space plan.

WRITTEN RESPONSES

"Prep [preparation] of open space plan"

Another respondent indicated their local government was influenced to conduct planned adaptation after witnessing flooding occurring within bordering towns.

"Severe flooding in neighboring towns"

Finally, a third local government appeared to be influenced to conduct planned adaptation due to financial support from the federal government.

"Federal grant funds to prepare a Climate Action Plan"

8.1.2 Obstacles toward Conducting Planned Adaptation

To better understand the influences of federal and state governments - as well as the impact of the general public - on local government adaptation decision making respondents were asked a number of questions about their perception of the support that exists external to their local government to address climate change impacts. All respondents responded to this question. About 70% of respondents perceived no financial support available from the federal government to address climate change impact; another 20% or so indicated there was some financial support available. Only four respondents said federal financial support exists for local governments to address climate change impacts. Local government perceptions of state level financial support were nearly identical. More support was perceived in terms of federal level informational support available to local governments addressing climate change impacts. Approximately 15% (n=22) of respondents perceived the existence of federal informational support, while 40% (n=55) indicated that there was some informational support. The perception of informational support available from the state was even greater. Nearly 20% (n=24) of local governments perceived the state to be providing information on addressing climate change impacts and another 30% or so (n=45) indicated there was some information available from the state. Finally, in terms of general local government support to address climate change impacts nearly 60% of respondents indicated public support exists (22% or 32 respondents indicated “yes public support exists” and 34% (n=48) indicated “some public support exists”).

As with the previous questions, respondents were given the option to provide open-ended responses. Again, two comments proclaiming their denial to the existence of climate change were present. Another respondent wrote they were unaware of support for climate change measures but were aware of support for “green” initiatives. An additional comment provided voiced frustration with the lack of support for small governments from both state and federal levels. In addition, this respondent felt their municipality faced a number of challenges including economic blight, a lack of employment opportunities and jurisdictional conflict with other governmental levels in solving these challenges. Another respondent felt support existed for local governments looking to address climate change impacts but was not easily accessible. Lastly, one respondent said there was support available from the county level to address climate change impacts.

For most survey questions respondents were given the option to select “other” and provide their opinion. Respondents were additionally given the opportunity to provide further comments at the close of the survey. A fair number of respondents took advantage of this opportunity. Again, disbelief in climate change was a topic of discussion. Some had a disbelief in climate change in general or did not believe in

man-made climate change. A few respondents seemed to genuinely distrust climate science or science in general. One respondent suggested preparing for climate change impacts although not believing climate change to be manmade. Another recalling 70 years of life experience was uncertain if climate change existed because he presumed climate change to be a natural part of the earth's cycle and discussed the difficulties of human perception of time and climate change.

WRITTEN RESPONSES

Others showed belief and concern regarding climate change, as demonstrated in this quote:

> *"I think we're only beginning to see what climate changes might be expected in Saugerties and the Hudson Valley region of New York. More extreme weather, possibly heating, but not sure. Effects: more storm damage, flooding, erosion, tree loss."*

Another respondent attested to concern within their local government but said they were just preoccupied with meeting current pressing issues:

> *"Please bear in mind just because we are doing list [little] about climate change at this time, that we are not concerned. We are. However, with so many people facing foreclosure of their homes, or loss of their jobs, their minds are focused on immediate survival."*

The most common response given for not addressing climate change impacts was currently dealing with other pressing issues (n=76). Other common responses given were related to resource availability, such as budget constraints, lack of climate change expertise and lack of staff. To a smaller extent jurisdictional conflict (n=11) was cited as a reason for not addressing climate change adaptation. It was anticipated that local governments that were not yet addressing climate change impacts perhaps had begun addressing climate change through mitigation efforts. A focus on mitigation has not been given as a reason to not yet conduct planned adaptation, as just seven local governments indicated their efforts were currently focused on mitigating climate change as a reason for not addressing climate change impacts.

Seventeen local governments indicated they were not addressing climate change impacts because their local government does not believe climate change to exist.

Why has your local government decided not to address climate change impacts at this time (Select all that apply)?		
Answer Options	Response Percent	Response Count
Our efforts are focused on mitigation (CO2 reduction)	6%	7
Currently dealing with other pressing issues	64%	76
Lack of climate change expertise	49%	58
Jurisdictional conflict	9%	11
Budget constraints	57%	67
Not enough staff	43%	51
We don't believe climate change exists	14%	17
Other (please specify)		22
Answered question		118
Skipped question		24

Table 17: Survey Question 16: Identifying Influence on Decision Not to Conduct Planned Adaptation (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

WRITTEN RESPONSES

Twenty-two respondents chose to elaborate on their decision to address climate change impacts in the open-ended section for this question. A number of the open-ended responses received for this question related to some sort of disbelief in climate change.

A number of responses exhibited disbelief in climate change, the existence thereof or doubt concerning anthropogenic climate change:

"We don't believe climate change is man-made"
"Carbon dioxide cannot influence the temperature of the atmosphere"
"Climate change has existed since the beginning of the earth. 10,000 years ago many of our lakes were not here. Further back, the Eastern United States was under an ice pack. So, yes, it exists--and there's nothing we can do to stop it. ……)"

Some respondents seemed threatened by the very topic of climate change and skeptical of science in general:

"The climate is changing naturally, as it has always done and as good science currently proves. The bad science (which I suspect you are adhering to) fuels fanatical and extremest [extremist] activities, but does no real good for any government at any level".

Other respondents perceived the existence of public disbelief in climate change:

"most residents are not sure that climate change exits"

"half of town probably dismisses climate change"

Some respondents mentioned climate change as being low on the list of priorities or not their responsibility.

"Much more work is being done about mitigation instead of climate change. Perhaps we should be preparing for climate change whether or not the cause is manmade."

Some respondents felt their communities had not been affected by climate change, were uncertain how their community would be affected or were uncertain of the measures they could take to combat climate change impacts.

"hasn't affected our area"

"Unsure what kind of impact climate change could have on a small WNY village"

"Not sure if there is a practical way to mitigate rising tides"

"not immiment [eminent] threat; inconclusive"

In some instances respondents indicated jurisdictional conflict to be the reason for their inaction:

"Our County is proscribed from any action in the NYC watershed by the NYS DEC and NYC DEP"

The largest influences on the decision to conduct planned adaptation according to respondents are possession of climate change knowledge and concern regarding severe weather. Respondents conducting planned adaptation indicated they were addressing climate change impacts due to concern regarding the future as opposed to the majority of the sample focused on dealing with current pressing issues. Written responses to this question were helpful in identifying the importance of environmental awareness and availability of funding in the decision to conduct planned adaptation.

In addition to directly asking respondents what influenced the decision to conduct planned adaptation to climate change, respondents were asked a series of questions to better understand other situational influences impacting the decision to conduct planned adaptation. All respondents were asked how concerned they were about a number of climate related impacts. They were also asked about the availability of internal resources and external support to address climate change impacts.

8.1.3 Availability of Resources toward Conducting Planned Adaptation

Survey respondents were asked whether or not their local government had the budget, staff and expertise to address climate change impacts regardless their

current or future plans regarding climate change. They were given the response options “yes”, “no” and “some”. A very small number indicated their local government possessed the resources available to address climate change impacts. Most respondents indicated their local government did not have the budget, staff or expertise to address climate change impacts. A small percentage indicated they had *some* budget, staff, and expertise available to address climate change impacts.

Regardless of current or future plans, does your local government have the following resources available to address climate change impacts?				
Answer Options	Yes	No	Some	Response Count
Budget	6	119	16	141
Staff	8	118	15	141
Expertise	9	107	26	142
Other resource constraint?				6
			Answered question	142
			Skipped question	0

Table 18: Survey Question 19: Identifying Resource Availability to Address Climate change Impacts Among Entire Sample
(Source: Author’s Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

The opinions expressed among open-ended responses were diverse. Again, a disbelief in climate change was expressed. The view that addressing climate change would be a waste of tax payer’s money was also given. There was also the perception of local opposition to action addressing climate change impacts as well as a lack of climate change awareness among local government board members. One respondent indicated that their local government was prevented from taking actions to address climate change impacts due to jurisdictional conflict. Another respondent flatly indicated addressing climate change impacts just was not a priority within their local government.

8.2 Hypothesis Testing to Identify Specific Variables which Influence the Decision to Conduct Planned Adaptation (RQ 2)

In the previous chapter spontaneous and planned adaptation among the sample were examined based on survey responses. It was found that some spontaneous adaptation to climate change is occurring, such as upgrading of storm-water infrastructure as well as identifying vulnerability toward flooding via floodplain map updates. Little planned adaptation to climate change is occurring according to the survey results, but even where local governments have said that they are adapting it is difficult to identify exactly how. However, approximately half of local governments surveyed are discussing climate change which could mean local governments in New York State are beginning to detect climate change as a problem, or at least a relevant social issue among constituents.

As gathered from the direct responses from the survey, the respondents as a whole are extremely concerned regarding heavy wind, rainfall and snow. Moderate to extreme concerns exist regarding storm-water runoff and diminishing quality of potable water. There was not a great level of concern regarding ecosystem changes among those surveyed. Although concern exists with only half of the sample having discussed climate change, the connection to climate change is often not being made. Of those having said they are conducting planned adaptation the strongest influences on the decision to adapt were extreme weather concern and concern regarding the future. This indicates that making the connection from extreme weather to climate change is an important influence on the decision of local governments to adapt. Fourteen percent of the sample said they were not adapting to climate change because they do not believe climate change exists. Beyond issues of disbelief, a greater number of local governments said they were not adapting as they are experiencing a number of other obstacles. Local governments surveyed pointed to a number of obstacles toward local government adaptation in New York State. Obstacles include current pressing issues within communities (e.g. housing foreclosures), limited local government budgets, lack of expertise, and jurisdictional conflicts between government levels (e.g. being prevented from acting by overarching governments e.g. county or state government). In this chapter the survey data is examined further in order to identify relationships between variables measured. There were two approaches to answer research questions: 1 - Directly asking respondents (which has already been completed and summarized above) and 2 - Examining the data further via hypothesis testing which will be the focus of this chapter.

Based on previous research four hypotheses have been created:

- HYPOTHESIS 1 (RQII): Local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments spontaneously adapting
- HYPOTHESIS 2 (RQII): Local governments perceiving existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change than local governments spontaneously adapting.
- HYPOTHESIS 3 (RQII): Local governments perceiving the existence of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change.
- HYPOTHESIS 4 (RQII): Local governments with large populations are more likely to conduct planned adaptation than local governments with small populations.

Dependent Variables Used to Test Hypotheses

In order to test hypotheses dependent and independent variables needed to be defined. Two dependent variables were used to test hypotheses:

(1) PLANNED ADAPTATION:

Conscious decision has been made to deliberately attempt to reduce community vulnerability to climate change.

and

(2) DISCUSSION OF CLIMATE CHANGE:

Formal discussions have taken place among elected officials concerning climate change within the respective local government.

Since the main topic of the dissertation is climate change adaptation, it would logically follow that the dependent variable measured would be local government decision to adapt to climate change. Consequently, as a result of field work, internet searches and informant discussions with climate and sustainability experts, it was believed that possibly few New York State local governments were intentionally attempting to address climate change impacts. Therefore, a second dependent variable regarding the discussion of climate change within local governments was included in the survey. In this way, even if local governments were not conducting planned adaptation, it would still be possible to examine which local governments are likely to have identified climate change as an important issue and could potentially take steps to address it in the future. By examining whether or not local governments are discussing climate change we can get a rough idea if local governments have identified climate change as a problem, which is the first step in conducting planned adaptation. There were enough local governments surveyed indicating they were conducting planned adaptation to allow using planned adaptation as a dependent variable. Nevertheless, where deemed appropriate, both dependent variables were used to test hypotheses.

Planned Adaptation (Dependent Variable 1)

As mentioned previously, 17% (n=24) of respondents indicated their local government to be conducting planned adaptation. The remaining 83% or 118 respondents indicated their local governments are not conducting planned adaptation to climate change.

Within your local government are steps being taken to prepare for climate change impacts?		
Answer Options	Response Percent	Response Count
Yes	17%	24
No	83%	118
	Answered question	142
	Skipped question	0

Table 19: Survey Question 10: Identifying Planned Adaptation among the Sample (dependent variable 1)
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Local Government Discussion of Climate Change (Dependent Variable 2)

A greater number of local governments surveyed indicated they were discussing climate change than conducting planned adaptation. Almost 55% of the survey sample indicated discussions concerning climate change had taken place within their local government. This may be a sign that local governments are beginning to identify the need to address climate change impacts. However, the majority of discussions taking place among local governments have been *informal*. Forty-seven percent (n=66) indicated *informal* discussion had taken place. Just 6% of those surveyed (n=9) indicated *formal* discussion had taken place concerning climate change. The lack of formal discussion on climate change is a sign of internal and external obstacles toward conducting planned adaptation to climate change. Climate change is on over half of local governments' radar, however, it has not been a part of the policy agenda. The results of the hypothesis tests help to shed some light on the decision of local governments to conduct planned adaptation to climate change or not.

Has the topic of climate change come up within your local government?		
Answer Options	Response Percent	Response Count
No	44%	63
Yes-during informal discussions	47%	66
Yes-formal discussion has taken place	6%	9
Unsure	3%	4
	Answered question	142
	Skipped question	0

Table 20: Survey Question 9: Identifying Discussion of Climate Change among Sample (dependent variable 2)
(Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Hypotheses were tested using one of the two dependent variables and sometimes both. Independent variables measures included obstacles, such as a lack of budget, staff and climate change expertise, and resources, such as public support as well as federal and state financial and informational support. The impact of municipal size on obstacles and resources experienced was examined. Respondents were asked both direct and indirect questions relating to their decision to prepare for climate change impacts. These questions made it possible to measure the hypotheses created in an attempt to explain the decision of local governments to adapt to climate change.

8.2.1 Influence of Climate Change Impact Concern (Hypothesis 1: Motivation)

There has been some conflicting information regarding the impetus behind adoption of innovations. According to innovation research, key events and crises did not appear to influence innovation adoption but rather manager skills, perceived need for change among staff, clear vision and manager skills (Newman et al., 2000). However, in terms of climate change adaptation there is some evidence for the impact of extreme weather concern on the decision to adapt to climate change. A survey conducted in 2014 among 30 European countries found extreme weather conditions to be the number one reason for implementation of adaptation policies (European Environmental Agency, 2014). Therefore, it is important to examine the influence of climate change impact concern on the decision to conduct planned adaptation to climate change.

It was hypothesized that local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments conducting only spontaneous adaptation. To test this hypothesis, the level of concern regarding specific climate change impacts was measured. All respondents were to rank their concern regarding climate change impacts in three areas:

- Extreme weather (heavy rainfall, snowfall, hail, winds)
- Water/precipitation and other related impacts (reduced water quality, water scarcity, reduced snow pack)
- Ecosystem changes (invasive plant and animal species, changes in bird migration patterns)

Respondents were asked their level of concern regarding climate change impacts on a Likert scale:

1=extremely unconcerned, 2=moderately unconcerned, 3=neither concerned nor unconcerned, 4=moderately concerned and *5=extremely concerned.*

In order to examine whether or not concern varied among the two groups - those that said they were addressing climate change impacts contrasted with those that said they were not addressing climate change impacts - three tables were created. Each table is broken down by concern of the entire sample, concern of those who indicated they are addressing climate change impacts and concern for those who indicated they are not addressing climate change impacts. Concern is measured in each table using the “mode” or most prevalent response. In the last column of each table a difference in concern is denoted by “no difference in concern”, “planned adaptation group more concerned” or “spontaneous group more concerned”. “No difference in concern” is interpreted as, there was no difference in concern between local governments having said they are conducting planned adaption and those having said they are not conducting planned adaptation. “Planned adaptation group more concerned” is interpreted as local governments having said they are conducting planned adaptation are more concerned regarding that specific climate change impact. “Spontaneous group more concerned“ is interpreted as, the local governments surveyed who indicated they are not conducting planned adaptation are more concerned regarding the specific climate change impact. This is the only hypothesis that is not tested for statistical significance, thus it is difficult to say whether or not the opinions are likely to represent the population of New York State governments or if the opinions are restricted to the sample surveyed. However, we see in subsequent hypothesis testing that interest and action relating to water and flood related measures were highest which help to substantiate the findings shown here.

Extreme Weather Concern Comparison of concern Across Groups

In general, concern among the entire sample in regards to extreme weather was high with the majority of impact types ranked moderately to extremely concerned (4 and 5 on a Likert scale where 5 is highest level of concern). Those conducting planned adaptation were more concerned regarding heavy rainfall and extreme drought. Those only spontaneously adapting were more concerned regarding extreme cold and hail. There were no differences in concern regarding heavy snowfall, heavy winds and extreme heat.

Extreme Weather Impacts	**Concern: Entire Sample**	**Concern: Conducting Planned Adaptation Group**	**Concern: Spontaneous Adaptation Group**	**Results: Difference in Concern Among Two Groups**
Heavy Snowfall	*4-Moderately concerned*	*4-Moderately concerned*	*4-Moderately concerned*	No Difference in Concern
Heavy Rainfall	*5-extremely concerned*	*5-extremely concerned*	*4-Moderately concerned*	Planned Adaptation Group More Concerned
Heavy Winds	*4-Moderately concerned*	*4-Moderately concerned*	*4-Moderately concerned*	No Difference in Concern
Extreme Drought	*4-Moderately concerned*	*4-Moderately concerned*	*3-neither concerned or unconcerned & 4-Moderately concerned*	Planned Adaptation Group More Concerned
Extreme Cold	*4-Moderately concerned*	*3-neither concerned or unconcerned & 4-Moderately concerned*	*4-Moderately concerned*	Spontaneous Adaptation Group More Concerned
Hail	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned & 4-Moderately concerned*	Spontaneous Adaptation Group More Concerned
Extreme Heat	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	No Difference in Concern

Table 21: Survey Question 1: Identifying Extreme Weather Concern among Sample (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Water, Precipitation and Other Impact Type Concern

Concern among the entire sample in terms of other conditions was not as high as concern regarding extreme weather. The sample as a whole was extremely concerned regarding one impact type, drinking water quality. They were moderately concerned about storm water run-off and neither concerned nor unconcerned for the rest of the impact types (e.g. beach water quality, water scarcity, earlier breakup of ice and snow, reduced snowpack, and landslides). Examining the two groups separately, we see that in terms of this category local governments conducting planned adaptation are more concerned in three areas: water scarcity, storm water runoff and earlier breakup of ice and snow. Concern between those conducting and

those not conducting planned adaptation did not differ in terms of drinking water quality, beach water quality, reduced snow pack, and landslides.

Water/Precipitation & Other Impacts	**Concern: Entire Sample**	**Concern: Conducting Planned Adaptation Group**	**Concern: Spontaneous Adaptation Group**	**Results: Difference in Concern Among Two Groups**
Drinking Water Quality	*5-extremely concerned*	*5-extremely concerned*	*5-extremely concerned*	No Difference in Concern
Beach Water Quality	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	No Difference in Concern
Water Scarcity	*3-neither concerned or unconcerned*	*4-Moderately concerned*	*3-neither concerned or unconcerned*	Planned Adaptation Group More Concerned
Storm Water Run-Off	*4-Moderately concerned*	*5-extremely concerned*	*4-Moderately concerned*	Planned Adaptation Group More Concerned
Earlier Breakup of Ice and Snow	*3-neither concerned or unconcerned*	*4-Moderately concerned*	*3-neither concerned or unconcerned*	Planned Adaptation Group More Concerned
Reduced Snow Pack	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	No Difference in Concern
Landslides	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	No Difference in Concern

Table 22: Survey Question 2: Identifying Water Related Impact Concern among Sample (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

Ecosystem Change Concern

In the third and final table concern regarding ecosystem impacts among those conducting planned adaptation and those not conducting planned adaptation were compared. For the most part, the group as a whole was neither concerned nor unconcerned regarding most impact types (e.g. animal habitat changes, bird migration changes and vegetation changes). The group as a whole was more concerned regarding invasive plant species and invasive animal species. Examining the two groups separately, we see no difference in concern regarding bird migration changes, invasive plant species or vegetation changes. Local governments conducting planned adaptation were more concerned about animal habitat changes.

Those indicating they are not addressing climate change impacts were more concerned about invasive animal species.

Ecosystem Impacts	**Concern: Entire Sample**	**Concern: Conducting Planned Adaptation Group**	**Concern: Spontaneous Adaptation Group**	**Results: Difference in Concern Among Two Groups**
Animal Habitat Changes	*3-neither concerned or unconcerned*	*4-Moderately concerned*	*3-neither concerned or unconcerned*	Planned Adaptation Group More Concerned
Bird Migration Changes	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	*3-neither concerned or unconcerned*	No Difference in Concern
Invasive Plant Species	*4-Moderately concerned*	*4-Moderately concerned*	*4-Moderately concerned*	No Difference in Concern
Invasive Animal Species	*4-Moderately concerned*	*3-neither concerned or unconcerned*	*4-Moderately concerned*	Spontaneous Adaptation Group More Concerned
Vegetation Changes	*3-neither concerned or unconcerned*	*4-Moderately concerned*	*3-neither concerned or unconcerned*	No Difference in Concern

Table 23: Survey Question 3: Identifying Ecosystem Impact Concern among Sample (Source: Author's Illustration Based on Local Government Responses to Online Survey Conducted November-December, 2011)

In summary, when considering the three categories of impact types, the sample as a whole was most concerned about extreme weather and in general less concerned about other conditions and ecosystem changes. Extreme concern existed among the sample as a whole regarding heavy rainfall and drinking water quality. For many of the impact types there was no difference in concern between the two groups (e.g. heavy snowfall, heavy winds, extreme heat, drinking water quality, beach water quality, reduced snowpack, landslides, bird migration patterns, invasive plant species and vegetation changes). It was even found that local governments not explicitly addressing climate change impacts were more concerned regarding a few impacts including extreme cold, hail and invasive animal species. Finally, local governments explicitly addressing climate change impacts were more concerned about heavy rainfall, extreme drought, water scarcity, storm water runoff, earlier breakup of ice and snow, and animal habitat changes.

The majority of the impact types local governments explicitly addressing climate change impacts were concerned with relate to precipitation of some type or water. Perhaps local governments dealing with precipitation-related impacts are more aware

of potential negative consequences of high levels of precipitation (e.g. flooding). There are a number of programs in New York State that support local governments in reducing vulnerability to flooding. It is possible this has resulted in an awareness of climate change among some local governments.

8.2.2 Influence of budget, staff and climate change expertise (Hypothesis 2: Resources)

Seventy-six percent of those surveyed indicated their local government lacked financial resources to address climate change impacts. In addition to a lack of financial resources, 75% of those surveyed indicated they do not have the staff resources available to prepare for climate change impacts either. A cross-tabulation table was created to examine the hypothesis "local governments perceiving the existence of resources to address climate change impacts are more likely to adapt to climate change than those not perceiving resources". The term "resources" refers to the independent variable(s) and is measured as budget, staff and climate change expertise (i.e. respondents indicated whether or not they felt they had these resources available within their local governments).

This hypothesis contains three sub-hypotheses:

- HYPOTHESIS 2. A (RQII): Local governments perceiving they have the capacity within their *budgets* to conduct planned adaptation are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 2. B (RQII): Local governments perceiving they have the capacity to conduct planned adaptation in terms *staff* numbers are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 2. C. (RQII): Local governments perceiving they have the capacity in terms of *expertise* to conduct planned adaptation are more likely to decide to conduct planned adaptation.

For each of the independent variables (budget, staff and climate change expertise) a cross-tabulation table has been created. The dependent variable used is planned adaptation (e.g. conducting planned adaptation or not).

HYPOTHESIS 2. A (RQII): Examining the Influence of Budget on the Decision to Conduct Planned Adaptation

Local governments perceiving they have the capacity within their budgets to conduct planned adaptation are more likely to decide to conduct planned adaptation. In order to test this relationship, a cross-tabulation table has been constructed and

significance tested using the Fisher's exact test (based on sample size). At first glance it appears support for the hypothesis has been found that availability of budget influences the decision to conduct planned adaptation.

Examining the cross-tabulation table we see 107 local governments indicated they do not have money in the budget to conduct planned adaptation to climate change and they are not conducting planned adaptation. At the same time, 13 local governments indicated they do have the budget to conduct planned adaptation to climate change and they are doing so. As the sample size for this table was not high enough to use a Chi-square to test statistical significance, the Fisher's Exact Test was used. Using the Fisher's Exact Test the direction of the relationship between dependent and independent variable cannot be given. However, results of the Fisher's Exact Test show a relationship between availability of budget and whether or not a local government is conducting planned adaptation to exist at the highest level of significance.

Test of Significance for Budget and Conducting Planned Adaptation:

$$Fisher's\ Exact\ Test\ p = .000$$

Based on the cross-tabulation table and test of significance:

A significant relationship exists between perceived capacity of local governments in terms of budget and the decision to conduct planned adaptation to climate change.

	Yes Budget Available	**No** Budget Available	**Total**
Yes Conducting Planned Adaptation	13	11	24
No Conducting Planned Adaptation	9	107	116
Total	22	118	140

Table 24: Cross tabulation: Conducting Planned Adaptation and Budget (Source: Author's Illustration)

HYPOTHESIS 2. B (RQII): Examining the Influence of Staff Numbers on the Decision to Conduct Planned Adaptation

Local governments perceiving they have the capacity to conduct planned adaptation in terms *staff numbers* are more likely to decide to conduct planned adaptation. Again, a cross-tabulations table was constructed to examine the relationship of staff availability to whether or not planned adaptation is being conducted. This table strongly resembles the table examining the influence of budget availability on the decision to conduct planned adaptation. Here, 105 local governments indicated they are not conducting planned adaptation and they do not have the staff to conduct planned adaption. However, 24 local governments indicated they are conducting planned adaptation to climate change, but exactly half said they did not have the staff to do so. Again, due to small cell sizes, a Chi-Square could not be used to test statistical significance; therefore Fisher's Exact Test was used. Again, statistical significance was found at the highest level.

Test of Significance for Staff and Conducting Planned Adaptation:

$$Fisher's\ Exact\ Test\ p = .000$$

Based on the cross-tabulation table and test of significance:

A significant relationship exists between perceived capacity of local governments in terms of staff and the decision to conduct planned adaptation.

	Yes Staff Available	**No** Staff Available	**Total**
Yes Conducting Planned Adaptation	12	12	24
No Conducting Planned Adaptation	11	105	116
Total	23	117	140

Table 25: Cross tabulation: Conducting Planned Adaptation and Staff Availability (Source: Author's Illustration)

Due to data restrictions, the direction of the relationship between budget, staff and explicitly addressing climate change impacts cannot be given. It can be said there is a significant relationship between perceived availability of budget and staff to address climate change impacts with the decision to explicitly address climate change impacts. In addition to a lack of staff and budget, 92% of those surveyed indicated

they were not conducting planned adaptation and do not possess the climate change expertise within their local government to do so.

A significant relationship was also found between perceived climate change expertise and the decision to explicitly address climate change impacts. That is, local governments without climate change expertise are less likely to be conducting planned adaptation

HYPOTHESIS 2. C (RQII): Examining the Influence of Climate Change Expertise on the Decision to Conduct Planned Adaptation

Local governments perceiving they have the capacity in terms of *expertise* to conduct planned adaptation are more likely to decide to conduct planned adaptation. Finally, to examine the third independent variable, again a cross-tabulations table has been constructed. Ninety-eight local governments indicated they do not have climate change expertise and they are not conducting planned adaptation to climate change. Sixteen local governments indicated they possess climate change expertise within their local government and they are conducting planned adaptation. The cell sizes were large enough to test statistical significance using the Chi-Square and, again, statistical significance was found at the highest level.

Test of Significance for Expertise and Conducting Planned Adaptation:

$$\text{Expertise } \chi^2(1) = 27.14,\ p = .000.$$

Based on the cross-tabulation table and test of significance:

A significant relationship exists between perceived capacity of local governments in terms of climate change expertise and the decision to conduct planned adaptation.

	Yes Climate Expertise	**No** Climate Expertise	**Total**
Yes Conducting Planned Adaptation	16	8	24
No Conducting Planned Adaptation	19	98	117
Total	35	106	141

Table 26: Cross tabulation: Conducting Planned Adaptation and Climate Change Expertise (Source: Author's Illustration)

RESULTS OF HYPOTHESIS 2 (RQII)

Support for the hypothesis that local governments perceiving existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change has been found for all three variables: budget, staff and climate change expertise. A significant relationship was found between whether or not a local government decided to conduct planned adaptation to climate change and its perceived internal availability of budget, staff and expertise.

HYPOTHESIS 2. A (RQII): A significant relationship exists between perceived capacity in terms of *budget* and the decision to conduct planned adaptation to climate change.

HYPOTHESIS 2. B (RQII): A significant relationship exists between perceived capacity of local governments in terms of *staff* and the decision to conduct planned adaptation.

HYPOTHESIS 2. C (RQII): Local governments perceiving they have the capacity in terms of *expertise* are more likely to decide to conduct planned adaptation to climate change than local governments perceiving they do not possess expertise.

8.2.3 Influence of Public, State and Federal Entities (Hypothesis 3: Obstacles)

The previous hypothesis examined the relationship between internal resources (e.g. budget, staff and expertise) within the local government, whereas this hypothesis examines the influence of external resources (e.g. public, state and federal level) on the decision of local governments to conduct planned adaptation to climate change. It was found that 70% of local governments within the sample indicated there was no *financial* support available from the federal government to address climate change impacts. Furthermore, local governments surveyed perceived a similarly low level of financial support to exist from the State of New York. However, local governments surveyed perceived a greater level of *informational support* to exist from both state and federal level governments as well as from *general support from the public*.

Fifty-five percent (n=77) of local governments surveyed perceived that informational support from the federal government exists. Fifty-percent (n=69) of local governments surveyed perceived informational support exists from New York State. Finally, the greatest percentage thus far, 60% of those surveyed perceived the general public to support local government action to address climate change.

Again, as previously discussed, conducting planned adaptation to climate change is used as the dependent variable. The independent variables measured for this hypothesis include perceived general public support, state and federal financial support, as well as state and federal informational support. The goal was to examine whether or not the perception of local government support external to local governments affected the decision to conduct planned adaptation. It is hypothesized local governments perceiving the existences of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change. The term "external resources" refers to the independent variable(s) for this hypothesis: federal and state *informational* support, federal and state *financial* support and finally *general public support* to address climate change (i.e. local governments surveyed indicated whether or not they perceived this kind of support to exist).

Therefore, Hypothesis 3 is simplified into five sub-hypotheses:

- HYPOTHESIS 3. A (RQII): Local governments perceiving the existence of ***general public*** support to conduct planned adaptation are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 3. B (RQII): Local governments perceiving the existence of ***state informational*** support to conduct planned adaptation are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 3. C (RQII): Local governments perceiving the existence of ***federal informational*** support to conduct planned adaptation are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 3. D (RQII): Local governments perceiving the existence of ***federal financial*** support to conduct planned adaptation are more likely to decide to conduct planned adaptation.
- HYPOTHESIS 3. E (RQII): Local governments perceiving the existence of ***state financial*** support to conduct planned adaptation are more likely to decide to conduct planned adaptation.

For each independent variable (state financial support, federal financial support, state informational support, federal informational support and general public support) a cross-tabulation table was created and statistical significance examined.

There were no significant associations found for: state financial support ($\chi^2(1) = .930, p = .335$) or federal financial support ($\chi^2(1) = 2.71, p = .100$). However, there were significant associations found for general public support, state informational support and federal informational support with both dependent variables - planned adaptation and discussing climate change.

HYPOTHESIS 3. A (RQII): Examining the Influence of Climate Change Public Support on the Decision to Conduct Planned Adaptation

Local governments perceiving the existence of general public support to conduct planned adaptation are more likely to decide to conduct planned adaptation. Twenty-two local governments indicated public support exists to address climate change impacts and that they are conducting planned adaptation. However, 58 local governments indicated public support exists and they are not conducting planned adaptation. It was found local governments perceiving the existence of public support are more likely to be explicitly addressing climate change impacts.

Test of Significance for public support and conducting planned adaptation:

$$\chi^2(1) = 11.57, p = .001$$

Based on the cross-tabulation table and test of significance:

Local governments perceiving the existence of general public support to conduct planned adaptation are more likely to conduct planned adaptation to climate change.[19]

	Yes Public Support	**No** Public Support	**Total**
Yes Conducting Planned Adaptation	22	2	24
No Conducting Planned Adaptation	58	49	107
Total	80	51	131

Table 27: Cross tabulation: Conducting Planned Adaptation and Public Support (Source: Author's Illustration)

[19] IT WAS ALSO FOUND LOCAL GOVERNMENTS PERCEIVING THE EXISTENCE OF PUBLIC SUPPORT ARE MORE LIKELY TO BE DISCUSSING CLIMATE CHANGE $(p = .000)$.

HYPOTHESIS 3. B (RQII): Examining the Influence of State Informational Support on Decision to Conduct Planned Adaptation

Local governments perceiving the existence of state informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation. Examination of the cross-tabulations table shows that 16 local governments indicated they were conducting planned adaptation to climate change and they believed state information on climate change to exist. On the other hand, 53 local governments indicated there was no state climate change information available for local governments and they are not conducting planned adaptation to climate change. Finally, in regards to information on climate change originating from the state, a significant association - while not strong - was found. Local governments perceiving the existence of climate change information from the state are more likely to be explicitly addressing climate change impacts.

Test of Significance for state informational support and conducting planned adaptation:

$$\chi^2(1) = 4.85, p = .028$$

Based on the cross-tabulation table and test of significance:

Local governments perceiving the existence of state informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation.[20]

	Yes State Climate Change Information	**No** State Climate Change Information	**Total**
Yes Conducting Planned Adaptation	16	5	21
No Conducting Planned Adaptation	53	53	106
Total	69	58	127

Table 28: Cross tabulation: Conducting Planned Adaptation and Climate Change Information from the New York State
(Source: Author's Illustration)

[20] JUST AS WITH PUBLIC SUPPORT LOCAL GOVERNMENTS PERCEIVING THE EXISTENCE OF STATE INFORMATIONAL SUPPORT ARE MORE LIKELY TO BE DISCUSSING CLIMATE CHANGE EITHER FORMALLY OR INFORMALLY WITHIN THEIR LOCAL GOVERNMENT ($p = .011$)

HYPOTHESIS 3. C (RQII): Examining the Influence of Federal Informational Support on Decision to Conduct Planned Adaptation

Local governments perceiving the existence of federal informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation. Seventeen local governments indicated federal informational support exists to address climate change impacts and they are conducting planned adaptation to climate change. On the other hand, 46 local governments indicated that there is no federal informational support to conduct planned adaptation and they are not doing so. A significant relationship was found for conducting planned adaptation and perceiving the existence of federal informational support.

Test of Significance for federal informational support and conducting planned adaptation:

$$\chi^2(1) = 4.35, p = .037$$

Based on the cross-tabulation table and test of significance:

Local governments perceiving the existence of federal informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation.

	Yes Federal Informational Support	**No** Federal Informational Support	**Total**
Yes Conducting Planned Adaptation	17	4	21
No Conducting Planned Adaptation	60	46	106
Total	77	50	127

Table 29: Cross tabulation: Conducting Planned Adaptation and Federal Informational Support (Source: Author's Illustration)

HYPOTHESIS 3. D (RQII):

No relationship found between *State Financial Support* and the decision to conduct planned adaptation to climate change: $\chi^2(1) = .930,\ p = .335.$

HYPOTHESIS 3. E (RQII):

No relationship found between *Federal Financial Support* and the decision to conduct planned adaptation to climate change: $\chi^2(1) = 2.71,\ p = .100$.

RESULTS OF HYPOTHESIS 3

Some support has been found for the hypothesis that local governments perceiving the existence of external resources to overcome obstacles toward adaptation planning are more likely to conduct planned adaptation to climate change. Two independent variables did not seem to affect the decision of local governments to conduct planned adaptation to climate change: federal and state financial support. However, significant relationships were found for general public support, state informational support and federal informational support.

HYPOTHESIS 3. A (RQII): Local governments perceiving the existence of general public support to conduct planned adaptation are more likely to conduct planned adaptation to climate change and to discuss climate change.[21]

HYPOTHESIS 3. B (RQII): Local governments perceiving the existence of state informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation and to discuss climate change.[22]

HYPOTHESIS 3. C (RQII): Local governments perceiving the existence of federal informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation.

HYPOTHESIS 3. D (RQII): No relationship was found between state financial support and the decision to conduct planned adaptation to climate change.

HYPOTHESIS 3. E (RQII): No relationship found between federal financial support and the decision to conduct planned adaptation to climate change.

[21] IT WAS ALSO FOUND LOCAL GOVERNMENTS PERCEIVING THE EXISTENCE OF PUBLIC SUPPORT ARE MORE LIKELY TO BE DISCUSSING CLIMATE CHANGE $(p = .000)$.

[22] LOCAL GOVERNMENTS PERCEIVING THE EXISTENCE OF STATE INFORMATIONAL SUPPORT ARE MORE LIKELY TO BE DISCUSSING CLIMATE CHANGE EITHER FORMALLY OR INFORMALLY WITHIN THEIR LOCAL GOVERNMENT $(p = .011)$.

9 Discussion and Conclusion

This dissertation set out to examine local government adaptation to climate change as it is experienced by all local governments, not just large cities in the United States. Inherently, that meant expanding the research focus to small local governments located in rural areas. It was the aim of this dissertation to examine whether or not planned adaptation among the general body of local governments was taking place (RQ1). Not only was this an interesting question to examine, but it also served as a prerequisite to examine the influences on the decision of local governments to adapt to climate change (RQ2). An online survey was conducted in order to measure both adaptation and the influences on the decision to adapt. A critical analysis based on existing empirical and innovation studies was conducted using hypothesis testing. Empirical and theoretical research examining adaptation in the U.S. at the time the research was conducted was limited. The focus of previous research examining climate change policy adoption among local governments in the U.S. tended to focus on the adoption of mitigation polices among large cities. Research has since progressed and has included an examination of adaptation among local governments in the U.S. However, examination of climate change adaptation among small local governments in rural areas has continued to be limited, thus substantiating the purpose of the dissertation. New York State was selected as an ideal case study with which to expand upon previous research based on the presence of New York City and an abundance of rural local governments. The results of this study are likely to only represent New York State, thus, they cannot be directly generalized to other states.

The study sought to answer the following two questions:

(1) Are local governments in the New York State adapting to climate change?

a. Is adaptation to climate change taking place?

b. What types of governments are adapting (e.g. towns, villages, cities/large or small)?

c. Is adaptation planned or spontaneous?

(2) What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?

a. What has motivated local governments to conduct planned adaptation to climate change?

b. What has deterred local governments to conduct planned adaptation to climate change?

9.1 Synthesis of Empirical Results

The main empirical findings were presented in chapters 7 and 8. This section is used to synthesize empirical findings and to address the dissertation's two main and sub-research questions. The first aim of this dissertation was to examine climate change adaptation among all local governments - whether or not adaptation was taking place, what type of adaptation (e.g. planned or spontaneous) and by whom (governments type, size). The second aim was to examine the influences on the decision to conduct planned adaptation to climate change. To address these questions the opinions of experts and local governments were used. Previous empirical and theoretical studies were also used to develop hypotheses for each question.

Results of Research Question 1:

Are local governments in New York State adapting to climate change?

Prior to conducting the online survey it was hypothesized the majority of local governments were not conducting planned adaptation to climate change in New York State. This hypothesis was based on field work and research conducted in preparation to conduct the survey. Results of informant discussions and internet searches indicated planned adaptation was highly unlikely to be taking place. Based on informant discussions, it was also thought that some level of spontaneous adaptation to flooding/sea-level rise could be taking place.

The online survey measured spontaneous adaptation, planned adaptation, and whether or not local governments were discussing climate change.

The main findings according to the survey results are provided below:

- **Over half of those surveyed are discussing climate change, however, only a small percentage has had formal discussions take place.**

Over half of the survey sample indicated discussions concerning climate change had taken place within their local governments. However, the majority of discussions taking place among local governments have been informal. Forty-seven percent (66 respondents) indicated informal discussion had taken place. Just 6% of those surveyed (9 local governments) indicated formal discussion had taken place concerning climate change. The level of discussion taking place on climate change indicated local governments are beginning to detect climate change as a problem; however, the lack of formal discussions points to a lack of urgency to address climate change impacts.

- **Spontaneous adaptation among New York State local governments is primarily concerned with flooding.**

Seventy-two percent of respondents indicated that their local government had upgraded its storm water infrastructure. A large percentage also indicated they were managing flood plains as well as promoting open-space and functional watersheds as a means to decrease flooding damage. The focus on addressing flooding by local governments is not unexpected considering the plethora of water bodies in New York State.[23] The findings also tend to support the trend of which cities among the U. S. are creating adaptation plans. The creation of adaptation plans among cities has tended to be concentrated among coastal communities and others susceptible to flooding and/or sea-level rise in the U.S.[24] Over half of the sample surveyed indicated they were located near at least one body of water. Somewhat surprising however, is the failure to address other major climate change impacts. New York State faces other major climate change impacts, such as changes in precipitation, temperature extremes and worsening air quality. Similarly, the U.S. as a whole is not only facing increased risk due to flooding, as instances of major disasters and other climate related changes have been increasing over time, disrupting the ability to ensure delivery of public services.[25] While spontaneous adaptation to flooding is valued to be better than no adaptation at all, it shows that local governments in New York State are not prepared to react to a variety of climate change impacts in the long-term. If something similar is happening among the entire U.S. that would mean that whole the general body of local governments are spontaneously adapting to only the most threatening climate change impacts in their regions or states.

- **A small minority of local governments have decided to conduct planned adaptation to climate change in New York State.**

Among this small group very few have implemented a preparedness plan. The majority of local governments conducting planned adaptation to climate change in

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[23] AS ALREADY DISCUSSED: THE STATE CONTAINS BUT IS NOT LIMITED TO TWO GREAT LAKES: LAKE ERIE AND LAKE ONTARIO AS WELL AS LAKE CHAMPLAIN AND THE ATLANTIC OCEAN (CAMPBELL, A. K. A. S., P.J. 2011. NEW YORK PROFILE FROM BRITANNICA WORLD DATA. ENCYCLOPAEDIA BRITANNICA.). WHAT IS MORE, THE STATE CONTAINS THE FINGER LAKES AND THREE MAIN RIVERS (THE HUDSON, MOHAWK AND GENESEE RIVERS) IN ADDITION TO OVER 6,713 NATURAL BODIES OF WATER OF ONE ACRE OR MORE. (DEVELOPMENT, N. Y. D. O. E., 2010).

[24] AS ALREADY DISCUSSED: LOCAL GOVERNMENTS HAVING CREATED AN ADAPTATION PLAN INCLUDE SEATTLE/WASHINGTON, CHULA VISTA/CALIFORNIA, BATH/MAINE, KEENE/NEW HAMPSHIRE, NEW YORK/NEW YORK, PHILADELPHIA/PENNSYLVANIA, AND ALEXANDRIA/VIRGINIA. (CENTER FOR CLIMATE AND ENERGY SOLUTIONS, 2015)

[25] AS ALREADY DISCUSSED: NATIONALLY, THERE HAS BEEN A STEADY INCREASE IN THE NUMBER MAJOR WEATHER RELATED DISASTERS IN THE U.S. SINCE THE 1980'S AS WELL AS OTHER WEATHER RELATED CHANGES, SUCH AS INCREASES TEMPERATURE, DROUGHT AND HEAVY RAINFALL (NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, 2011; U.S. GLOBAL CHANGE RESEARCH PROGRAM, 2009). CLIMATE CHANGE IS EXPECTED TO IMPACT THE UNITED STATES NEGATIVELY IN A NUMBER OF WAYS: DISRUPTIONS TO WATER AND ENERGY DELIVERY, TRANSPORTATION DELAYS, REDUCED AGRICULTURAL PRODUCTIVITY, ALTERED ECOSYSTEMS AND NEGATIVE IMPACTS ON HEALTH AND SOCIETY IN GENERAL. (U.S. GLOBAL CHANGE RESEARCH PROGRAM, 2009)

New York State have upgraded floodplain maps. This is likely due to funds provided through the American Recovery and Reinvestment Act of 2009 (ARRA). Through ARRA, funds were provided for domestic infrastructure projects much of which were used to reduce vulnerability to flooding by protecting and/or expanding wetlands and updating information regarding floodplains and rebuilding infrastructure prone to flood damage. Interest in conducting planned adaptation is unlikely to be due to anticipation of benefits as a result of climate change, as only few local governments anticipate benefits to climate change impacts (e.g. increases in tourism, reduced need for snow removal) in New York State. This may be related to the fact that most local governments are in the early stages of thinking about climate change adaptation. Survey results are consistent with informant opinions in New York State and showed very little planned adaptation to be taking place among local governments in New York State. By not having created or implemented an adaptation plan, these small groups of local governments in New York State were not necessarily behind other local governments nationally or internationally. The majority of climate change active local governments world-wide are in the preparatory stages of climate change adaptation.[26] However, the majority of local governments in New York State have not decided to conduct planned adaptation to climate change and for the most part they are not taking advantage of membership based organizations that guide adaptation.

- **Local governments located in urban areas are more likely to be conducting planned adaptation than local governments located in rural areas.**

It was hypothesized local governments located in urban areas are more likely to conduct planned adaptation than rural local governments. According to this study, local governments located in urban/suburban areas are indeed more likely to be conducting planned adaptation than rural local governments $(\chi^2(1) = 8.950, p = .003)$. Local governments located in urban/suburban areas were also found more likely to be discussing climate change than rural local governments $(\chi^2(1) = 11.761, p = .001)$. On the one hand, it is not surprising that local governments located in urban/suburban regions are more active in conducting planned adaptation and discussing climate change. The motivation for cities to adapt to climate change is great; flooding, extreme heat and wind are exacerbated by city infrastructure. In conjunction with the challenges climate change poses for infrastructure, population

[26] THE MAJORITY OF ICLEI MEMBERS WORLD-WIDE INCLUDING THE U.S. ARE ONLY IN THE PREPARATORY STAGES OF ADAPTATION PLANNING, THAT IS, JUST 18% OF ICLEI MEMBERS WORLD-WIDE HAVE IMPLEMENTED A PLAN CARMIN, J., NADKAMI, N., AND RHIE, C. 2012. PROGRESS AND CHALLENGES IN URBAN CLIMATE ADAPTATION PLANNING: RESULTS OF A GLOBAL SURVEY. CAMBRIDGE, MA: MIT.

growth is expected to increase among cities world-wide.[27] Furthermore, climate change organizations in the U.S. have either been created by or for cities (e.g. the Sierra Club's Cool Cities Program or the U.S. Mayors' Climate Protection Agreement). Cities - as opposed to counties, villages and towns - have also been the first to take action on climate change mitigation and adaptation.[28]

On the other hand, motivation should exist for rural local governments to adapt to climate change as well. In the U.S., rural areas are inhabited by vulnerable populations, such as the elderly and very young. Rural areas also tend to consist of concentrated poverty and suffer from "brain drain" as well as lagging academic achievement among youth. In conjunction, there is low provision of public services such as public health and transportation; furthermore, infrastructure such as roads, bridges and water pipelines are ageing. Finally, rural areas also tend to depend on industries sensitive to climate change, such as agriculture and tourism.[29]

Local governments conducting planned adaptation to climate change tended to be located either in New York City or North of the city. Some New York City counties identified as having a high risk in terms of flooding are some of the most active local governments (i.e. discussing climate change, conducting planned adaptation) in terms of those surveyed (e.g. Nassau, Dutchess and Westchester Counties). The differences in adaptation activity between "downstate" and "upstate" New York may be explained by differences in economic conditions and flood risk. New York City and surrounding areas are at a high risk of flooding and sea level rise; at the same time,

[27] AS ALREADY DISCUSSED: THERE ARE A NUMBER OF REASONS TO BE CONCERNED ABOUT CLIMATE CHANGE VULNERABILITIES IN URBAN AREAS. FIRSTLY, CITIES WORLDWIDE ARE EXPECTED TO STRUGGLE WITH TEMPERATURE VARIATIONS AND EXTREMES AS WELL AS INCREASED SEA LEVEL AND EXTREME WEATHER EVENTS, SUCH AS HEAVY PRECIPITATION AND DROUGHT (UNITED NATIONS HUMAN SETTLEMENTS PROGRAMME, 2011). SECONDLY, URBAN INFRASTRUCTURE TENDS TO EXACERBATE ALREADY CHALLENGING CLIMATE CHANGE IMPACTS SUCH AS EXTREME WIND AND HEAT (U.S. DEPARTMENT OF STATE, 2010). CHALLENGES POSED BY CITY INFRASTRUCTURE INCLUDE MINIMIZING WIND TUNNEL EFFECTS AS WELL AS THE URBAN HEAT ISLAND EFFECT. CITIES HAVE EVEN BEEN REFERRED TO BY CLIMATE CHANGE SCIENTISTS AS "THE ULTIMATE LANDSCAPE MODELING CHALLENGE" (DIXON, 2010). FINALLY, NOT ONLY ARE CITIES EXPECTED TO EXPERIENCE INTENSIFIED CLIMATE CHANGE IMPACTS, THEY ARE ALSO EXPECTED TO EXPERIENCE POPULATION GROWTH. ACCORDING TO THE WORLD HEALTH ORGANIZATION, BY 2030, SIX OF EVERY 10 INDIVIDUALS WILL LIVE IN A CITY. THAT IS, BY 2030, SIX OF EVERY TEN INDIVIDUALS WILL BE EXPERIENCING EXACERBATED EFFECTS OF CLIMATE CHANGE IF STEPS ARE NOT TAKEN TO ALTER CITY INFRASTRUCTURE TO PROTECT AGAINST CLIMATE CHANGE IMPACTS. IN BRIEF, ADAPTABILITY OF CITY INFRASTRUCTURE TO HANDLE CLIMATE CHANGE IMPACTS IS VITAL IN MINIMIZING NEGATIVE IMPACTS OF CLIMATE CHANGE WORLDWIDE.

[28] THE CITY OF PORTLAND, OREGON, CREATED THE FIRST LOCAL ACTION PLAN IN THE U.S AS A STRATEGY TO REDUCE GREENHOUSE GASES AND THE CITY OF KEENE, NEW HAMPSHIRE, WAS THE FIRST LOCAL GOVERNMENT TO DEVELOP AN ADAPTATION PLAN IN THE U.S. AS PART OF ICLEI'S CLIMATE RESILIENT COMMUNITIES PROGRAM (CRC) (LOCAL GOVERNMENTS FOR SUSTAINABILITY (ICLEI), 1995-2008A; CITY OF PORTLAND, 2010).

[29] RURAL AREAS ARE LESS POISED THAN URBAN AREAS TO DEAL WITH A CHANGING CLIMATE IN A NUMBER OF WAYS. FIRST, INDIVIDUALS IN RURAL AREAS ARE OFTEN DEPENDENT ON INDUSTRIES DIRECTLY SENSITIVE TO CLIMATE CHANGE IMPACTS SUCH AS AGRICULTURE, TOURISM, FORESTRY AND FISHERIES (LAL, 2011). SECOND, RURAL AREAS OFTEN LACK THE EXPERTISE TO DEAL WITH THE HIGHLY COMPLEX NATURE OF CLIMATE CHANGE ADAPTATION. RURAL AREAS TEND TO LOSE HIGHLY EDUCATED RESIDENTS THROUGH MIGRATION TO URBAN AREAS OR SUFFER FROM WHAT IS CALLED "BRAIN DRAIN". WHAT IS MORE, THE ACADEMIC ACHIEVEMENT OF YOUNGER GENERATIONS IN RURAL AREAS IS LAGGING IN COMPARISON TO THE NATIONAL AVERAGE (THE WHITE HOUSE, 2010). RURAL POPULATIONS ARE LARGELY COMPRISED OF VULNERABLE POPULATIONS SUCH AS THE YOUNG AND THE ELDERLY (LAL, 2011). MOREOVER, THESE VULNERABLE POPULATIONS ARE PLAGUED BY CONCENTRATED POVERTY AND FACE LOW PROVISION OF PUBLIC SERVICES. FOR EXAMPLE, ACCESS TO PUBLIC TRANSPORTATION AND HEALTHCARE IS NOT AS PREVALENT AS IN URBAN AREAS (HOWITT, 2011). EMERGENCY RESPONSE SYSTEMS TEND TO BE WEAKER AND TRAVEL COSTS FOR RESIDENTS SEEKING HEALTH SERVICES TEND TO BE HIGHER IN RURAL AREAS (LAL, 2011).

this part of the state has been able to maintain population and economic growth. Geographically, the majority of New York State is not at risk of sea level rise and faces very different economic conditions such as population shrinkage and economic decline.

Little planned adaptation and formal discussions are taking place among New York State governments. Spontaneous adaptation has mostly been focused around the issue of flooding. Furthermore, local governments located in urban areas are more likely to have decided to conduct planned adaptation to climate change than rural local governments. The second aim of this dissertation helps to shed light on the reasons behind the level of adaptation taking place in New York State by examining the influences on the decision of local governments to conduct planned adaption to climate change.

Results of Research Question 2:

What has influenced the decision of local governments to conduct planned adaptation to climate change in New York State?

The main findings according to experts, New York State local governments and hypothesis testing are provided below:

Influences on the decision to conduct planned adaptation according to environmental and climate change experts in NYS (expert discussions, qualitative results):

Climate change adaptation among local governments in New York State is deterred by the lack of a requirement to address climate change impacts, varying policy, resource and incentive conditions throughout the state, a lack of urgency to adapt (non-priority), disbelief in climate change, the lack of a support system for local governments looking to act on climate change adaptation, ageing infrastructure, a lack of expertise and national momentum to address climate change impacts. According to informants, motivation to adapt to climate change has been related to sea-level rise/flooding in New York State.

Influences on the decision to conduct planned adaptation according to New York State local governments (survey, qualitative results):

The most common reason given by local governments for not conducting planned adaptation was currently dealing with other pressing issues. Furthermore, budget constraints, a lack of climate change expertise and staff deter planned adaptation to climate change. To a lesser extent disbelief in climate change and jurisdictional conflict between governmental bodies deter planned adaptation to climate change.

According to local governments in New York State, motivation to conduct planned adaptation stems from being knowledgeable about climate change and possessing concern regarding climate change impacts and the future. Surprisingly, only a small number of local governments cited the presence of a climate change leader, ecosystem changes and economic risk as motivations to conduct planned adaptation.

Influences on the decision to conduct planned adaptation according to hypothesis testing (survey quantitative results):

- **Local governments are more likely to conduct planned adaptation to climate change where: climate change concerns are water related (Motivation)**

Firstly, it was hypothesized that local governments conducting planned adaptation to climate change are more concerned regarding climate change impacts than local governments spontaneously adapting. All survey respondents were asked to rank their concern regarding climate change impacts in three areas: extreme weather, water/precipitation, and other impacts and ecosystem changes on a Likert scale (where 1 represented “extremely unconcerned” and 5 represented “extremely concerned”). It was hypothesized that local governments conducting planned adaptation to climate change were more likely to be concerned about climate change impacts. Partial support for this hypothesis was found. The results of this study indicate that the decision to address climate change impacts is related to the type of climate change impact concern. Among local governments surveyed, those conducting planned adaptation to climate change indicated they were more concerned regarding heavy rainfall, extreme drought, water scarcity, storm-water runoff, earlier breakup of ice and snow, and animal habitat changes (than local governments not conducting planned adaptation to climate change). Possessing climate change impact concern in general does not mean local governments will act. Expert informants talked about the lack of a state and national support system to adapt to climate change as a reason for local government to not act on climate change. As previously discussed, there were a number of programs already in place within New York State addressing issues related to flooding and sea-level rise, including the New York State Sea-Level Rise Task Force, the Local Water Revitalization Program and the New York Sea Grant. Thus, a support system does exist in New York State to address flooding and water related impacts. Whether these programs lead to planned adaptation remains to be seen. However, these programs provide expertise, financial resources and awareness among local governments regarding the risks of sea-level rise and flooding. This may explain the

tendency of local governments concerned about water related impacts to be more active in adapting to climate change impacts.

- **Local governments are more likely to conduct planned adaptation to climate change where: budget, staff and climate change expertise are available to do so (Resources)**

Secondly, it was hypothesized that local governments perceiving the existence of internal resources to address climate change impacts are more likely to conduct planned adaptation to climate change than local governments spontaneously adapting. To test this hypothesis a cross-tabulations table was created to examine each of the independent variables (budget, staff and climate change expertise). The dependent variable used was "planned adaptation" (e.g. conducting planned adaptation or not). Statistical significance was examined using either the Fisher's exact test or a Chi-square. Statistical significance was found at the highest level for all three variables budget, staff and climate change expertise, meaning there is a high likelihood that the relationship examined can also be found among the population of local governments in New York State. [30]

That is, where local government officials perceive the internal resources budget, staff and climate change expertise exist to conduct planned adaptation to climate change they are more likely to do so (than local governments not conducting planned adaptation).

- **Local governments are more likely to conduct planned adaptation to climate change where: public support to address climate change impacts as well as state and federal informational support are perceived (Obstacles)**

Thirdly, it was hypothesized that local governments perceiving the existence of external resources (to overcome obstacles) toward adaptation planning are more likely to conduct planned adaptation to climate change.

To test this hypothesis, a cross-tabulations table was created to examine each of the independent variables (public support, federal and state informational support, and federal and state financial support). The dependent variable used was planned adaptation (e.g. conducting planned adaptation or not). Statistical significance was examined using either the Fisher's exact test or a Chi-square. Statistical significance was not found for both state and federal financial support. The majority of the survey sample consisted of local governments with populations of 10,000 or less. This may explain the failure to find a significant relationship between those conducting planned

[30] TEST OF SIGNIFICANCE FOR BOTH FOR BUDGET AND STAFF AND PLANNED ADAPTATION FISHER'S EXACT TEST P=.000, TEST OF SIGNIFICANCE FOR EXPERTISE AND PLANNED ADAPTATION: $\chi^2(1) = 27.14,\ p = .000.$

adaptation and financial support from state and federal levels. It may be the case that state and federal financial support (often in the form of grants) does not influence the decision of small local governments to conduct planned adaptation as they are often ineligible to apply. In cases where smaller local governments are eligible to apply, lengthy applications in the midst of a lack of expertise and staff may hinder applications from smaller governments. Smaller municipalities tend to rely on self-generated funds, whereas larger cities tend to rely on a combination of self-generated and federal and state funding. Furthermore, funds available through state programs also tend to be available to a narrowed group of local governments (i.e. financial assistance through the LWR program in New York State is limited to specific communities located near water bodies).

Support was found for the remaining independent variables. That is, where local governments perceive public support and state and federal informational support they are more likely to conduct planned adaptation to climate change.[31] Furthermore, local governments are more likely to be discussing climate change where the public supports action on climate change and state informational support is perceived.[32] The results indicate the decision of local governments to conduct planned adaptation to climate change is influenced by external entities including the public as well as state and federal governments.

9.2 Implications for Innovation Theory and Previous Empirical Research

The previous section was used to synthesize the results of this dissertation. This section is used to discuss the theoretical implications of research results. The main findings of this study indicate that local governments in New York State (outside of New York City) are doing little address climate change impacts. Specifically few local governments are conducting planned adaptation to climate change. Furthermore, about half of the sample surveyed indicated they were discussing climate change but that formal discussions within their localities have been limited. Much interest exists among local governments concerning flooding and other water related impacts. Thus, it is not surprising spontaneous adaptation by New York State local governments has primarily concerned flooding. Aside from disbelief in anthropogenic climate change and distrust in climate science, local governments in New York State face a number

[31] TEST OF SIGNIFICANCE: PUBLIC SUPPORT $\chi^2(1) = 11.57, p = .001$, STATE INFORMATIONAL SUPPORT $\chi^2(1) = 4.85, p = .028$, FEDERAL INFORMATIONAL SUPPORT $\chi^2(1) = 4.35, p = .037$.

[32] TEST OF SIGNIFICANCE, PUBLIC SUPPORT AND DISCUSSION OF CLIMATE CHANGE ($p = .000$), TEST OF SIGNIFICANCE STATE INFORMATIONAL SUPPORT AND DISCUSSION OF CLIMATE CHANGE ($p = .011$), NO STATISTICAL SIGNIFICANCE FOR FEDERAL INFORMATIONAL SUPPORT AND DISCUSSING CLIMATE CHANGE.

of legitimate challenges when it comes to conducting planned adaptation to climate change.

By testing the relationship of specific variables on the decision to conduct planned adaptation to climate change, influences on the decision to conduct planned adaptation could be identified. Specific influences identified include whether or not local governments are located in urban or rural areas (relates to population size), the perception of internal resources to plan for climate change (budget, staff and expertise) and the perception of external support geared toward local governments (public support and state and federal informational support).

According to hypothesis testing, local governments located in urban areas are more likely to both be conducting planned adaptation to climate change and to be discussing climate change. A Canadian study conducted in 2012 and published in 2014 found similar results. All of Canada's larger cities (i.e. those with populations of 500,000 or above) were found to be involved in climate change adaptation or to be discussing adaptation (15 communities were identified as having an adaptation plan or strategy in place). Approximately 65% of local governments with populations fewer than 5,000 were found not to have an adaptation plan in place and were not considering implementing a plan or discussing climate change seriously. Even though, half of these small local governments have experienced damages from either or both flooding and heavy rainfall (The University of British Columbia, 2014). This more recently conducted study can help to support validity of the data research results specifically related to influences on the decision to adapt.

The results of the current study showed that local governments were more likely to be conducting planned adaptation to climate change where climate change concerns were water related, local governments possess budget, staff and climate change expertise, and government officials perceive public support as well as state and federal informational support to exist to address climate change.

Theoretical and Empirical Implications of Research Results Relating to Research Question 1:

General Influences on the Level of Planned Adaptation Taking Place among Local Governments

In discussing implications regarding the level of adaptation actions among local governments in New York State the factors which may influence the decision to adopt planned adaptation to climate change, essentially addresses the second research question. However, these are simply general observations; more specific implications

will be discussed under implications of research results relating to research question two.

For this reason, here, general observations regarding the relationship of the results to the theoretical background are provided. It was found that a small minority of local governments has decided to conduct planned adaptation to climate change in New York State with just half of those surveyed discussing climate change either formally or informally. The low level of planned adaptation should not be surprising in some respects, as Ryan and Gross (1948) highlighted in their diffusion of hybrid corn study; change is difficult and requires considerable effort by the adopter. Planned adaptation to climate change is no exception, as it requires local governments to commit their financial, staff and expertise resources in the long-term. Furthermore, local governments have to adjust internal operations to accommodate planned adaptation to climate change. This is not happening on a large scale in New York State; however, there is some evidence of structural adjustments according to written survey responses. For example, one local government official indicated there was an *"ad hoc group just forming"* and another *"We currently have a temporary position working on these types of issues (grant funded)"* and finally a *"joint effort with NYCDEP [New York City Department of Environmental Protection] and NYSDEC [New York State Department of Environmental Conservation] on (…) Creek"*.

Many local governments in New York State were able to provide the responsible entity for climate preparedness measures within their jurisdiction. However, there was some uncertainty among a number of local government officials. Some local government officials were outright uncertain who was responsible - the question of someone being responsible for climate preparedness never entered their minds or no formal designation had been assigned. In some cases, local government officials felt responsibility was dispersed across various departments or government types. Uncertainties regarding responsibility for climate preparedness measures as well as responsibility being dispersed among a number of parties make it difficult to hold any one entity accountable. These results may suggest the findings of Betsill (2001) that a "lack of an institutional home" for climate change policy not only pose a challenge for local governments implementing climate change policies but also prevent local governments from *deciding* to implement climate change policies. However, it is important to note that threats posed by climate change are and will continue to effect the well-being including health and safety of citizens which local governments are responsible for protecting.[33] In addition to confusion regarding responsibility for

[33] AS PREVIOUSLY DISCUSSED IN CHAPTER 2, LOCAL GOVERNMENTS ARE RESPONSIBLE FOR THE WELL-BEING OF THE CITIZENS WITHIN THEIR JURISDICTIONS IN A NUMBER OF WAYS INCLUDING, HEALTH AND SAFETY AND PROVISION OF SERVICES WHICH CONTRIBUTE TO A FUNCTIONING SOCIETY (STADEN, M. V. 2010. COMMUNITIES, MITIGATION AND ADAPTATION. IN: STADEN, M. V. A. M., F. (ED.)

climate preparedness measures, some local governments are uncertain about climate science.

It is difficult to define the problem of climate change if local governments question whether or not climate change is a problem. Results of this study support what Bostrom (2007) found, disbelief in anthropogenic climate change has further complicated the issue of climate change. Some reasons given for not conducting planned adaptation to climate change in this study include disbelief in anthropogenic climate change and climate change in general. One respondent indicated climate change to be part of the earth's natural cycle; others doubted that the public believed in climate change. Lorenzoni et al. (2007) found a lack of public support to address climate change was related to uncertainty and mistrust regarding scientific information. Distrust in science and scientists in general were also present in this study. As discussed in chapter 3, environmental issues, especially climate change, are politically charged issues and a large partisan divide tends to exist between Democrats and Republicans in the U.S. Furthermore, media coverage in the U.S. has often failed to accurately report on climate change further contributing to confusion surrounding climate change. The confusion surrounding the topic of climate change may help explain why local governments that tend to be highly concerned about climate related impacts are not conducting planned adaptation to climate change.

Results of this study suggest local governments in New York State as a whole are concerned about climate related impacts but not about climate change itself. The majority of local governments indicated they were not conducting planned adaptation to climate change. Yet, when asked how concerned they were about a number of climate conditions related to climate change, a number of local governments were moderately to extremely concerned (concern of 4/5 where 5 is most concerned). For example, local governments surveyed as part of this study were moderately to extremely concerned regarding extreme weather, such as heavy rainfall, snowfall, hail and winds. The sample as a whole was extremely concerned regarding drinking water quality as well. When asked why they were not conducting planned adaptation to climate change some local governments responded "it hasn't affected our area", "unsure of what kind of impact climate change could have on a small WNY village" and "Not imminent threat: inconclusive". These findings support Betsill (2001) who found local governments were uncertain of how they could contribute to reduce mitigate greenhouse gases in the absence of a federal mandate (in this case contributing to climate change adaptation). Furthermore, the results of this study support Newman (2000) in that key events and crises do not appear to influence

innovation adoption (here planned adaptation) but rather manager skills, perceived need for change among staff, clear vision and manager skills. Local governments have indicated they are concerned regarding a number of climate related impacts, yet, they are failing to realize their concerns may be related to climate change. This may highlight the lack of local government officials' expertise on climate change and science. Thus, contrary to a survey conducted among European countries found in 2014 extreme weather concerns alone cannot explain the decision to conduct planned adaptation to climate change (European Environmental Agency, 2014). Many local governments were concerned about extreme weather conditions and had not decided to conduct planned adaptation to climate change. However, flooding and water related extremes do appear to influence the decision to conduct planned adaptation to climate change. When considering Moser's framework to diagnose barriers to climate change adaptation and survey results, it appears most New York State local governments are failing to progress to the understanding phase.[34] A small number of local governments identified as conducting planned adaptation to climate change have not managed to progress past the planning stage (no official planning documents on implementation of plans could be identified through the survey).

The Influence of Size on Adoption of Planned Adaptation

Concerning the question of what types of governments are adapting, this study found that local governments located in urban areas are more likely to be conducting planned adaptation (and discussing climate change) than local governments located in rural areas. A strong relationship between innovation adoption and organizational size has been reported in the literature. Mohr (1969), Knoke (1982), Boyne et al. (2005), Bingham (1976), Brudney (1995), and Vasi (2006) among others have found size to be the strongest predictor of innovation adoption which often correlates to the level of financial and other resources. Lubell et al. (2009) found a greater likelihood of environmentally sustainable polices to exist within communities with financial resources and a high social-economic status. According to survey results local governments conducting planned adaptation to climate change are generally located in and around New York City where population and economic growth are present, as opposed to areas far north of New York City that are rural and suffering from population shrinkage and economic decline. Thus, the differences among local

[34] MOSER PRESENTED A FRAMEWORK TO EXAMINE THE PROCESS OF ADAPTATION DECISION MAKING BASED ON RATIONAL DECISION MAKING (MOSER, S. C. A. E., J.A. A FRAMEWORK TO DIAGNOSE BARRIERS TO CLIMATE CHANGE ADAPTATION. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCE OF THE UNITED STATES OF AMERICA (PNAS), 2010. PNAS, 22026-22031.). THIS FRAMEWORK IS BASED ON THE PROCESS OF PLANNED ADAPTATION AND INCLUDES THREE MAJOR PHASES: UNDERSTANDING, PLANNING AND MANAGING. IN GENERAL WHILE CONDUCTING PLANNED ADAPTATION LOCAL GOVERNMENTS FIRST TRY TO UNDERSTAND THE PROBLEM. IN THE NEXT PHASE, LOCAL GOVERNMENTS BEGIN PLANNING BY DEVELOPING ADAPTATION IDENTIFYING RESPONSIBLE PARTIES. LASTLY, THE MANAGING PHASE ENTAILS EVALUATING THE SITUATION AND IMPLEMENTING OPTIONS (IBID.).

governments conducting planned adaptation in the New York City area and the remainder of the state may be explained by economic and social economic differences.

The tendency of local governments conducting planned adaptation to be located in or around New York City supports previous research conducted by Knoke (1982) which found local governments were more likely to adopt new policies where a higher percentage of surrounding local governments had already done so. This relationship on innovation adoption has also been found in the realm of climate change policy. Vasi (2006) and Krause (2010) found that local governments were more likely to adopt climate mitigation policies and join global climate change programs where a higher percentage of other local governments having adopted these policies existed. The effect of proximity on adoption has been found to be strong where potential adopters are similar to those that have already adopted (Walker, 1969). This may help to clarify why planned adaptation to climate change has failed to spread among the majority of local governments in New York State, as few local governments are similar to New York City and neighboring municipalities. What is more, as identified by expert informants, incentives and barriers experienced vary from government to government - for example eligibility for grants or other funding may vary depending on municipality type, size or memberships. Furthermore, attitudes regarding climate change and the need for action are likely to differ depending on the community.

Here, general conclusions based on the results of this study were drawn in relation to their theoretical or empirical implications based on previous research. The next section examines more specifically theoretical implications based on the results of hypotheses tested as part of this study.

Theoretical and Empirical Implications of Research Results Relating to Research Question 2:

Specific Influences on the Decision to Conduct Planned Adaptation to Climate Change in New York State

Mohr hypothesized “innovation to be 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. 111). This hypothesis applied in the context of this study is as follows: adoption of planned adaptation is influenced by local government officials’ motivation, by obstacles which are in opposition to planned adaptation and by the availability of resources to overcome said obstacles to planned adaptation. Mohr found resource constraints, such as a lack of staff, expertise, specialized training and financial resources, to be

the strongest predictors of innovation adoption. Organizational size has been found to be the strongest predictor of innovation adoption as it is strongly related to the level of resources an entity possesses (Mohr, 1969). Support for Mohr's hypothesis has been found by Krause (2010) who examined the decision of cities to join programs focused on reducing greenhouse gas emissions. This study expands on the work of Mohr and others by examining whether or not Mohr's hypothesis can be used to predict adaptation decisions. Mohr's hypothesis was used to investigate the influences on the decision of local governments to conduct planned adaptation to climate change. According to hypothesis testing, local governments in New York State are more likely to conduct planned adaptation to climate change where:

A. Climate change concerns are water related (Motivation),

B. Excess budget, staff and climate change expertise are available within local governments (Resources)

   and

C. Public support, as well as state and federal informational support exist to address adaptation (Obstacles).

A. Climate Change Concerns are Water Related (Motivation)

Mohr suggested that adoption of new policies or practices are influenced by the decision-maker's motivation. Research conducted at both the state and local levels have found the perceived need for a new policy by decision makers to affect innovation adoption (Damanpour, 2008; Fagerberg, 2006, 2009; Walker, 1969). Motivation to conduct planned adaptation has been linked to past extreme events and extreme weather at local (Field, 2012) as well as national levels (Massey et al., 2014). One goal of this study was to determine if perceived need (in the form of climate change impact concern) affected the decision of local government decision makers to conduct planned adaptation to climate change. It was hypothesized that local governments conducting planned adaptation to climate change would be more concerned regarding general climate change impacts than local governments spontaneously adapting. Only partial support for this hypothesis was found.

Results of this study suggest the decision to address climate change impacts is related to the type of climate change impact concern. Local governments were concerned about a number of climate change impact types but that did not translate to planned adaptation in most cases. Those conducting planned adaptation to climate change were found to be more concerned about water-related impacts than those not conducting planned adaptation. Some of the latest studies examining the decision to conduct planned adaptation have also found concern regarding flooding to be one of the main influences to adapt to climate change which further validates

the results of this study (Amundsen et al., 2007; Association, 2014; Biesbroek et al., 2013; Brugger, 2013; Press Association, 2014).

Within New York State it appears extreme weather in the form of flooding and related impacts promotes interest in conducting planned adaptation to climate change. One possible explanation for increased interest in adaptation where flooding concerns exist is the level of support from outside organizations present in New York State. The support network to address flooding and sea-level rise and related impacts available to New York State local governments from the state and national level appear to be the most developed in comparison to other climate impact types. There are a number of programs that provide expertise and funding opportunities to New York State local governments at risk for flooding which may explain the tendency for local governments with these types of concerns to be the most active in climate change adaptation. The results of the last two hypotheses help to further support this possible explanation.

B. Local governments possess budget, staff and climate change expertise (Resources)

Mohr suggested adoption of new policies or practices to be directly related to resources available to overcome obstacles to said innovation. This dissertation has identified in the realm of climate change adaptation specific influences on the decision of local governments to conduct planned adaptation. Budget, staff and climate change expertise were found to be significantly related to the decision of New York State local governments to conduct planned adaptation to climate change. A more recent study substantiates these results. The adoption of planned adaptation to climate change has been found to be related to the availability of resources to implementation. According to a survey conducted among 30 European countries, barriers such as lack of time, money and technology are preventing adaptation to climate change (European Environmental Agency, 2014). Both in the Colorado Mountains and Florida Keys budget constraints have been identified as the most significant barrier toward climate change adaptation at the local government level (Archie et al., 2012; Mozumder et al., 2011).

C. Local governments perceive public support, as well as state and federal informational support to address climate change impacts (Obstacles).

Mohr suggested innovation to be inversely related to the strength of obstacles present. The community, and federal and state governments can deter innovation adoption by decision-makers if opposition exists.

This may suggest, in the perceived absence of public support, obstacles toward planned adaptation are perceived to be too high to adapt. The results of this study

show that public support has an important influence on the decision of local governments to address climate change impacts. That is, where the public supports action on climate change, local governments are more likely to decide to conduct planned adaptation to climate change. New York State local governments perceiving the existence of general public support to conducting planned adaptation were found to be more likely to both be discussing and conducting planned adaptation to climate change. Local government officials are elected to represent public opinions thus they are likely to decide on climate change action based on the public's attitude regarding climate change. Both past and current research studies support these findings.

Community demands have been found to have a large impact on the decision of local governments to adopt new polices or programs (Bingham, 1976). Additional, research studies examining climate change adaptation have found the community to either hinder or encourage adoption of adaptation policies (Archie et al., 2012; Mozumder et al., 2011). A qualitative study conducted among U.S. cities found that local decision makers were more likely to be conducting or to be preparing for planned adaptation to climate change if they perceived the public to believe in climate change (Carlson, 2015). A study examining the propensity among U.S. cities to take action on climate change looked at three elements: inhibitors, swing factors and resource catalysts. *Inhibitors* are ways of thinking and framing climate change adaptation, such as scientific uncertainty or climate politicization that delay adaptation but do not necessarily stop it. *Swing factors* affect climate change adaptation; they can be characteristics of communities which promote or deter adaptation action, such as extreme weather events and political culture. *Resource catalysts* are types of information and moral grounding which provide a basis to motivate adaptation planning, such as local academic resources and advocacy or political engagement (Carlson, 2015).

Thus, more current research also support the research findings of this study that public support affects the decision of local governments to adapt to climate change.

In addition to the public, federal and state governments have been found to hinder or encourage adoption of new policies by local governments. In general, availability of resources from state and federal levels, such as funding, equipment and expertise, have been found to affect whether or not local governments are willing to adopt any given innovation (Bingham, 1976). This relationship has also been found among local governments adopting mitigation policies in the U.S. (Betsill, 2001). The current study found local governments perceiving the existence of state informational support to conduct planned adaptation are more likely to decide to both be discussing and conducting planned adaptation. Furthermore, local governments perceiving the existence of federal informational support to conduct planned adaptation are more likely to decide to conduct planned adaptation. More recent studies have also found

the provision of information to play an important role in climate change adaptation (Archie et al., 2014; Waters et al., 2014). One of the most interesting findings in this study was that the decision to conduct planned adaptation was not influenced by state and federal financial support. As previously discussed in this chapter, this may be explained by ineligibility of small local governments for federal and state grants. Another possibility is that the provision of temporary funding, such as grants, is not enough for local governments to act on climate change adaptation. Perhaps long-term financial support is needed. Lubell et al. (2009) found a greater likelihood of environmentally sustainable polices to exist within communities with financial resources and a higher social-economic status, while smaller cities were found to need substantial technical, financial and planning assistance. A survey conducted in Canada found local funding was the most important influence on the decision of large local governments to conduct adaptation. Smaller local governments cited provincial and local financial sources as the most important. Federal financial sources were found to be less important, possibly as a result of federal funding to be largely temporary (The University of British Columbia, 2014).

The use of Mohr's hypothesis has helped to avoid solely focusing on the actions and motivation of local government officials on the decision to conduct planned adaptation to climate change. Examination of the motivation to innovate, strength of obstacles and resources to overcome obstacles in this study helped to provide a well-rounded examination of the influences on the tendency of local government decision to conduct planned adaption to climate change.

9.3 Implications for Climate Change Policy

<u>The results of this study indicate (RQ1):</u>

1.) **a small percentage of local governments have had formal discussions take place regarding climate change**

2.) **spontaneous adaptation has been primarily concerned with flooding and**

3.) **a small minority of local governments have decided to conduct planned adaptation to climate change in New York State.**

The lack of formal action to minimize negative impacts of climate change among local governments suggests that current policies meant to encourage increased resilience toward climate change are not working to their full potential. This especially applies to rural local governments which have been shown in this study as less likely to both be discussing and conducting planned adaptation to climate change than their urban counterparts.

Failure of rural governments to conduct planned adaptation to climate change could have considerable impacts on national adaptation. Firstly, the majority of landmass in the U.S. is considered rural, thus, a failure of adaptation to take place among rural local governments would mean the U.S. as a whole is not prepared to deal with climate change impacts. Secondly, a failure to adapt rural economies to climate change impacts is likely to negatively affect the national economy as a whole as large parts of the U.S. are economically dependent on a number of rural industries (i.e. energy and agriculture). Finally, a lack of preparedness among rural local governments may result in negative impacts to citizens within their jurisdictions - citizens which are often less poised to adapt to climate change and more likely to be reliant upon climate-sensitive industries. The main theoretical contributions of this dissertation may help to provide a better understanding of the effect current policies may be having on the decision of local governments to conduct planned adaptation to climate change and what may be necessary to create more effective policies.

Mohr's hypothesis was used as a heuristic to help explain the influences of different factors of local decision makers to conduct planned adaptation to climate change.

The results of this study indicate (RQ2):

Local governments having indicated they were conducting planned adaptation to climate change

1.) **tend to be more concerned about flooding and other water-related impacts than other local governments,**

2.) **possess internal resources, especially budget, staff and climate change expertise, and**

3.) **perceive fewer external obstacles toward adaptation, specifically the existence of community support and the provision of informational support from the federal and the state government.**

The following section will be used to relate research findings to contextual factors within New York State and to current policies.

A high level of concern regarding flooding should not be surprising considering the number of local governments bordering bodies of water. Furthermore, sea-level rise is one of the major climate change impacts expected in New York State. It is likely the presence of a number of programs (i.e. the New York State Sea Level Rise Task Force, the Local Waterfront Revitalization Program (LWRP), New York Sea Grant) with various purposes revolving around protecting coastal communities (revitalize and protect waterfronts, protecting against sea-level rise) has created an awareness of climate change risks and the need to act among coastal communities eligible to participate in these programs. However, the impact of these programs is limited as

they are focused on guiding specific governmental bodies and not all local governments. For example, the New York State Sea Level Rise Task Force has focused their efforts to Westchester, Nassau and Suffolk counties. Furthermore, the Local Waterfront Revitalization Program provides financial support only to communities located near specific bodies of water. It was found in this study that local governments conducting planned adaptation to climate change tended to be located either in New York City or North of the city. New York City counties, specifically Nassau, Dutchess and Westchester Counties, were identified as more likely to be conducting planned adaptation and discussing climate change. Therefore, local governments concerned about flooding and water related impacts may be more likely to conduct planned adaptation because they receive information and other assistance from various programs operating in New York State. However, Nassau, Dutchess and Westchester counties are some of the most at risk when it comes to flooding, which could also play a role in the level of concern and interest that exits to adapt to climate change.

The New York State Climate Smart Communities (CSC) Program is one exception as it is geared toward all local governments in New York State. The CSC program is also focused on climate change and is meant to bring a climate change element to all local government decision making. The CSC program provides an abundance of information to New York State governments on both mitigating and adapting to climate change. This is likely to encourage planned adaptation as, according to this study, local governments perceiving informational support from the state were more likely to conduct planned adaptation. On the other hand, funding and other resource opportunities are limited and often rewarded on a competitive basis. According to this study, local governments with limited internal resources are less likely to decide to conduct planned adaptation. Therefore, availability of more resource support from the CSC program, specifically financial, expertise and staff, has the potential to improve the likelihood of local governments to decide to conduct planned adaptation to climate change.

The results of this study may suggest there are similar levels of climate change adaptation and influences on the decision to conduct planned adaptation across the U.S. Local governments with high levels of motivation to adapt in the form of extreme weather risks, such as flooding/sea level rise or drought, where appropriate resources are present. Specifically budget and staff and climate change expertise, as well as the perception of federal, state and public support to address climate change impacts. In this study, large and urban local governments were found more likely to be conducting planned adaptation to climate change; this is likely related to the level of resources available. Within New York State, New York City has been the most active municipality in terms of adapting to climate change as well as its neighboring

local governments. The tendency of New York City and its neighboring localities to be more active in addressing climate change could be explained by both a high risk of sea-level rise/flooding and by economic stability in comparison to the majority of New York State local governments. In the midst of the absence of a federal mandate to plan for climate change and voluntary state programs which offer minimal financial and technical aid, small local governments with limited resources are unlikely to conduct planned adaptation to climate change.

9.4 Study Limitations & Future Research Suggestions

This study has contributed to the body of adaptation research by thoroughly examining influences on the decision of both urban and rural local governments to conduct planned adaptation to climate change. Furthermore, by examining the influence of specific variables related to motivation, resources and obstacles on the decision to conduct planned adaptation it was possible to provide suggestions in order to improve adaptation policies within New York State. Despite the contributions of this study at least three limitations need to be considered.

Firstly, the current investigation was limited by the study design. As a cross-sectional research design - a study which examines variables at one point in time - it is limited in identifying determinants of planned adaptation as we are uncertain about how variables change over time. Furthermore, as research is conducted in the “real world”, controlling variables is highly difficult which results in some threats to internal validity as opposed to a laboratory or simulated setting where the external validity is typically easier to establish. Nevertheless, the tradeoff for reality may be worth the sacrifice to internal validity. Secondly, the sampling technique used to distribute the online survey to local governments was intended to be simple random sampling. However, after distribution of the survey it became clear that some of the e-mail addresses were outdated, thus suggesting a convenience sample was used. There is a chance that some local governments were not invited to participate in the survey. Additionally, the online survey conducted was voluntary and thus poses the risk of a non-response bias within the sample survey; this is the case with a great many research studies. Furthermore, the sample size is relatively low with a response rate of 9% (141/1,600 x 100); however, this has been found to be typical of voluntary surveys conducted online both in general and concerning adaptation. The limited sample size resulted in some restrictions, such as being able to compare different populations and government types. However, statistical analyses were still possible and local government opinions were received from most of New York State geographically.

Finally, the survey data was collected at the end of 2011. It is possible that the level planned and spontaneous adaptation has changed or that local governments now are reacting and thinking about climate change differently. In 2011 the U.S. economy was in the process of recovering from a recession due to a housing and financial crisis, economic recovery has been relatively slow compared to other economic recessions seen since the Great Depression (Congressional Budget Office, 2011a). However, economic indicators such as unemployment rates have decreased indicating an improvement in the overall economy (Congressional Budget Office, 2016b). Improvement of economic conditions may translate to an increase in availability of resources for local governments and may have resulted in more local governments having decided to conduct planned adaptation to climate change. Furthermore, the stance the federal government has taken on climate change has continuously grown stronger since 2011 but it is unlikely that conditions at the local level have significantly changed.

The results of this dissertation are still valid for a number of reasons.

Research Findings Are Still Likely to Be Valid

This study found that in New York State few local governments were taking serious action to adapt to climate change adaptation, that is, few local governments were found to be discussing climate change formally or conducting planned adaptation to climate change. As discussed in the introduction of this dissertation, doubts still exist presently among researchers and policy analysts as to the willingness and preparedness of local governments to address climate change impacts. As found in this study, a number of roadblocks exist toward conducting planned adaptation, especially for small rural local governments as opposed to larger urban local governments which tend to possess more resources. As discussed in chapter 3.2, the information that does exist suggests planned adaptation is not occurring on a large scale and that the U.S. is trailing behind other wealthy nations in commitments to conduct planned adaptation to climate change. Planned adaptation to climate change in the U.S. appears to be concentrated among wealthy and/or large cities located along the West or East Coast, or among those susceptible to flooding and/or sea-level rise. There is little reason to think the level of planned adaptation has changed because the conditions that influence the decision to conduct planned adaptation are unlikely to have changed considerably.

Political Conditions in the U.S. Have Not Significantly Changed (especially at the local level)

As discussed in chapter 3.1, climate change is a politically charged issue in the U.S. especially among Republicans and Democrats. The political divide among Republicans and Democrats has continued to increase over the past two decades. Democrats have been found more likely to support climate change action and Republicans and conservatives have been found less likely to support climate change action even among highly educated or when given more information concerning climate change. Despite efforts to take a stronger stance on climate change at the federal level from the Obama Administration (years of administration 2009 until January 2017) and record-breaking climate conditions, such as record-high temperatures, drought, flooding, and wildfires, a national poll conducted at the end of 2015 found concern regarding climate change to be decreasing among Americans (as compared to recent previous years) (National Centers for Environmental Information, 2015). Less than half (43%) of Americans polled believed scientific consensus on climate change to exist among research scientists, which is important because those believing in scientific consensus have been found to be more likely to support governmental action on climate change. This study found that under the Obama Administration just 40% of individuals - as compared to 70% during the Bush Administration years - believe the government should do more to address climate change. That is, despite the efforts of the Obama Administration to take a stronger stance on climate change the majority of Americans do not support additional governmental action on climate change. Just 22% of Republicans believe the government should take additional action to address climate change compared to two-thirds of Democrats (Tyson, 2015). Most if not all actions taken by the Obama Administration to address climate change have been the result of executive actions implemented by the president (i.e. requiring only approval from the president) as opposition from the Republican Party has been too high to pass meaningful legislation on climate change. Therefore, policy changes at the federal level have not resulted in major changes in the resources, budget or staff available to local governments to conduct planned adaptation to climate change. Funding provided by the federal government to address climate change has primarily been allocated toward research, energy technology development and international assistance. What small amount has been made available to local governments (just 1% of all funding) has been competitive temporary funding, which is prohibitive to small local governments overburdened with their current responsibilities and short on staff. Recent efforts by the federal government to improve climate change expertise among local governments require local government officials to take education courses online or to network with other experts in their vicinities using an “online tool kit” and other

online resources. In addition to political opposition toward addressing climate change, opposition from the public for the government to do more to address climate change, and minimal funding and expertise assistance from the federal government, the focus of federal policies has remained on greenhouse gas emission reductions (mitigation) rather than adaptation. The tendency for climate change funding to be focused on mitigation rather than adaptation, this could be related to the ability to promote mitigation measured as measured toward cost savings or economic improvements especially among Republicans.

As discussed in chapter 7, informant discussions indicate little has changed politically within New York State. Despite having been able to increase membership in the CSC program, few governments have made progress on mitigation and adaptation planning. An effort to implement a certification program has been met with limited success because few governments have taken steps to submit required certification materials. Local government interest has continued to remain on mitigation measures rather than adaptation often because measures to reduce greenhouse gas emissions result in cost savings. Much of the focus on the state to reduce vulnerability toward extreme events appears to have continued to be focused on flooding in the Hudson Valley rather than state-wide climate change adaptation. A lack of financial support from the state and federal level government was thought by informants to be delaying planned adaptation to climate change. What is more, federal and state funding made available to address flooding-related impacts at the local level does not require consideration of climate change.

When considering the policies implemented during and after the survey was conducted in 2011, there is little reason to believe that obstacles faced by local governments have been significantly lessened or that resources have significantly increased.

This study found that local governments perceiving the existence of public support to address climate change impacts were more likely to be conducting planned adaptation to climate change; as discussed here; public support has actually decreased over time. Suggesting that, an increase in adaptation cannot be expected as a result of public pressure to do so.

The present study also found that local governments perceiving the existence of informational support from the federal and state government were more likely to be conducting planned adaptation to climate change. The federal government has increased the information provided to local government decision-makers, however, much of the information has to be sought out, further developed and applied to the perspective community by elected officials. The present study also found local governments possessing budget, staff and climate change expertise were more likely

to be conducting planned adaptation to climate change. Related to this, urban local governments were found to be more likely to be conducting planned adaptation to climate change and to be discussing climate change. Those possessing staff and expertise are likely to more easily be able to cultivate and further develop climate data to suit their municipality's needs, as compared to rural local governments that tend to be short on staff, expertise and resources. Thus, the mere presentation of additional information online from the federal government is unlikely to affect the level of planned adaptation taking place among rural local governments; rather it further supports those already having the means to conduct planned adaptation.

Support for Study Results Can Be Found Among Other Research Studies

In order to assess the validity of research results, the literature review was updated to include research conducted after the data was collected (see chapter 4). Here, the findings of current research are discussed as they relate to the main findings of this dissertation. Support for the research results of this study could be found among current research studies.

Level of Planned Adaptation

In this study a small number of local governments were identified as conducting planned adaptation to climate change (24 local governments). Four local governments indicated they were currently creating a climate preparedness plan. Not a single local government indicated that a climate preparedness plan had been completed or implemented; eight local governments were found to be integrating climate preparedness measures into other plans. A study conducted in Canada examined adaptation in a similar way and found similar results. A survey of local governments in Canada found only 5% of local governments had an adaptation plan in place, 15% were either developing or incorporating adaptation plans into existing plans, 20% indicated they were beginning to discuss climate change and 45% did not have an adaptation plan in place and were not considering adaptation. Similarly to results found in this dissertation, larger Canadian cities were found to be more likely to be conducting planned adaptation to climate change as well as discussing climate change (cities with populations of 500,000 or above were either planning for climate change adaptation or discussing adaptation). Approximately 65% of local governments with populations fewer than 5,000 did not have an adaptation plan in place. In addition, they were not considering implementing a plan and no serious discussion concerning climate change was found to be taking place. Approximately half of the small local governments surveyed had experienced either or both significant flooding and high amounts of rainfall which had resulted in damage (The University of British Columbia, 2014). Also in the Netherlands, low levels of planned adaptation have been found to be taking place among municipal governments; the

researchers suggest this is due to the actions of higher-tier governments. In the Netherlands, climate change adaptation has not been properly supported financially nor has it been the focus of policy-makers. Instead, climate change has been framed as a water issue, which may explain the tendency of local governments to be focused on flooding (Hoppe et al., 2014). A lack of a clear stance on climate change nationally has also been found to hinder planned adaptation to climate change by local governments in Australia as local governments are uncertain of how to approach climate change (Waters et al., 2014). That is, adaptation to climate change appears to be motivated in many parts of the world - not just New York State - by concern regarding flooding and other water related impacts either as a result of concern regarding extreme weather or as a result of how climate change has been framed by state and federal governments.

Flooding as Motivation to Adapt

The results of this dissertation suggest that few local governments are conducting planned adaptation to climate change. However, there were many concerns regarding flooding and other water related impacts among many local governments in New York State. Both planned and spontaneous adaptation in New York State appears to be largely motivated by concern regarding flooding and other water related impacts. It was suggested in this chapter that the tendency of local governments conducting planned adaptation to be concerned about flooding was related to the number of state and federal programs operating in New York State to reduce flood risk. Research conducted in the rural American Southwest also found that water was the most frequently mentioned weather and climate-related topic (Brugger, 2013). In the UK, flooding which took place in 2014 may have had an effect on how the issue of climate change was perceived (Press Association, 2014). Thirty out of 28 countries in Europe have cited extreme weather, such as flooding and extreme heat, as influencing their decision to address climate change (Association, 2014). Many researchers have found local governments to focus on and react to extreme conditions such as flooding and extreme precipitation (Biesbroek et al., 2013; Amundsen, 2007).

Public Support as an Obstacle toward Adaptation

Through the work of this dissertation a number of obstacles toward planned adaptation were identified. The presence or absence of public support was found to be significantly related to whether or not a local government was conducting planned adaptation to climate change. Local governments having said public support existed within their communities to address climate change were more likely to be conducting planned adaptation to climate change. A number of studies examining local government adaptation to climate change have also found public support to effect the

decision of local governments to conduct planned adaptation to climate change. Archie et al. (2012) found that a lack of perceived public importance and public awareness as well as demand to take action to be the biggest challenges toward implementation of adaptation measures. Mozumder (2011) found opposition from the community as well as other stakeholders to stifle implementation of adaptation plans. In a qualitative study conducted among U.S. cities Tampa, Florida, was found to be one of the least prepared cities even though it is at the highest risk for hurricanes. The public and political climate are said to have impeded action in this case. Los Angeles is also at high risk for weather extremes, including wildfires and heat waves, but unlike Tampa, the political climate present in Los Angeles promotes actions to adapt to these impacts and thus improving the city's ability to deal with those impacts. In cities with conservative political parties, actions to address climate change impacts were found less likely to be taking place. Cities where local decision makers felt the public believed in climate change were more likely to be taking actions to prepare for climate change impacts (Carlson, 2015).

The lack of financial, educational and administrative support for climate change measures have been shown to make it difficult for local governments to act on both climate change mitigation and adaptation (Mozumder et al., 2011).

The Influence of State and Federal Support on the Decision to Adapt at the Local Level

The current study found local governments that felt higher-tier governments were providing information on climate change were more likely to be conducting planned adaptation to climate change. More recent studies have also found the availability of information on climate change to play an important role in climate change adaptation. A survey conducted in 2011 among county governments in the Colorado Mountains found the most common barriers toward adaptation to be information related. For example, a lack of locally specific information on climate change as well as information at relevant scales and a lack of useful information were given as the most common barriers toward adaptation planning (Archie, 2014; see also: Waters et al., 2014). A survey conducted among European Union countries found a lack of access to adaptation knowledge and information from other EU countries hindered climate change adaptation suggesting information exchange between peers to be important (Massey et al., 2014).

Results of this study showed that the decision to conduct planned adaptation was not influenced by state and federal financial support. A survey conducted in Canada found that the decision of small local governments to adapt was related to availability of provincial and local financial sources rather than federal financial resources.

Federal funding was thought not to be as important because it is often temporary short-term funding (The University of British Columbia, 2014).

The Influence of Internal Resources on the Decision to Adapt

Another main finding of this study is that budget, staff and climate change expertise are significantly related to the decision of local governments to conduct planned adaptation to climate change. The presence or absence of financial resources has been found to have a strong impact on the decision to conduct planned adaptation to climate change. Budget constraints both in the Colorado Mountains and Florida Keys have been identified as the most significant barrier toward climate change adaptation at the local government level (Archie, 2012; Mozumder et al., 2011). Also, perceived financial and economic consequences of climate change adaptation policy implementation have been found to hinder adaptation (Waters et al., 2014). Among European Union countries, a lack of resources and institutional capacity were cited as major barriers toward climate change adaptation; notability, a lack of resources was ranked as a larger barrier by countries with lower GDP's (Massey et al., 2014).

In summary, the main findings of this dissertation could be substantiated within the findings of more current research studies. Firstly, more current research studies conducted in Canada, the Netherlands and Australia also found a low level of planned adaptation to be taking place among local government. Secondly, government size has been found to influence the likelihood of conducting planned adaptation (rural vs. urban) as related to resource availability in Canada and the EU. Thirdly, adaptation has been found to be motivated by weather extremes, namely flooding in the American Southwest, the UK and many other EU countries. Finally, a lack of support from both the public and higher-tier governments (information and other resources) has been found to be deterring planned adaptation toward climate change.

Suggestions for Further Research

Future research might expand on this current study by furthering explore how rural local governments in other U.S. states are thinking about and reacting to climate change. Research examining adaptation by local governments until this point has been very limited, thus, there are many possibilities to expand our knowledge. General questions still remain concerning the level of actions being taken by rural local governments, how they think about climate change and what motivates or deters planned adaptation to climate change impacts. Related to research findings of this study, it would be interesting to further understand the interaction between adaptation-active local governments and the creation of state policies and programs. For example, the data shows that local governments at most risk to flooding and

those with financial and other resources are more likely to decide to adapt to climate change. These local governments have also been the focus of state and local policies addressing flooding and climate change. It would be worth elaborating on the relationship between these municipalities and the state in relation to who initiates these policies (i.e. do local governments push for these programs, does the state push for these programs or both?). In this study, financial support from the federal level was not found to influence the decision to conduct planned adaptation to climate change. Further work needs to be done to establish whether or not federal financial support does not matter to smaller local governments as they are often ineligible to apply for competitive funds or for some other reason. It may be interesting to examine how action on climate change varies among republican- versus democrat-dominated voting districts.

More research is needed to identify rural local governments that have managed to overcome barriers toward climate change adaptation with minimal resources. Practitioners in New York State identified the need to better understand how local governments can overcome barriers.

In this study it was difficult to examine differences among municipality types. Counties, for example, are in a special position to guide climate change adaptation as they encapsulate other towns, cities and villages, and serve as a mediator between federal and local government levels. Thus, more research examining counties is needed, especially concerning the adaptation actions being taken by county level governments, the influences on their decision to undertake adaptation measures as well as the potential counties possess to lead planned adaptation within their jurisdictions.

9.5 Overall Conclusion

As discussed in the introduction of this dissertation, doubts exist among researchers and policy experts regarding the preparedness and willingness of the U.S. in general to deal with the impacts of climate change. The results of this dissertation at least in the case of New York State support the doubts of researchers and policy experts in that the level of preparedness to deal with climate change impacts is low. However, the use of the term willingness to explain the lack of planned adaptation taking place in some cases is misleading. Local governments as indicated by the results of this dissertation are experiencing a number of roadblocks toward conducting planned adaptation to climate change. These road blocks toward planned adaptation are largely present as a result of actions taken (or not taken) by federal and state governments as well as perceived low public support to address climate change.

In this study it was found that over half of those local governments surveyed are discussing climate change. However, the majority of discussion taking place has been informal and has seldom transferred into planned adaptation. This can partially be explained by the number of obstacles local governments have to overcome before they conduct planned adaptation toward climate change. Expert discussions and qualitative results of the survey suggest a number of general explanations for the low level of planned adaptation taking place among local governments outside of New York City. Firstly, there is a lack of urgency to adapt to climate change and at the same time disbelief in anthropogenic climate change or distrust of climate change science. Secondly, national momentum to conduct planned adaptation to climate change is lacking as well as a support system for local governments looking to adapt. Thirdly, local governments are often preoccupied with other pressing issues such as aging infrastructure and other economic issues.

New York City has been one of the most forward-thinking and acting cities nationally and internationally in terms of climate change adaptation. However, New York City is an exceptional local government because it is experiencing an unusually high flood risk and, at the same time, is one of the most economically well-off cities world-wide. New York City faced a number of obstacles when attempting to conduct planned adaptation to climate change, including a lack of monetary support from the federal and state government as well as other bureaucratic obstacles, such as gaining permission to implement adaptation measures. New York City officials were able to overcome these obstacles, likely as a result of having the resources in the form of monetary, expertise and staff numbers. The City of New York was able to generate the necessary data (high resolution mapping, elevation data) in order to identify vulnerability of the city to climate change impacts as well as to create a climate change task force that consists of state and federal officials as well as other private actors. Ultimately, the city managed to create and implement an adaptation plan. A number of the measures outlined in the PlaNYC have been implemented - this is uncommon even among governments world-wide having decided to conduct planned adaptation to climate change. That is to say, New York City is unique in terms of its size, motivation and availability of resources to adapt to climate change. Other states in the U.S. are unlikely to have an equivalent to New York City or a local government leading and pushing climate change policy within the state-they may even be more rural than New York State.

Hypothesis testing conducted as part of this dissertation was helpful in identifying specific variables which tend to be related to whether or not a local government has decided to conduct planned adaptation to climate change or not. Similarly to New York City, local governments having decided to conduct planned adaptation tend to be even more concerned regarding flooding and other water related concerns than

the general population of local governments and be located in urban areas. Additionally, local governments conducting planned adaptation to climate change tend to perceive that the public supports action on climate change and that climate change information via state and federal governments is available. Finally, local governments conducting planned adaptation to climate change are more likely to possess sufficient internal resources to conduct planned adaptation, such as budget, staff and climate change expertise, highlighting the important role resources play in the decision to conduct planned adaptation to climate change. Yet, none of the local governments surveyed has been able to create or implement an adaptation plan, suggesting that the challenge of creating and implementing an adaptation plan is still too high even for local governments having an interest in doing so. Considering the example of New York City and the results of this dissertation, Mohr's hypothesis can be used to explain the decision of local governments to adopt planned adaptation to climate change. Mohr said that 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. 111).

Here, it was found that planned adaptation was directly related to the motivation to adapt in the form of flood concern, inversely related to the strength of obstacles to planned adaptation - specifically public support and informational support from state and federal governments - and directly related to the availability of resources to overcome obstacles toward planned adaptation - specifically local government budget and staff levels as well as climate change expertise.

Support for Mohr's findings that organizational size is the strongest predictor of innovation adoption as it relates to resources was also found. Local governments located in urban areas were found more likely to be conducting planned adaptation to climate change as opposed to local governments located in rural areas. This is likely to be related to the advantages larger local governments have, such as the ability to gain more revenue through taxation, higher eligibility for competitive federal grants and other funds. Rural local governments, which tend to be smaller, are concerned about flooding and other impacts, but not as concerned as urban local governments appear to be. Rural local governments are less motivated to adapt and perceive obstacles, such as a lack of public and governmental support, to be greater. At the same time, they tend to possess fewer resources to overcome obstacles toward planned adaptation and in some cases tend to be overwhelmed with their daily challenges. As one local government surveyed said: "Please bear in mind just because we are doing list [little] about climate change at this time, that we are not concerned. We are. However, with so many people facing foreclosure of their homes, or loss of their jobs, their minds are focused on immediate survival."

Without additional financial and other support from the public and from state and federal government, urban local governments having decided to conduct planned adaptation may not progress to adaptation plan creation and implementation, and at the same time, small rural governments are unlikely to decide to conduct planned adaptation. It is difficult to convince those doubting climate change science that action to address the impacts of climate change is necessary. However, it is not unheard of for local officials that do not believe in climate change to take part in greenhouse gas mitigation activities when incentives exist to doing so (e.g. energy cost savings, other monetary support). Therefore, it may be possible to incentivize planned adaptation to climate change without having to first convince elected officials of climate change science. Though, it may be better to focus on local governments that are interested in adapting to climate change but are hesitant to act as a result of meager resources. As discussed in chapter 4, the adoption of innovation can be made easier. Limited funding such as grants are unlikely to result in long-term changes especially among small local governments; whereas the provision of long-term financial resources has been shown to significantly impact innovation adoption. What is more, adoption of planned adaptation by large overlapping governments may result in reduced costs to smaller local governments. Counties encapsulate cities, towns and villages, and have the possibility of creating climate change data and adaptation plans for their jurisdictions. Partnerships are another possibility to ease adoption of planned adaptation: counties have the potential to collaborate with local governments within their jurisdictions or several local governments have the potential to work together to cultivate climate data or to create adaptation plans. Lastly, state and federal governments should ensure that bottlenecks toward creation and implementation of adaptation plans are reduced or at best eliminated. The motivation for local governments to adapt in the United States is likely to exist as a result of ever increasing negative impacts of climate change; however, a number of obstacles exist toward conducting planned adaptation, in conjunction with limited resources.

Recent policy developments in climate change, such as the signing of the COP21 and the introduction of a bill in New York State to eliminate greenhouse gas emissions, point to positive developments in addressing climate change in New York State, the U.S. and internationally. However, just as in the past, success appears to be highly dependent on whether or not the next president of the U.S. is republican or democrat, as Republicans tend to oppose action on climate change. Furthermore, even if the next president is a democrat, it is unclear how current international agreements could impact adaptation to climate change at the local level. The focus still appears to be very much on mitigation of greenhouse gases rather than adapting to climate change. Hence, it may take time for policy actions taken at the federal level to affect conditions at the local level, especially related to adaptation.

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Appendix

- Survey
- Survey Invitation
- Survey Reminder
- Focus Group Agenda
- Consent Form Focus Group
- Consent Form Telephone Discussions

Weather and Ecological Change Survey/Paper Version

Welcome and thank you for your interest in this survey! Your opinion is needed to gain a better understanding of the conditions local governments are operating under when dealing with weather and ecological changes in New York State. Opinions from a variety of municipality types (e.g. villages, towns, cities/variety of sizes) are important to the success of the study.

The survey addresses impacts of climate change (e.g. weather extremes, ecosystems changes, etc.) as opposed to mitigation (e.g. reduction of CO2 emissions). Opinions are needed from both local governments currently addressing climate change impacts and those that are not. The findings of this survey will be used as part of a dissertation project.

*Your responses are anonymous-your name and e-mail address will not be associated with the findings.

*You will be asked for your consent at the end of the survey

*This survey will take approximately 15-20 minutes to complete

*You will have the opportunity to obtain survey results

Further Instructions:

Any questions marked with an asterisk (*) require an answer in order to progress through the survey.

In order to progress through this survey, please use the following navigation buttons:

Click the Next button to continue to the next page.
Click the Previous button to return to the previous page.
Click the Exit the Survey Early button if you need to exit the survey.
Click the Submit button to submit your survey.

If you have any questions please contact:

Jessica Hemingway
Technical University of Dresden
Dresden Leibniz Graduate School
E-Mail: j.hemingway@dlgs.ioer.de

1. How concerned is your local government about the following weather extremes?

	Extremely concerned	Moderately concerned	Neither concerned or unconcerned	Moderately unconcerned	Extremely UNconcerned
Heavy rainfall	◯	◯	◯	◯	◯
Heavy snowfall	◯	◯	◯	◯	◯
Extreme heat	◯	◯	◯	◯	◯
Extreme cold	◯	◯	◯	◯	◯
Extreme drought	◯	◯	◯	◯	◯
Heavy winds	◯	◯	◯	◯	◯
Hail	◯	◯	◯	◯	◯

Other (please specify)

Weather and Ecological Change Survey/Paper Version

2. How concerned is your local government about the following conditions?

	Extremely concerned	Moderately concerned	Neither concerned or unconcerned	Moderately unconcerned	Extremely UNconcerned
Reduced quality of drinking water	◯	◯	◯	◯	◯
Reduced quality of beach water	◯	◯	◯	◯	◯
Water scarcity	◯	◯	◯	◯	◯
Storm-water run-off	◯	◯	◯	◯	◯
Earlier break-up of snow and ice	◯	◯	◯	◯	◯
Reduced snow pack	◯	◯	◯	◯	◯
Landslides	◯	◯	◯	◯	◯

Other (please specify)

3. How concerned is your local government about the following ecosystem changes?

	Extremely concerned	Moderately concerned	Neither concerend or unconcerned	Moderately unconcerned	Extremely UNconcerned
Animal habitat changes	◯	◯	◯	◯	◯
Changes in bird migration patterns	◯	◯	◯	◯	◯
Invasive plant species	◯	◯	◯	◯	◯
Invasive animal species	◯	◯	◯	◯	◯
Vegetation changes	◯	◯	◯	◯	◯

Other (please specify)

*4. Is your community.....?

- ☐ In-land (please skip to #6)
- ☐ Coastal
- ☐ On a river
- ☐ On a lake

Other (please specify)

5. As a coastal/river/lake community, how concerned are you about the following conditions?

	Extremely concerned	Moderately concerned	Neither concerned or unconcerned	Moderately unconcerned	Extremely UNconcerned
Water-level rise	◯	◯	◯	◯	◯
Storm-surge flooding	◯	◯	◯	◯	◯
Shore-line erosion	◯	◯	◯	◯	◯
Ecosystem changes	◯	◯	◯	◯	◯

6. Which, if any, of the following measures has your local government taken to protect PUBLIC HEALTH (select all that apply)?

- ☐ Access to cooling centers during high temperature days (e.g. air conditioning, access to swimming)
- ☐ Public access to health care during emergencies
- ☐ Managing spread of diseases (e.g. spraying for mosquitoes)
- ☐ Managing air quality
- ☐ Installation of a high temperature warning system
- ☐ Installation of flood warning system

Other (please specify)

7. Which, if any, of the following measures has your local government taken toward PUBLIC OUTREACH (select all that apply)?

- ☐ Wildfire safety education
- ☐ Heatwave awareness education
- ☐ Flooding awareness education
- ☐ Infectious borne illness education (e.g. lyme disease/west nile virus)

Other (please specify)

8. Which, if any, of the following measures has your local government taken to decrease FLOODING damage (select all that apply)?

- [ ] Upgrading storm water infrastructure
- [ ] Upgrading building infrastructure to handle large amounts of rain
- [ ] Promoting healthy forests
- [ ] Promoting open-space
- [ ] Promoting functional watersheds
- [ ] Managing flood plains

Other (please specify)

9. Has the topic of climate change come up within your local government?

- ◯ No
- ◯ Yes-during informal discussions
- ◯ Yes-formal discussion has taken place (e.g. as an agenda item)
- ◯ Unsure

***10. Within your local government are steps being taken to prepare for climate change impacts?**

- ◯ Yes
- ◯ No (please skip to #16)

11. What prompted the decision to address climate change impacts (Select all that apply)?

- [ ] Presence of a climate change leader
- [ ] Severe weather concerns
- [ ] Ecosystem changes (e.g. invasive species, fish population changes)
- [ ] Economic risk
- [ ] Concern about the future
- [ ] Knowledge of climate change

Other (please specify)

12. Did any of the following impact the decision to address climate change impacts?

- [ ] Non-governmental agency
- [ ] Universities
- [ ] Federal agencies
- [ ] State agencies

13. How is your local government planning for climate change adaptation?

- ◯ Currently creating a climate preparedness plan
- ◯ Have finished a climate preparedness plan
- ◯ Implementing a climate preparedness plan
- ◯ Integrating climate preparedness measures into other plans

Other (please specify)

14. Which, if any, of the following measures has your local government taken to identify vulnerabilities to climate change?

	Have not implemented	Considering implementing	Already implemented	Unsure	Not Applicable
Climate impact assessment	☐	☐	☐	☐	☐
Infrastructure vulnerability Assessment	☐	☐	☐	☐	☐
Invasive species vulnerability assessment	☐	☐	☐	☐	☐
Landslide susceptibility analysis	☐	☐	☐	☐	☐
Map Updates(e.g. to include flood plains, landslides)	☐	☐	☐	☐	☐
Creation of Climate Change Committee	☐	☐	☐	☐	☐

Other (please specify)

15. Does your local government anticipate any of the following benefits due to changes in climate (Select all that apply)?

	Yes	No
Increases in summer recreation	☐	☐
Increases in summer tourism	☐	☐
Increases in certain fish populations	☐	☐
Increases in agricultural production	☐	☐
Reduced need for snow removal	☐	☐

Other (please specify)

***16. Why has your local government decided not to address climate change impacts at this time**
(Select all that apply)?

- ☐ Our efforts are focused on mitigation (CO_2 reduction)
- ☐ Currently dealing with other pressing issues
- ☐ Lack of climate change expertise
- ☐ Jurisdictional conflict
- ☐ Budget constraints
- ☐ Not enough staff
- ☐ We don't believe climate change exists

Other (please specify)

17. Does support exist for local governments looking to address climate change impacts?

	Yes	No	Some
Public support	◯	◯	◯
Financial support	◯	◯	◯
Informational support	◯	◯	◯
State level financial support	◯	◯	◯
State level informational support	◯	◯	◯
Federal level financial support	◯	◯	◯
Federal level informational support	◯	◯	◯

Other (please specify)

18. Which, if any, is your local government a member of (Select all that apply)?

- ☐ ICLEI-Climate Resilient Communities
- ☐ ICLEI-Cities for Climate Protection
- ☐ DEC-Climate Smart Communities
- ☐ Sierra Club-Cool Cities Program
- ☐ Mayor's for Climate Protection
- ☐ None
- ☐ Other (please specify)

19. Regardless of current or future plans, does your local government have the following resources available to address climate change impacts?

	Yes	No	Some
Budget	◯	◯	◯
Staff	◯	◯	◯
Expertise	◯	◯	◯

Other resource constraint?

20. Which county is the government you work for located?

Other (please specify)

21. What best describes the communities your local government serves?

- ◯ Urban
- ◯ Suburban
- ◯ Rural

Other (please specify)

22. Is there a unit, department or individual responsible for climate preparedness measures within your local government (Select all that apply)?

- ◯ Individual (I am not that person)
- ◯ Individual (I am the individual responsible)
- ◯ Department
- ◯ Unit

Other (please specify)

***23. Which type of government do you work for?**

- ◯ City
- ◯ Village
- ◯ Town

Other (please specify)

24. Approximate population of your municipal jurisdiction?

Unsure? Check here: http://quickfacts.census.gov/qfd/states/36000.html

- ◯ Below 500
- ◯ Below 10,000
- ◯ 10,000-20,000
- ◯ 20,000-40,000
- ◯ 40,000-70,000
- ◯ 70,000-100,000
- ◯ 100,000-300,000
- ◯ Over 300,000

Other (please specify)

***25. I give permission for my responses to be used as part of a research study without the use of identifying information such as name or e-mail address.**

◯ No

◯ Yes, LAST NAME, FIRST NAME (stored separately from survey data and kept confidental)

26. As a participant in this survey, results will be made available to you. If you would like results to be e-mailed to you please provide your e-mail address below:

27. Further comments?

For more information about climate change and New York State, see: New York State Climate Action Council
http://nyclimatechange.us/InterimReport.cfm

From: survey-noreply@smo.surveymonkey.com [mailto:survey-noreply@smo.surveymonkey.com]
On Behalf Of hemingway.jessica@gmail.com via surveymonkey.com
Sent: Thursday, October 13, 2011 8:31 AM
To: Wayne Euvrard
Subject: NYS local government weather and ecological variation opinion survey

Dear Elected Official,

My name is Jessica Hemingway, I'm a native of Central New York working toward my doctorate at the Technical University of Dresden in Dresden, Germany. I'm conducting a survey examining local government experiences dealing with weather and ecological changes as part of my dissertation.

I would greatly appreciate it if you or another knowledgeable individual within your local government could find the time to fill-out this survey (i.e. approximately 15-20 minutes). Your responses are invaluable to my research and could be used to improve policy. In return for your participation results of the study will be made available to you.

Please do not hesitate to participate for any reason, responses from all cities, villages and towns in New York State are welcomed.

Here is the link to the survey:

https://www.surveymonkey.com/s.aspx?sm=eExhXi9h1j4DJs_2b99WrK_2bg_3d_3d

I sincerely appreciate your time and assistance!

All the best,

Jessica Hemingway
City and Regional Planning, M.A.
Technical University of Dresden
Dresden Leibniz Graduate School

-----Original Message-----
From: survey-noreply@smo.surveymonkey.com [mailto:survey-noreply@smo.surveymonkey.com]
On Behalf Of hemingway.jessica@gmail.com via surveymonkey.com
Sent: Wednesday, October 26, 2011 8:31 AM
To: ghelsmoortel@saugerties.ny.us
Subject: Friendly Reminder: Weather and Ecological Change Survey

Dear Town Elected Official,

My name is Jessica Hemingway and I would be grateful if you or another individual knowledgeable about your town's experience with weather and ecological change could find 15 minutes to complete my survey https://www.surveymonkey.com/s.aspx?sm=efDThc0uu5M3gUjBfU4eIA_3d_3d .

This survey is part of my dissertation and is intended to build on currently limited knowledge of how local governments are experiencing changes in climate.
-Participation is anonymous
-Results will be provided to you as a participant

Thank you for your time!

Sincerely,

Jessica M. Hemingway
Dresden Leibniz Graduate School |Leibniz Institute of Ecological Urban and Regional Development

(My research is supported by the Dresden Leibniz Graduate School--an international and interdisciplinary school of spatial science, economics and social sciences at the Technical University of Dresden, Germany. In 2010 I was accepted as one of 10 doctoral candidates to work under the umbrella topic “Dealing with Change-Regional Strategies in Times of Demographic, Climate and Economic Change”. This work is being supervised by Professor Bernhard Mueller, Director of the Leibniz Institute of Ecological and Regional Development (IOER). Completion of dissertation anticipated end of 2012.)

Jessica Hemingway
Dresden Leibniz Graduate School
E-Mail: j.hemingway@dlgs.ioer.de

Albany Focus group discussion
August 18, 2011, 12 p.m.

Working title: Municipal adaptation to climate change: what are local governments in New York State are doing and why?

Agenda

- Brief introductions
- Brief dissertation description

Informed consent

- Discussion recorded
- Sign consent form

Review Survey

- Run-though survey(specific questions listed below)

For each survey question:

1. Are questions understandable (correct jargon, meaning)? Is there jargon specific to the NYS/US that I'm not aware of that could be easier to understand?
2. Are the answer options provided for each question sufficient (is anything missing that should be there)?

Specific Questions about survey:

1. Regarding question 13: Is anything happening in the state regarding exploitation of climate change to benefit the economy (e.g. agriculture)?
2. Regarding question 17: Which types of funding exist for local governments wanting to take adaptation measures? How have local governments that have already taken adaptation measures been able to fund them?

General Questions

1. The survey will be distributed to villages, towns, cities and counties in New York State-- do you see value in doing this? Why or why not?
2. How can I best distribute the survey to the 'right' person within the municipality? Should I send an e-mail with the survey link to the Mayor/supervisor and ask them to forward it to the person responsible for climate change measures?
3. Further tips for distributing the survey?
4. Who would be interested in the results of the survey?
5. Interested in meeting again to discuss results?

Consent form

<Working Title> "Municipal adaptation to climate change: what are local governments in New York State are doing and why?"

As part of my dissertation project at the Dresden Leibniz Graduate School in Dresden, Germany I'm in the process of creating a municipal climate change survey. I'm interested in speaking with you in order to gain a better understanding of the environment local governments are working in to address climate change and their action options when it comes to climate change.

I would like to record our discussion so that I may listen to it at a later date in case I missed something during our initial conversation.

You may terminate your participation in the discussion at anytime for any reason without penalty.

Thank You for your participation, it's greatly appreciated!

Jessica Hemingway
Dresden Leibniz Graduate School
Tel: 0351 463 42349 | E-Mail: j.hemingway@dlgs.ioer.de

1. Participant Information

Name:

Company:

Email Address:

2. I give my permission to have my responses digitally recorded?

- YES
- NO

3. I give permission for direct quotes to be used in presentations or publications (without my name or institution name)?

- YES
- YES- only after it is reviewed and approved by myself or my institution
- NO

Other (please specify)

Consent form

<Working Title> "Local government response to climate change in New York State"

As part of my dissertation project at the Dresden Leibniz Graduate School in Dresden, Germany I'm in the process of creating a municipal climate change survey. I'm interested in speaking with you in order to gain a better understanding of the environment local governments are working in to address climate change and their action options when it comes to climate change.

I would like to record our conversation so that I may listen to it at a later date in case I missed something during our initial conversation.

Quotations may be selected for publication or presentations from our conversation (without your name and without your organization name).

You can terminate the conversation at anytime for any reason.

Thank You for your participation, it's greatly appreciated!

Jessica Hemingway
Dresden Leibniz Graduate School
Tel: 0351 463 42349 | E-Mail: j.hemingway@dlgs.ioer.de

1. Participant Information

Name:
Company:
Email Address:

2. I give my permission to have my responses digitally recorded?

- YES
- NO

3. I give permission for direct quotes to be used in publications (without my name or any identifying information)?

- YES
- NO