Assessing Policy Innovation: Climate Action Planning in the U.S. Southwest

ASSESSING POLICY INNOVATION:
CLIMATE ACTION PLANNING IN THE U.S. SOUTHWEST

by

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As members of the Dissertation Committee, we certify that we have read the dissertation prepared by **Ladd Keith**, titled **Assessing Policy Innovation: Climate Action Planning in the U.S. Southwest** and recommend that it be accepted as fulfilling the dissertation requirement for the Degree of Doctor of Philosophy.

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DEDICATION

For Robb, Liam, and Rowan.

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LIST OF ABBREVIATIONS

APA	American Planning Association
CAP	climate action plan
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GHG	greenhouse gas
ICLEI	Local Governments for Sustainability
IPCC	Intergovernmental Panel on Climate Change
NCA	National Climate Assessment
NOAA	U.S. National Oceanic and Atmospheric Administration
U.S.	United States
USDN	Urban Sustainability Directors Network

GLOSSARY

This dissertation contains many disciplinary- and research-specific terms that often have different uses in scholarship and practice. I present this glossary of key terms used throughout this dissertation in an effort to increase the accessibility of the following papers to a wider audience.

adaptive capacity | The potential of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, take advantage of opportunities, and cope with the consequences.

climate acknowledgment | When a planning action openly refers to climate change as the primary or contributing cause for the action.

climate action plan | A technical plan produced specifically for the purpose of addressing climate action planning in a community.

climate action planning | Planning actions to locally mitigate greenhouse gas emissions and reduce climate risk and pursue climate adaptation.

climate adaptation | Planning actions to reduce a community's vulnerability to increasing climate risk due to climate change.

climate change | Changes in the global or regional climate system attributed to human-caused greenhouse gas emissions.

climate information | A broad term that refers to climate science, including published results, assessments, syntheses, and data visualization, with respect to the past, current or projected climate of a place, region, or the entire planet Earth and the Earth's climate system. Such information is used in planning decision-making.

climate risk | Risks are threats to life, health and safety, the environment, economic well-being, and other things of value. Risks are often evaluated in terms of how likely they are to occur (probability) and the damages that would result if they did happen (consequences).

comprehensive plan | A long-range plan that broadly sets out a community's vision for the next 10-20 years, through establishing a fact base, determining goals for the vision, specifying policies to achieve those goals and implementation measures for the plan. Also referred to as general plans.

dedicated approach | The creation of specific and sole-purpose plans, which are often technical in nature and can lack regulatory enforcement as they often fall outside of required plans at the local level.

greenhouse gasses (GHG) | Gases that absorb heat in the atmosphere near the Earth's surface, preventing it from escaping into space. If the atmospheric concentrations of these gases rise, the average temperature of the lower atmosphere will gradually increase, a phenomenon known as the greenhouse effect. Greenhouse gases include, for example, carbon dioxide, water vapor, and methane.

internal determinants model | A model within policy innovation theory that attributes likelihood of of new policy adoption by a community to the characteristics within that community.

mainstreaming | The process when a new topic, such as climate action planning, is integrated into existing planning processes, plans, and regulatory documents.

mitigation | Planning actions to reduce a community's emissions of greenhouse gasses which contribute to climate change.

plan quality | The objective measure of a plan's inclusion of criteria established in planning scholarship, shown to increase plan effectiveness. These criteria are categorized by the plan's fact base, goals, policies, and implementation measures.

plan quality evaluation | A specific research method within the broader content analysis methods where plans are systematically coded and analyzed based on established criteria of what constitutes a high quality plan.

policy diffusion model | A model within policy innovation theory that explains the adoption of new policies by a community to learning through networks and/or spatially correlated learning, such as the influence of nearby communities.

policy innovation | A theory that explains the adoption of policies, defined as actual policies or programs, by a government entity for the first time.

resilience | Resilience is the ability of a system to recover after a disruption. Resilience is often used in practice interchangeably with climate adaptation, although the two terms have distinct definitions and uses.

semi-structured interviews | A research method where participants are interviewed to better understand a predetermined set of questions or themes, but also flexible and open to allow for the exploration of new ideas based on participant responses as they emerge.

Southwest | Within the context of this dissertation, refers to the states of Arizona and New Mexico.

systematic literature review | A research method of analysis of peer-reviewed papers of a specific topic or interest area that is conducted systematically and described in enough detail to make it reproducible by other researchers.

vulnerability | The degree that a system is unable to cope with changes, such as those caused by climate change. Social vulnerability refers specifically to the populations least able to cope with the changes due to existing social and political systems that disadvantage them.

ABSTRACT

Cities are on the front lines of climate change, and local climate action planning has the potential to both reduce greenhouse gas emissions through mitigation and reduce vulnerability to climate risk through climate adaptation. A growing body of planning research has explored climate action planning but has primarily focused on dedicated climate action plans and generally relied upon a narrow sample of coastal and larger cities that do not represent the diversity of cities that planners serve within the United States. This dissertation focuses on climate action planning in arid lands with an overarching research question: How are cities in the U.S. Southwest planning for climate change? The original research I present in this dissertation addresses this question through three interrelated papers that assess the state of planning literature on climate action planning research (Appendix A), document the concerns, approaches, and catalyst and barriers planners report facing when addressing climate risk (Appendix B), and evaluate how climate action planning is being mainstreamed into comprehensive plans (Appendix C). This dissertation advances planning scholarship and practice by expanding the understanding of climate action planning in cities in the arid lands of the U.S. Southwest.

CHAPTER 1: Introduction

Climate change is one of humanity's grand challenges, and the Fifth Assessment Report of the Intergovernmental Panel on Climate Change highlighted that cities' responses to this challenge are critical (IPCC, 2014). Local climate action planning has the potential to both mitigate greenhouse gas emissions and reduce vulnerability to climate risk through climate adaptation (Bierbaum et al., 2013; Bulkeley, 2010). A growing body of planning research has explored how cities are addressing climate change, which is essential to understand the needs in the planning profession as the topic continues to grow in prominence (Baker, Peterson, Brown, & McAlpine, 2012; Nordgren, Stults, & Meerow, 2016). The research on climate action planning has primarily focused on dedicated climate action plans, rather than mainstreamed approaches to planning which integrate climate action planning into existing land use regulations and long-range plans (Nordgren et al., 2016; M. R. Stevens & Senbel, 2017). The focus on dedicated climate action plans may be presenting a skewed view of how climate action planning is occurring.

The research on climate action planning has also often relied upon samples of coastal cities and their early climate adaptation efforts against sea-level rise, as well as larger cities that do not represent the diversity of cities that planners serve within the United States (Berke & Stevens, 2016). The lack of planning research on cities in arid lands has been noted in planning literature, and has had consequences for how these cities were planned and now interact with their natural environment (Ewan, Fish, & Burke, 2005; Golany, 1978). For the U.S. Southwest, a growing region that faces unique climate challenges, a better understanding of climate action planning efforts in planning is needed to improve mitigation and climate adaptation efforts.

In this chapter, I will present the research questions, share my research motivation and provide an overview of the literature that informed my work. I will then provide context for the study area and describe the integrated methods used to answer the research questions. Finally, I will present a summary of the results of the research and the contributions this dissertation makes to the practice and scholarship of climate action planning.

Research Questions

This dissertation addresses the need for a better understanding of climate action planning in arid lands, with the overarching question that guides the individual papers presented: *How are cities in the U.S. Southwest planning for climate change?* The specific research questions and the corresponding dissertation papers in which they are explored are as follows:

- What is the state of research on policy adoption of climate action planning? What are the relevant themes and findings from the literature for planning practitioners and scholars? What are the areas of climate action planning research needed? (Appendix A)
- Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking? What catalysts and barriers do the planners report in planning for climate risks? How do planners report framing planning responses as climate change related? (Appendix B)
- How are cities in the Southwest mainstreaming climate action planning into comprehensive plans? To what extent are cities in the Southwest addressing relevant climate risks in comprehensive plans? (Appendix C)

The integrated work I present within this dissertation is intended to further climate action planning research and help inform planners, decision-makers, and climate service providers. While the research is grounded in planning practice and theory, the final product is an interdisciplinary scholarly work. The research draws directly from climate science, to better understand the climate impacts facing the Southwest. It also draws from urban climate change governance literature for additional insights and is informed by literature on the co-production of climate science. Finally, several of the research methods used in this dissertation were strengthened by drawing from best practices in other disciplines.

Research Motivation

The motivation for the research presented within this dissertation began with experiences I had as the Chair of the City of Tucson Planning Commission during the city's comprehensive plan update, beginning in 2012. As Chair, I presided over the public hearings and worked with dedicated city planning staff to ensure the public and commissioners' feedback was incorporated into the plan. The city made the conscious decision that the plan would address both traditional long-range planning topics as well as emerging topics in planning, like climate change. Voters ratified the Tucson General & Sustainability Plan, and it was officially adopted in 2013.

During the drafting of the plan, the climate adaptation resources available at the time appeared to be written for cities facing sea level rise and those in temperate climates. During the public hearings and review of plan drafts, I observed that climate adaptation related topics were often framed with the economic development and public health co-benefits of pursuing the policies, to the point that sometimes the climate adaptation connection was removed altogether. Mitigation efforts appeared to be more accepted since they are built on existing smart growth and

sustainability efforts. Like all topics in long-range plans though, climate action planning goals and policies had to be carefully weighed and prioritized with other, often more visible and urgent, community concerns.

This was also the same period where I observed a growing number of peer-reviewed papers in planning literature that analyzed how cities were pursuing climate action planning through dedicated climate action plans. The focus of research on climate action plans, to explore how planning was addressing climate change, was logical, since the plans were dedicated to the topic and contained a wealth of data to analyze. These climate action plans were highly technical documents, often produced by consultants, who elicited little or no public participation; the plans appeared to lack integration into existing planning processes, long-range plans, and land use regulations.

These observations about the Tucson comprehensive plan update sparked my interest in climate action planning in the other cities in the U.S. How were cities, that could not pursue climate action plans, due to lack of resources or public support, planning for climate change? How well were cities, which integrated climate action planning policies into existing plans, addressing climate change? These initial observations formed the basis for the research questions that guide the work within this dissertation.

Overview

In this section, I will introduce the salient planning concepts, geographic context, and theoretical basis that connects the research presented in the dissertation. First, I will review the concept of climate action planning, including the emergence of greenhouse gas mitigation and climate adaptation in the planning profession, as well as the state of research and areas of further

need. Next, I will review the geographic context of arid lands and the need for more research on cities in arid lands. Finally, I will review policy innovation theory, including the internal determinants and policy diffusion models.

Climate Action Planning

Climate change poses a challenge to the planning profession, in the urgent need for cities to both mitigate local contributions to greenhouse gas (GHG) emissions and also to prepare for increasing climate risks (Bassett & Shandas, 2010; Castán Broto & Bulkeley, 2013). These local planning efforts to mitigate GHG emissions and reduce climate risk are collectively known as climate action planning (Bassett & Shandas, 2010).

Local GHG mitigation efforts, hereafter collectively referred to as mitigation, are essential, as nation-level action will likely fall short of voluntary Paris Agreement actions to keep global temperature increases under 1.5°C (Castán Broto, 2017). At the current rate of global GHG emissions, global temperature is likely to increase by 1.5°C between 2030 and 2052 (IPCC, 2018). Considering that between 71-80% of global GHG emissions originate from cities, the planning profession plays a critical role in the mitigation of GHG emissions. (Hoornweg, Sugar, & Gómez, 2011). Mitigation efforts in planning include local control over the development of land uses that shape the urban form, with more efficient and compact urban form decreasing building- and transportation-related GHG emissions (Bulkeley, 2010; Ewing et al., 2007). City governments can also decrease the associated GHG emissions from their municipal operations (Bulkeley, 2010).

Climate adaptation is the actions taken both in anticipation and in response to climate change impacts (Baker et al., 2012). Climate adaptation in planning will play a key role in the

degree of urban preparedness for climate change impacts (Baker et al., 2012; Bierbaum et al., 2013). Limiting climate change and its respective impacts to a 1.5°C increase of global temperatures would require, "rapid, far-reaching and unprecedented changes in all aspects of society," (IPCC, 2018). The likelihood of a 2°C increase of global temperature further intensifies many regions' projected risks of flooding, heat extremes, drought, and sea-level rise, meaning that unless transformational societal changes occur, climate adaptation needs for cities will be substantially higher than at 1.5°C of global warming (IPCC, 2018). As is well documented, increasing climate risks impact the most vulnerable populations in cities, exacerbating existing racial, cultural, and income inequities (Anguelovski et al., 2016; Howell & Elliott, 2018; Myers, Slack, & Singelmann, 2008).

Compared with mitigation research in planning literature, climate adaptation is an emerging area in both practice and scholarship (Nordgren et al., 2016). The topic of climate adaptation does not emerge in planning literature until the 2010s (Bedsworth & Hanak, 2010). As recently as 2010, less than 25 publications cataloged in the Web of Science contained "climate," "urban," "adaptation" and "planning" in the title, keywords, or abstract (Meerow & Mitchell, 2017). That number increased to over 125 publications on climate adaptation by 2016 (Meerow & Mitchell, 2017).

The current planning literature on how planners are addressing climate change has thus far focused mainly on early adopter cities and climate action plans (CAPs) (M. Stevens & Senbel, 2017). CAPs are dedicated and stand-alone policy documents that represent some of the first efforts of cities to address climate change (M. R. Stevens & Senbel, 2017). They are also often highly technical documents, informed by little to no public participation; therefore they

also often lack legitimacy and fail to reflect the values of the community (Berke & Stevens, 2016). CAPs also risk being "a plan gathering dust on the shelf," and the stand-alone documents often have no regulatory status and are not integrated with day-to-day planning decisions in the community (Butler, Deyle, & Mutnansky, 2016).

Mainstreaming is another approach to climate action planning (Butler et al., 2016; Uittenbroek, Janssen-Jansen, & Runhaar, 2013). In mainstreaming, climate action planning efforts are integrated into everyday processes, ensuring that they are weighed along with other considerations and community values (Uittenbroek et al., 2013). Examples of mainstreaming including integrating climate action planning into existing development regulations, comprehensive plans, and hazard mitigation plans. A drawback to the mainstreaming approach is that the focus on climate change is diluted and likely outweighed by more pressing community issues (Uittenbroek et al., 2013). There is a need in the literature to further explore and document mainstreaming policy outcomes, such as how climate action planning is being mainstreamed into existing plans and land use regulations (Runhaar, Wilk, Persson, Uittenbroek, & Wamsler, 2018). A more complete understanding of climate action planning efforts may be overlooked if research focus remains on dedicated planning efforts (Berke et al., 2015).

The focus of planning research on cities that made early efforts on climate action planning and on CAPs has advanced the planning literature on how the profession is addressing climate change. A drawback of this continued research focus, however, has been an oversampling of climate adaptation efforts in coastal cities that face sea-level rise and in larger cities with the resources and political support to address climate change (Berke et al., 2015). There is a need in planning literature to further explore climate action planning in non-coastal

cities, smaller cities, and those with less resources and political support for the topic (Berke et al., 2015). Nordgren, Stults, and Meerow (2016), conclude that while there are abundant climate adaptation resources for cities adapting to sea-level rise, there are, "glaring omissions that need to be addressed," for cities facing other climate risks. The need for research in planning literature on the planning of cities in arid lands is not a new issue, though, as the next section will detail.

Arid Lands

The term arid lands, used within this dissertation, follows the Hutchinson and Herrmann (2008) definition, adapted from Thomas and Middleton (1997), which describes drylands generally characterized by lack of precipitation, including hyperarid, arid, semiarid, and dry-subhumid areas, outside of the polar and subpolar regions. These arid lands comprise 41.3% of the Earth's surface and are home to 2.1 billion people, or one out of every three people (UNCCD, 2011). Arid lands are also experiencing the most significant global population growth, at a rate of 18.5% faster than non-arid lands (UNCCD, 2011). This population growth is increasing existing resource strains on arid lands, which is an important consideration, since 72% of the area of arid lands is located within developing nations whose populations already have the greatest needs (Hutchinson & Herrmann, 2008).

Hutchinson and Herrmann (2008) posit that the most significant challenges with human interactions and arid lands will include diminishing sources of water and difficult decisions over its uses, continued growth in populations and urbanization, shifting agricultural production, desertification and environmental degradation, and the role of power production such as solar energy in land use decisions (Hutchinson & Herrmann, 2008). The vulnerability of cities within arid lands to future water scarcity was also presented by Gober (2010) and included complex

dynamics in water-energy uses, tradeoffs between irrigated landscaping for heat mitigation, and the relationship between urban growth, the economy, and environment.

Climate change impacts add additional stress to the aforementioned challenges. Regardless of the rate of global temperature increase, there is high confidence that arid lands will be among the regions most disproportionately impacted by climate change (IPCC, 2018). By 2030, almost half of the world's population will live in areas of high water stress (UNCCD, 2011). In many arid and semi-arid areas, the United Nations Convention to Combat Desertification (2011) estimates climate change could exacerbate water availability issues and displace anywhere between 24 million and 700 million people. The ability of inhabitants of arid lands to adapt could be an indication, "for how the world will cope with future change under scenarios that predict increasing dryness, temperatures and variability," (UNCCD, 2011).

Given these concerns with future challenges of populations in arid lands, the role of the planning of cities in these areas is of importance. Stenger (1987) argued that, historically, cities either must adapt to arid conditions or attempt to "engineer them out of existence." Many cities in arid lands, throughout the 20th Century, focused on the suppression of the existence and impacts of aridity, as opposed to adapting to the conditions they present (Ewan, 2004). This had the effect, noted by Ewan (2004), of "allowing urban planning to proceed as if the desert did not exist." Discussing the impact of migration and loss of local planning and design traditions in the city of Be'er Sheva in Israel, Meir (2011) stated, "Most of the first planners and architects had very little or no acquaintance with the special environmental constraints of the desert." This loss of local planning and design traditions was repeated around the world during the 20th Century, as well as in cities in the arid lands in the United States (Ewan et al., 2005). Given the

environmental constraints in arid lands, Golany (1978) argued that the planning profession should not import policy and design solutions developed in other areas that do not address the unique context of cities in arid lands.

Policy Innovation Theory

Given the emergence of climate action planning in the planning profession and the historic and increasing environmental strains on cities in arid lands, there is a need for improved understanding on how the experimentation of climate action planning efforts occurs, how policies spread from one city to another, and why some cities take action and when others do not. Policy innovation theory explains the adoption of policies, defined as actual policies or programs, by a government entity for the first time (Berry & Berry, 1999; Krause, 2011). Policy innovation theory is relevant in planning practice and scholarship, because it seeks to describe the catalysts, barriers, and paths for the adoption of new policies, as new challenges and opportunities emerge (Berry & Berry, 1999). Climate change is challenging the planning profession and spurring policy experimentation at the local level, making it a worthwhile topic for the use and advancement of policy innovation theory.

Mohr (1969) hypothesized and presented evidence that policy innovation is, "directly related to the motivation to innovate, inversely related to the strength of obstacles to innovation, and directly related to the resources available for overcoming such obstacles." Berry and Berry (1999) further advanced policy innovation theory, by introducing the complementary models of internal determinants and policy diffusion. Within the internal determinants model, policy innovation is a function of the government's existing political, social, and economic characteristics (Berry & Berry, 1999). The policy diffusion model began with Berry & Berry

(1999) as the regional diffusion mode, with spatial proximity to innovating governments being the factor that determines policy adoption (Berry & Berry, 1999). This idea has been further developed over the years and now also recognizes the influence of non-spatial influences in policy innovation, such as learning networks and professional organizations (Shipan & Volden, 2012). Referred to now as the policy diffusion model, it is broadly recognized as having both spatial and non-spatial factors in the adoption and spread of policy (Shipan & Volden, 2012).

Study Context

Planning research focused on climate action planning efforts in cities in the Southwest is an underexplored area in the literature, which has consequences for the ability of the planning profession to improve and implement mitigation and climate adaptation efforts at the local level (Berke et al., 2015). While the definition of what constitutes the Southwest varies culturally and politically, for this dissertation, I utilize the regional area defined by The Third National Climate Assessment, which includes the states of Arizona, California, Colorado, Nevada, New Mexico, and Utah (Garfin et al., 2014).

The current population of the Southwest, 56 million people, is 12% more urbanized than the national average with an urban population rate of 92.7% (Garfin et al., 2014). In addition to a highly urbanized population, the Southwest is a region will continue to grow, with estimates that the region will be home to 94 million people by 2050 (Garfin et al., 2014). This highly urbanized and growing population means the use of efficient land use planning can help mitigate increases in future GHG emissions in the Southwest.

The Southwest is considered the hottest and most arid region in the nation, with a history of climate variability projected to be exacerbated by climate change (Cayan et al., 2013; Garfin

et al., 2014). Although the region varies geographically and climactically, it is characterized by low precipitation, warm temperatures in the lower deserts and cooler temperatures in the higher elevations (Sheppard, Comrie, Packin, Angersbach, & Hughes, 2002).

It has been argued by Overpeck and Udall (2010; 2017) that the Southwest will be the region in the U.S. most impacted by climate change in the coming decades. Localized drought is projected to increase, and snow-drought and earlier spring snowmelt in the region's mountains will impact potable water supply of cities, particularly those that rely on the Colorado River (Wehner, Arnold, Knutson, Kunkel, & LeGrande, 2017). Increasing heat due to climate change, coupled with the urban heat island effect, will also pose risks for public health and infrastructure in cities (Berisha et al., 2017; Garfin et al., 2014). Flooding risk in cities may also increase, due to changes in short-duration atmospheric rivers (Demaria et al., 2017; Ralph et al., 2017). Finally, wildfires are projected to increase, due to interactions between rising temperatures and drought (Abatzoglou & Williams, 2016; Barbero, Abatzoglou, Larkin, Kolden, & Stocks, 2015; Westerling, 2016). Wildfires will have a direct impact on those cities near forests and natural lands, but will also impact cities throughout the region through decreased air quality and the potential for increased flooding (Garfin et al., 2014).

Methods

Case Study Cities

I chose three case study city pairs in Arizona and New Mexico (Figure 1) to explore climate action planning in the Southwest. The term "case study," as used in this dissertation, follows Yin's (2017) definition, where the case study is an empirical method that, "investigates a contemporary phenomenon in depth and within its real-world context." The three case study city

pairs include Flagstaff, AZ and Santa Fe, NM; Yuma, AZ and Las Cruces, NM; and Tucson, AZ and Albuquerque, NM. The research presented within this dissertation was supported in part by funding from the Climate Assessment for the Southwest (CLIMAS) program, part of the National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments program. CLIMAS's service area is Arizona and New Mexico, which are frequently included in the "core" of the Southwest (Byrkit, 1992; Liverman & Merideth, 2002), and contains a range of environment types represented within the larger Southwest region.

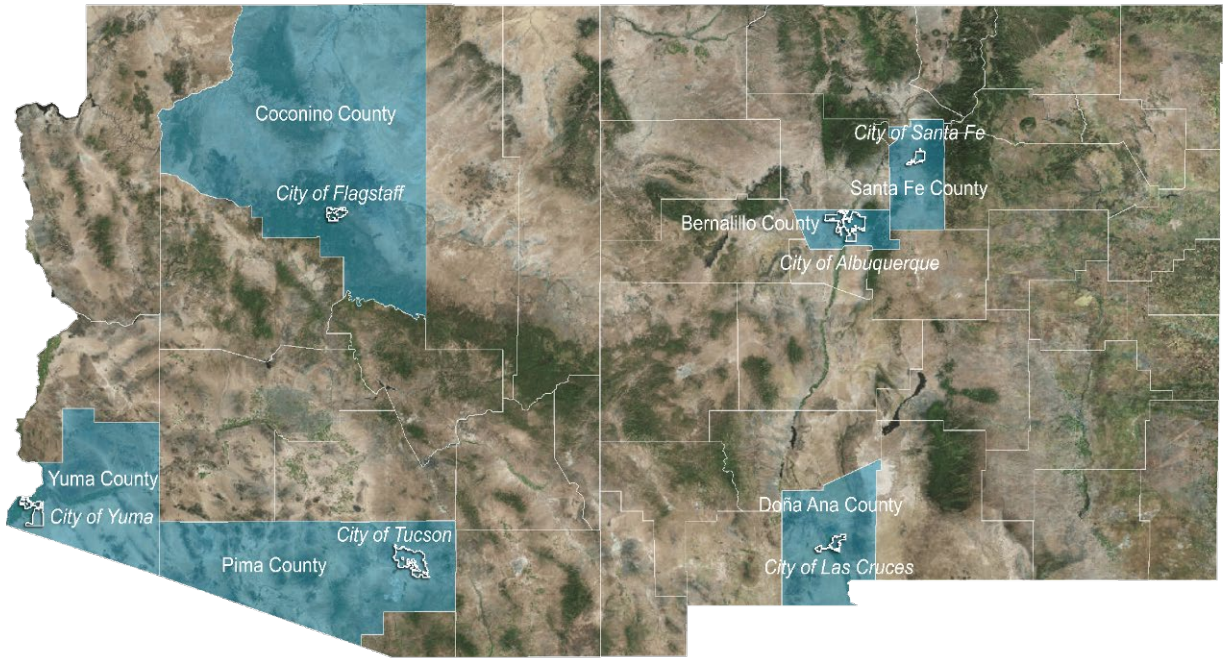

Figure 1. Case study cities. The six case study cities in Arizona and New Mexico with their respective counties shaded in blue.

I chose each case study pair across the two states, based on their comparative population sizes (Table 1). The geographic typologies represented across the case studies also encompass the range of current and projected climate risks to cities in the Southwest. I anticipated that the cities' geography, climate, and the surrounding natural environment would influence both

climate risks and planning responses. All of the case study cities are projected to be impacted by increasing climate risks for flooding, drought, and heat. While all the cities could also be indirectly impacted by wildfire through reduced air quality and increased flooding, the direct risk from wildfire is highest in the higher elevation and more forested cities, Flagstaff, AZ and Santa Fe, NM.

Table 1. Case Study City Characteristics

City and State	**City Population (2010 Census)**	**County**	**Geography**	**Elevation (ft)**
Flagstaff, AZ	65,870	Coconino County	Mountain, forest	6,910
Santa Fe, NM	67,947	Santa Fe County	Mountain, forest	7,199
Yuma, AZ	90,660	Yuma County	Desert	141
Las Cruces, NM	97,618	Doña Ana County	Desert	3,000
Tucson, AZ	520,116	Pima County	Desert	2,389
Albuquerque, NM	545,852	Bernalillo County	Desert	5,312

I anticipated that the population sizes of each city (Table 1) could influence access to resources, such as funding availability and planning staff size. I also chose the variety of population sizes to better understand the range of climate action planning activities taking place; as discussed earlier, most current research focuses on the climate action planning in larger municipalities. Each city also serves as its county seat and is the largest municipality in its respective metropolitan region. Finally, pairing the cities across the two states allowed an opportunity to explore the impact of state mandates, through policy innovation theory, as Arizona has strong state mandates for planning while New Mexico does not.

Research Design and Analysis

The methods used to answer the overarching research question of this dissertation and the more specific questions within each paper are summarized below (Table 2) and are each explained in more detail in their respective papers included in the appendices.

Table 2. Integrated Research Methodology

Appendix	Research Questions	Methods	Primary Data Sources	Analysis
A	What is the state of research on policy adoption in climate action planning literature? What are the relevant themes for planning practitioners and scholars from the literature? What are the future directions of research?	Systematic literature review	Peer-reviewed publications	Textual narrative synthesis Scoping review
B	Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking? What are the policy innovation catalysts and barriers in planning for climate risks? How do planners report framing planning responses as climate change related?	Semi-structured telephone interviews	Interview transcripts	Bottom-up coding and theme identification Integrated analysis with results from Appendix C
C	Are cities in the Southwest mainstreaming climate action planning into comprehensive plans? To what extent are the comprehensive plans addressing relevant climate risks?	Plan quality evaluation	Comprehensive plans	Descriptive statistics Integrated analysis with results from Appendix B

The first paper, *An Assessment of Original Research on Policy Adoption in Climate Action Planning Literature*, is presented within Appendix A of this dissertation. The research

questions of this paper include: 1) What is the state of research on policy adoption in climate action planning literature?, 2) What are the relevant themes for planning practitioners and scholars from the literature?, and 3) What are the future directions of research? I conducted a systematic literature review of original U.S. and Canadian climate action planning research published between 2000 and April 2018. This systematic literature review follows the best practices suggested by Xiao and Watson (2017), including a rigorous paper selection criteria methodology to increase the reliability of the papers selected and reproducibility for future research. Data collected from the reviewed papers included the theories explored and tested, samples selected, methods used, and results generated. This systematically coded data was summarized and categorized in a table for analysis, using both textual narrative synthesis and a scoping review (Xiao & Watson, 2017).

The second paper, *Planning for Climate Risk in the U.S. Southwest: Reported Concerns, Policy Approaches, and Policy Innovation Catalysts and Barriers*, is presented within this dissertation in Appendix B. The research questions of this paper include: 1) Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking? 2) What catalysts and barriers do the planners report in planning for climate risks? 3) How do planners report framing planning responses as climate change related? With assistance from two graduate research assistants, we conducted semi-structured telephone interviews with thirty-two planners across the case study cities. We selected these interview participants to represent a range of current city planners, long-range city planners, long-range county planners, and sustainability coordinators, to explore potential differences in perceptions based on job function. Interviews were recorded, transcribed, and then coded thematically using

multiple sorting and comparison techniques presented by Bernard (2003). Analysis of this coded data was qualitative and included additional reviews of the content of the transcriptions and comparison of descriptive statistics. Policy innovation theory provided a lens through which we discuss the data on catalysts and barriers, although our analysis was not limited to the theory.

The third paper, *Evaluating How Climate Action Planning Is Being Mainstreamed into Comprehensive Plans in the U.S. Southwest,* is presented within this dissertation in Appendix C. The research questions of this paper include: 1) Are cities in the Southwest mainstreaming climate action planning into comprehensive plans?, and 2) To what extent are the comprehensive plans addressing relevant climate risks? With assistance from two graduate research assistants, we conducted plan quality evaluation of the previous and current generations of comprehensive plans based on established methods in the planning literature (Baer, 1997; Berke & Godschalk, 2009; Lyles & Stevens, 2014). We adapted the initial indicators for scoring from Baynhams & Stevens (2013) and utilized grounded theory to make them more relevant to the institutional and environmental context of Arizona and New Mexico. We analyzed the coded data from the two generations of comprehensive plans, using descriptive statistics to explore the mainstreaming of climate action planning over time.

I conducted the research in this dissertation through an iterative process (Figure 2). I started an initial literature review first, reviewing papers on climate action planning and policy innovation within the planning and climate change literature. Data from the reviewed papers, including planning theories tested, samples researched, methods used, and results were all summarized and categorized in a table for analysis. This data was sorted and qualitatively analyzed to generate emergent themes. I used emergent themes from this initial literature review

to inform the research design of the semi-structured interviews and plan quality evaluation (Figure 2). I intentionally utilized the same case study cities in both the semi-structured interviews and plan quality evaluation, to explore both perceptions from a variety of planners within the cities, as well as comparing and contrasting the perceptions with what the comprehensive plans reflected. I concurrently began data collection for the semi-structured interviews and plan quality evaluation during the same time period.

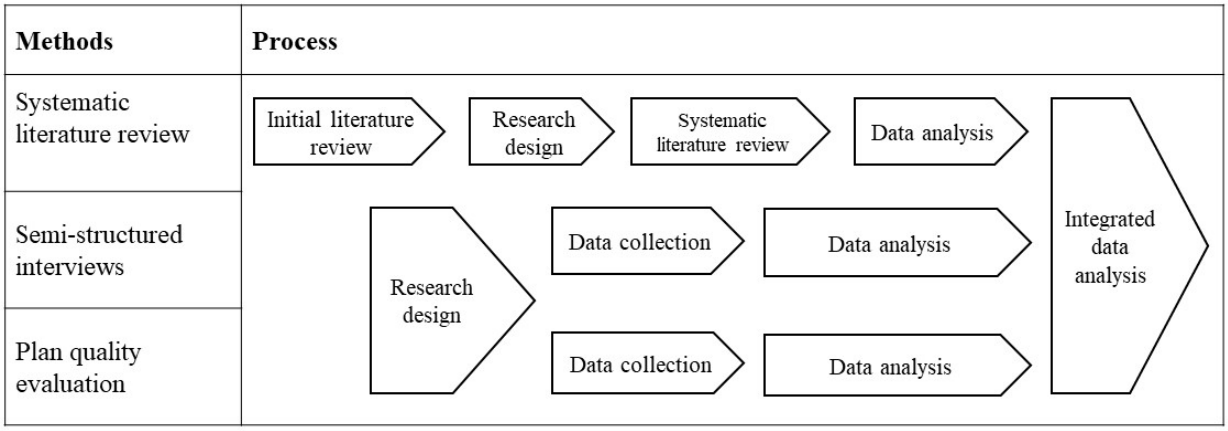

Figure 2. Integrated Research Methods and Process

At this point, I also designed the systematic literature review criteria, based off of criteria established by Xiao & Watson (2017), to increase replicability. With the new systematic literature review criteria, I searched and re-analyzed the literature to ensure relevant original research on the policy innovation of climate action planning was included in the data for analysis. This resulted in the inclusion of a number of relevant papers initially missed during the first literature review.

I initially conducted separate data analysis for the results of each method, ensuring the results were thoroughly analyzed. I then conducted an integrated analysis of the data for the case study cities, by comparing coded data from the interviews and quality plan evaluation within

each city, by case study pairs across states, and by all cities within each state. An example of this was that I compared the reported climate risks by the planners in the coded interview data to the scores for climate risk topics within the quality plan evaluation. This comparison showed evidence of climate risk policy action in some cases that matched the planners' expressed concern for Appendix B and better contextualized the plan quality evaluation scores on climate risk in Appendix C. The integrated analysis approach provided more insight into the findings of each paper and resulted in this dissertation being a more cohesive body of scholarly work.

Results

Several key outcomes emerged from the research in the papers within this dissertation. In Appendix A, I provide evidence that confirms the assertation made in planning literature that non-coastal and small to medium-sized cities are underrepresented in climate action planning research. Many of the cases reviewed in Appendix A also rely on samples of cities already involved with environmental or climate networks and cities that had adopted a CAP. In Appendix A, the papers I reviewed showed the factors most associated with policy adoption of climate action planning include leadership, public support, and the presence of environmental nonprofits. I also found evidence that the majority of climate action planning research has focused on internal community characteristics in the internal determinants model within policy innovation theory and adaptive capacity. While the policy diffusion model of policy innovation theory was less often researched, the adoption of policies by neighboring communities was found to be a factor in policy innovation when researched. I also found evidence that adaptive capacity was becoming more prominent in planning literature to explore climate action planning research.

In Appendix B, I found that the planners interviewed reported that significant climate events, future state or national mandates, and access to peer case studies were the most likely catalysts for planning for climate risks. The barriers they reported in planning for climate risks included lack of resources, assistance messaging the issue, and political leadership and public support. Planners most frequently discussed concern with the climate risks of drought, flooding, extreme heat and wildfire. Planners in Flagstaff, AZ and Santa Fe, NM reported wildfire as a climate risk of concern and planners in Las Cruces, NM reported air quality as a concern.

In both Appendices B and C, I found that heat stood out as an emerging climate risk in the planning profession. During the semi-structured interviews, planners discussed concern regarding heat risk but lacked specificity when discussing its impacts or potential ways to address the risk. In the plan quality evaluation of comprehensive plans, heat was the only climate risk that was absent in the previous generation of plans to emerge within the current generation of plans.

In both Appendices B and C, I found evidence regarding the mainstreaming of climate action planning. Through the semi-structured interviews, planners in five of the six cities reported only using mainstreaming approaches as they integrated climate risk into their existing development regulations and long-range plans, rather than dedicated planning approaches such as climate action plans. Planners in Flagstaff were alone in discussing dedicated planning approaches to climate risk, in addition to the mainstreaming activities they reported pursuing. Planners across all cities reported more success in advancing climate action planning by focusing on co-benefits, particularly economic development and public health benefits.

In Appendix B, I found that the current generation of comprehensive plans acknowledge climate change to a greater extent and incorporate more climate action planning policies than the previous generation. While mitigation policies were also present in the previous generation, climate adaptation policies increased in the current generation of comprehensive plans, showing further evidence of mainstreaming. Consistent with policy innovation theory and planning literature on state mandates, the stronger comprehensive plan mandates in Arizona were correlated to more frequent updates and higher plans scores than those in New Mexico.

Finally, in Appendices A, B, and C, the use of climate information for climate action planning was documented. Several of the cases reviewed in Appendix A presented evidence that it is not the access to climate information that presents a barrier to its use, but its communication and translation that is the barrier. Most cities lack the internal technical expertise to translate climate information into locally relevant and usable climate information. In Appendix B, planners reported a diversity of climate information sources they turn to, including professional organizations, local universities, and federal agencies. Finally, in Appendix C, while many of the current generation of comprehensive plans cited sources on climate change, it was only to strengthen the argument that it existed or in general reference to global warming. None of the plans reviewed used regional or national climate change projections to inform climate adaptation policies.

These results are detailed and discussed further in their respective papers in Appendices A, B, and C.

Contributions of the Present Study

The research I present in this dissertation contributes to and advances planning scholarship and practice as well as arid lands literature in several ways. The understanding of policy adoption of climate action planning is advanced in Appendix A, which demonstrates current theories tested and explored, samples selected, methods used, and reveals future research directions. The research in Appendices B and C contributes to policy innovation theory, through the semi-structured interviews and plan quality evaluations, which add insights to the literature about which factors act as barriers and catalysts for innovation within the case study cities explored.

The research within Appendices B and C in this dissertation is also a contribution to literature on climate action planning in cities within the Southwest, an arid region growing in population and challenged by the impacts of climate change. The results from Appendices B and C also contribute to the understanding of urban planning within arid lands. The documentation of the emergence of heat as a climate risk of concern in the case study cities shows the importance of climate adaptation research exploring the diversity of communities served by planners in the U.S.

Finally, the plan quality evaluation research in Appendix C, represents an important contribution to plan quality literature. This paper joins Brody's (2003) longitudinal quality plan evaluation as one of the few to analyze changes in plan quality over time. Appendix C demonstrates the usefulness of longitudinal plan quality evaluation as a research method to explore the mainstreaming of climate action planning.

Recommendations for Research and Practice

Based on the research presented in this dissertation, I make several recommendations for both the research and practice of climate action planning. First, I recommend more climate science translation and messaging assistance to planners. As also confirmed by interviews with planners in the case study cities in the Southwest, "There is already a bounty of scientific information available," (Nordgren et al., 2016). This messaging need was also evident in the comprehensive plans analyzed, which included no national or regional projections in their fact base to inform climate adaptation policies. The technical expertise needed to translate that climate science into locally relevant and usable climate information is still not available to most cities. The coproduction of climate science knowledge through a process of collaboration between scientists and decision-makers is one potential solution researchers can pursue to help planners with this issue (Meadow et al., 2015). The collaboration and engagement between scientists and stakeholders can result in more usable science for the stakeholders (Dilling & Lemos, 2011).

Second, I recommend more research into climate adaptation related to the climate risk of extreme heat. Where the cases reviewed showed that the climate risks of floods, droughts, and wildfires had been mainstreamed into comprehensive plans and specific planning and design policies referred to by planners in the interviews, heat stood out as the emergent climate risk. The exploration of heat as a climate risk was also largely absent in the systematic literature review, as the samples within the cases were skewed towards coastal and temperate cities. More research is recommended on climate action planning for both the heat-related impacts to cities as well as the climate adaptation tools the planning profession can use to mitigate the impacts of heat. This

would benefit not only cities in the Southwest but also cities in hot and arid lands outside of the U.S.

Finally, I recommend that future research continue to increase the understanding of the climate action planning occurring in non-coastal cities, small to medium-sized cities, and cities not involved in environmental or climate learning networks. The communities that planners serve are diverse in all of these characteristics, and planning literature should reflect this diversity in order to find a more accurate representation of how climate change is being addressed by cities in the U.S. As demonstrated by the interviews and confirmed by the plan quality evaluations, mainstreaming approaches to climate action planning were favored in the cases reviewed in this dissertation. I also recommend that climate action planning research that uses policy innovation theory more clearly articulate which models and factors are being tested, in an effort to continue to advance understanding of the theory.

CHAPTER 2: The Present Study

The papers presented in Appendices A, B, and C represent the body of original research completed for this dissertation. While each paper has individual research objectives, methods, findings, and discussion of results, the findings of each inform the others and as such, represent an integrated body of scholarly work. This dissertation presents my scholarly work to advance both the research and practice of climate action planning through policy innovation theory. The findings of the papers are also intended to inform planners, decision-makers, and climate information service providers in practice, by improving understanding of how cities in the U.S. Southwest are pursuing climate action planning.

I am the primary author of each of the following papers and ensured their integration with each other for this dissertation. I created the research objectives, conceived the research design, led the research process, and conducted the majority of analysis of each paper. For the paper presented in Appendix A, I was the sole researcher and author. For the paper presented in Appendix B, I was assisted by two research assistants in data collection, with Joseph E. Iuliano named as co-author as he also participated in the analysis of data and review of the paper. For the paper presented in Appendix C, I was assisted by two research assistants in data collection. Gregg M. Garfin is named as co-author in this paper for his role in editing. Each paper will be submitted to a peer-reviewed journal.

Following are summaries of the research presented in the papers comprising Appendices A, B, and C.

Appendix A: An Assessment of Original Research on Policy Adoption in Climate Action Planning Literature

Climate action planning continues to gain prominence in the planning profession, as a growing number of cities act to mitigate greenhouse gas emissions and prepare and respond to increasing climate impacts. I conducted a systematic literature review of original research of policy adoption of climate action planning to 1) present the current state of literature, including theories tested and explored, samples selected and methods used, 2) synthesize themes for both planning practitioners and scholars from the research findings, and 3) suggest future research directions. Results included that non-coastal and small to medium-sized communities are underrepresented in the current literature. Adaptive capacity was becoming more prominent in planning literature to explore climate action planning research. Key factors within the internal determinant model, associated with climate action planning, included leadership, public support, and the presence of environmental nonprofits. While less explored in the papers reviewed, factors within the policy diffusion model, such as the adoption of policies by neighboring communities, were highly correlated to policy innovation when tested. Future research on climate action planning should not discount the importance of policy diffusion in policy innovation theory.

Appendix B: Planning for Climate Risk in the U.S. Southwest: Reported Concerns, Policy Approaches, and Policy Innovation Catalysts and Barriers

The Southwest is considered the hottest and most arid region in the United States, with increasing climate risks to its cities due to climate change, yet there is little documentation on how planners in this region are responding. We conducted interviews with thirty-two planners in six cities in Arizona and New Mexico in 2016 and 2017 to better understand: 1) Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking? 2) What catalysts and barriers do the planners report in planning for climate risks? 3) How do planners report framing planning responses as climate change related? The planners interviewed acknowledged both climate change and the anticipated climate risks to their communities, but also often discussed choosing not to frame responses as climate change related, due to the politicization of the issue. Planners reported mainstreaming approaches to integrating climate risk into existing development regulations and long-range plans, rather than dedicated planning approaches, such as climate action plans. Planners also reported that significant climate events, future state or national mandates, and access to peer case studies were the most likely catalysts for action. Reported barriers to action included lack of resources, lacking assistance messaging the issue, and lack of political leadership and public support. These findings contribute to the understanding of how planners in the Southwest are planning for climate risk.

Appendix C: Evaluating How Climate Action Planning Is Being Mainstreamed into Comprehensive Plans in the U.S. Southwest

Local climate action planning has the potential to both mitigate greenhouse gas emissions and decrease vulnerability to climate impacts. Addressing these impacts is particularly important for Southwest cities, where climate change is projected to increase the severity of drought, heat, rainfall events, and wildfires. We used plan quality evaluation to analyze: 1) how cities in Southwest are mainstreaming climate action planning into comprehensive plans, and 2) to what extent cities in the Southwest are addressing climate risks in comprehensive plans. We paired the six cities in Arizona and New Mexico to explore the impact of state mandates on comprehensive plans. While the current plans acknowledge climate change to a greater extent and incorporate more climate action policies than earlier plans, they do not include climate information in the fact base of the plans. The impact of state mandates is evident in these cases, with stronger mandates in Arizona leading to more frequent plan updates and higher plan scores than in New Mexico. We recommend strengthening state comprehensive planning mandates and stating climate information in the fact base of the plans, to inform climate action planning policies. We also recommend that planners include relevant climate information, both past and projected risks, in the fact base of comprehensive plans, to inform climate action planning policies.

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APPENDIX A: An Assessment of Original Research on Policy Adoption in Climate Action Planning Literature

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Abstract

Climate action planning continues to gain prominence in the planning profession, as a growing number of cities act to mitigate greenhouse gas emissions and prepare for increasing climate impacts. I conducted a systematic literature review of original research of policy adoption in climate action planning to ascertain the theories explored, the samples selected and methods utilized, and synthesize findings for practitioners and scholars. I found that policy innovation theory was prevalent early in climate action planning research as a theoretical framework, but the use of adaptive capacity has since become more prominent. Non-coastal and small to medium-sized communities were underrepresented in the papers reviewed, which has implications for planning practice as the communities planners serve are more diverse in size, location, and climate risk. The characteristics of communities associated with policy adoption included leadership, public support, the presence of environmental nonprofits, and neighboring city adoption of climate policy. I recommend that future research on climate action planning further explore efforts in non-coastal communities, small to medium-sized communities, and communities without involvement national climate action networks.

Keywords

policy innovation, adaptive capacity, climate change, climate action planning

Introduction

Climate change poses a challenge to the planning profession in the urgent need for cities to both mitigate local contributions to greenhouse gas (GHG) emissions and also to prepare for increasing climate risks (Bassett & Shandas, 2010; Castán Broto & Bulkeley, 2013). As planners and cities experiment with how to meet the challenges of climate change, researchers have sought to understand the catalysts and barriers for the adoption of these new policies (Bassett & Shandas, 2010; Castán Broto, 2017). Researchers have been exploring these issues in climate action planning through policy innovation theory and adaptive capacity, contributing to a growing body of literature over the last two decades. Despite the growing prominence of climate change and climate action planning in planning literature, there are few collective reviews of original research on the drivers of policy adoption of climate action planning efforts.

The objectives of this study are to:

1) Present the current state of original research on policy adoption of climate action planning, including theories explored, the samples selected, and methods utilized,
2) Synthesize adoption policy findings from the literature reviewed for both planning practitioners and scholars, and
3) Identify future research directions.

In this study, I first present climate action planning, including its history in the planning profession and the complementary objectives of greenhouse gas mitigation and climate adaptation. I then review the use of policy innovation theory and adaptive capacity within planning literature to explore policy adoption. I then describe a systematic literature review of original research of policy adoption in climate action planning in the United States and Canada

from 2000-2018. Finally, I present the results from the research and conclude with recommendations for research and practice.

Climate Action Planning

Planning responses to mitigate and reduce climate risk are collectively known as climate action planning (Bassett & Shandas, 2010). Planners and cities have a role to play in climate mitigation or actions that reduce or eliminate the emission of GHGs, as nation-level action will likely fall short of voluntary Paris Agreement actions to keep temperature under 1.5°C (Castán Broto, 2017). Planners can help decrease GHG emissions caused by their cities' municipal operations as well as through more efficient planning of transportation, industry, and building energy usage (Bulkeley, 2010). Planners are central in decisions over land use and transportation patterns, with continued trends in the profession towards recommending more walkable and denser urban areas (Bulkeley, 2010).

Planning also has a critical role in preparing cities for the impacts of climate change, through local actions known as climate adaptation (Baker, Peterson, Brown, & McAlpine, 2012; Bierbaum et al., 2013). Three reasons that highlight the importance of the planning profession understanding and acting to reduce climate risk to cities include the continued trend of global urbanization, how urban form can amplify climate risk, and the presence of vulnerable populations within cities (Carter et al., 2015). The continued trend of global urbanization will define the 21st Century, as the majority of population growth over the next century will take place in urban areas (United Nations, Department of Economic and Social Affairs, 2009). In many cases, this continued growth will add to existing economic, social, and environmental pressures in cities (Carter et al., 2015; United Nations, Department of Economic and Social

Affairs, 2009). Planning also plays a role in shaping urban climatology, where climate risks may be increased through the physical form of the built environment (Carter et al., 2015). Examples of these risks include decreased pervious surfaces leading to increased flood risk, and increased hardscapes and exhaust waste exacerbating the urban heat island effect (Corburn, 2009). Finally, the impacts of climate change, through increasing climate risks, directly threaten complex interconnected systems within cities, including connected and interdependent infrastructure systems, high population densities, concentrations of vulnerable populations, and cultural and economic assets (Carter et al., 2015).

Climate action planning has grown in prominence in both planning practice and scholarship over the last two decades. After the 1990s, where climate change was discussed primarily as a global issue, there was a wave of city engagement in GHG mitigation starting in early 2000s (Bulkeley, 2010; Bulkeley & Castán Broto, 2013). Events like the United States Conference of Mayors in 2000 brought more attention to the role cities could play in mitigating emissions (Bulkeley, 2010). The U.S. Mayor's Climate Protection Agreement, launched in 2005, was signed by over 1,000 mayors by 2009, representing over 86 million residents (Bulkeley, 2010). Planning for increased climate risk in the U.S. also became more prominent following events like Hurricane Katrina in 2005 and corresponding research followed suit (Meerow & Mitchell, 2017). Meerow and Mitchell (2017) found the number of papers published with the terms urban, climate, adaptation, and planning in the title, keywords, or abstract grew from less than ten in 2006 to over 125 by 2016.

Climate change poses unique challenges to the profession for both mitigation and adaptation related policies and actions. The planning profession has in recent years advocated for

increased density, walkability, and transit use, but Kousky and Schneider (2003) expressed concern that cities may not have the motivation to seriously reduce greenhouse gases, as the individual benefit is limited if they act alone. Increasing climate risks also pose new challenges, despite the planning profession's history of natural hazard risk reduction. The typical long-range planning timeframe of 10-20 years is often mismatched with the timeframes presented in climate projections, that model future climate and impacts to 2050 or 2100, leading to confusion over how to utilize the projections for actions today (Bedsworth & Hanak, 2010; Stults & Larsen, 2018). There is also a perceived spatial mismatch of available climate projections—at scales far coarser than city boundaries—which can make local messaging difficult (Bedsworth & Hanak, 2010; Stults & Larsen, 2018). Finally, the issue of climate change and its politicization in the U.S. can be difficult for planners to manage, as they rely on public support and political leadership, in addition to analytical data, for decision-making (Bedsworth & Hanak, 2010).

Policy Innovation Theory

Policy innovation theory has long been relevant in planning literature, as it seeks to describe the catalysts, barriers, and paths for the adoption of new policies, as new challenges and opportunities emerge (Krause, 2011). Climate change has spurred experimentation with climate action planning, making it a worthwhile topic of policy innovation theory research. In the following section, I will review policy innovation theory and its two complementary models, internal determinants and policy diffusion.

Policy innovation theory seeks to explain the adoption of policies, defined as actual policies or programs, by a government entity for the first time (Berry & Berry, 1999; Krause, 2011). Policy innovation theory is distinct from policy invention theory, described as the

independent development of a new policy by a government entity (Berry & Berry, 1999; Krause, 2011). In a seminal policy innovation paper, Mohr (1969) hypothesized and found evidence that policy innovation is, "directly related to the motivation to innovate, inversely related to the strength of obstacles to innovation, and directly related to the resources available for overcoming such obstacles." Mohr's hypothesis was elaborated upon by Berry and Berry (1999), who created two models that explain policy innovation: internal determinants and regional diffusion. The regional diffusion model is now more broadly referred to as the policy diffusion model (Krause, 2011). Berry & Berry (1999) stressed that these two models are not mutually exclusive perspectives, but instead complementary models of research and understanding. Importantly, they recommended that empirical models should consider both for the complete understanding of policy innovation (Berry & Berry, 1999).

In the internal determinants model, policy innovation and adoption are a function of political, social, and economic characteristics of the municipality in question (Berry & Berry, 1999; Shi, Chu, & Debats, 2015). Under this model, one should be able to predict the governments that are more receptive to innovation, based on an analysis of their existing characteristics (Berry & Berry, 1999; Shi et al., 2015). In the internal determinants model (Table A1), factors most commonly explored include access to resources, local leadership, information and communication, and state policy framework (Shi et al., 2015).

Table A1. Internal Determinants and Policy Diffusion Models and Factors

Internal Determinants	**Policy Diffusion**
Access to resources Information and communication Local leadership Mandated planning	Learning Imitation Normative pressure Competition Coercion and incentives

The internal determinants and policy diffusion models and factors as described by Berry & Berry (1999).

Access to resources is one of the most studied and cited factors in the internal determinants model (Bassett & Shandas, 2010; Shi et al., 2015). Resources relevant for urban planners, in a climate action planning context, are funds for consultants, mapping and technical support, planning staff time, and resources for public outreach (Shi et al., 2015). Smaller and financially constrained municipalities, in particular, are impacted by access to these resources.

Local leadership is another factor in the internal determinants model (Bassett & Shandas, 2010). Local leaders could refer to either elected officials or high-level planning staff and they would be anticipated to build political support for action and, eventually, dedicated financial resources (Shi et al., 2015).

Information and communication is another factor within the internal determinants model (Bassett & Shandas, 2010; Shi et al., 2015). Information and communication relate to the well-researched difficulties that planners often have in obtaining, interpreting and communicating scientific data and information to the public or leadership (Bassett & Shandas, 2010; Bierbaum et al., 2013; Moser, 2016; Shi et al., 2015). The gap between climate data and urban planning is not

new, as Eliasson (2000) documented that urban climatology is underutilized in planning policy decisions.

The final factor in the internal determinants model is mandated planning, often in the form of state or federal requirements (Shi et al., 2015). Mandated policy or the lack of mandated policy can be either an incentive or deterrent in planning (Shi et al., 2015). A state mandate for climate planning can require climate change to be considered in long-range plans or land development approvals, incentivizing the adoption of urban resilience policies (Bedsworth & Hanak, 2010). Aside from simply requiring policy, though, a broad climate mandate, even if it is recommended, and not legally required, can be used by local municipalities as political cover to pursue progressive climate policy (Bedsworth & Hanak, 2010). Mandated planning has a strong influence on local planning activity and is often studied in depth (Berke & French, 1994; Berke, Lyles, & Smith, 2014; Berke, Roenigk, Kaiser, & Burby, 1996).

The policy diffusion model is defined as one government's policy innovation choices influenced by the actions of other governments or institutions (Shipan & Volden, 2012). Historically in planning literature, this was viewed from a geographic and spatial perspective, where policy innovation occurs in geographic clusters and is observed as a regional phenomenon (Bassett & Shandas, 2010; Berry & Berry, 1999). Two examples of policy innovation with a spatial component, that are commonly cited in planning literature, are urban planning growth management regulations and the geographic spread of state lotteries (Bassett & Shandas, 2010; Berry & Berry, 1999). More recent research on the policy diffusion model also recognizes the importance of non-spatial peer-networks and the globalization of information and includes both geographic and non-geographic factors (Shipan & Volden, 2012). Five factors included in the

policy diffusion model (Table A1) include learning, imitation, normative pressure, competition, and coercion (Berry & Berry, 1999; Shipan & Volden, 2012).

In learning, the first factor of the policy diffusion model, planners in one municipality learn about the success of a policy from another municipality and imitate and adopt it within their regulatory structure (Berry & Berry, 1999). In this case, the policy is diffused due to its perceived success (Berry & Berry, 1999). The learning hypothesis states that, "the likelihood of a city adopting a policy increases when the same policy is adopted broadly by other cities throughout the state," (Shipan & Volden, 2008).

Within the imitation factor of the policy diffusion model, planners from one municipality adopt a policy from a neighboring municipality that is perceived as a policy leader (Berry & Berry, 1999). In this case, the policy is not being adopted for its success, but due to the reputation of the municipality that first adopted it (Berry & Berry, 1999). The imitation hypothesis states, "the likelihood of a city adopting a policy increases when its nearest bigger neighbor adopts the same policy," (Shipan & Volden, 2008).

In the normative pressure factor of the policy diffusion model, planners from one municipality give in to peer pressure to adopt a policy (Berry & Berry, 1999). In this case, they are not necessarily imitating anyone, but adopt the policy due to shared norms and the perception that the policy has been "proven" (Berry & Berry, 1999). Under this scenario, one would expect the urban planners adopting policies under normative pressure to be late adopters, as the policy would already be widespread at that point. Importantly, normative pressure can also be attributed to individuals and is closely aligned with social network analysis research that evaluates stakeholder networks and their influences on the planning process (Lyles, 2015). In some cases,

the learning, imitation, and normative pressure factors are considered too closely aligned to be separated for practical or research purposes (Shipan & Volden, 2008).

With the competition factor of the policy diffusion model, planners from one municipality would adopt a policy for the advantage it gives their municipality over another (Berry & Berry, 1999). In this case, the calculation for the advantages the policy would offer change, depending on whether or not neighboring municipalities also adopt it (Berry & Berry, 1999). In the competition factor, "The likelihood of a city adopting a policy decreases when there are negative economic spillovers from that adoption to nearby cities and increases with positive spillovers from nearby cities," (Shipan & Volden, 2008). Common examples for this factor would be economic development incentives, such as tax breaks for corporation relocation in a region with many municipalities.

Finally, in the coercion and incentives factor of the policy diffusion model, planners could be forced into adopting a policy due to the use of force or incentives by another actor (Berry & Berry, 1999). Shipan & Volden (2008) stated, "The likelihood of a city adopting a policy decreases when the state adopts a similar policy that covers the city. This decrease is even more substantial when the state law preempts either future local laws on the same policy or future stronger laws." Coercion can occur through the use of incentives by external actors, such as the availability of grant funding (Berry & Berry, 1999). When operationalized in research, the coercion factor is often closely aligned with the mandated planning factor included in the internal determinants model.

Adaptive Capacity

Adaptive capacity is, "the potential of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, take advantage of opportunities, and cope with the consequences," (IPCC, 2007). By examining the potential of cities to adjust to address climate change through exploring aspects of a city's capacity to adapt, adaptive capacity provides a practical mechanism through which planners can think about implementing climate-related practices and policies. Adaptive capacity has been used in planning literature to explore the ability of cities to react and prepare for climate risk (Bierbaum et al., 2013; Moser, 2016; Shi et al., 2015). Although adaptive capacity developed outside of planning theory, it has gained increasing prominence in planning literature as climate action planning research draws from other disciplines also exploring similar areas of climate change (Meerow & Mitchell, 2017). In the context of climate action planning, Meerow, Newell, & Stults (2016) caution that general adaptive capacity should not be conflated with the planning outcome of becoming highly adapted to climate change.

The characteristics that determine adaptive capacity vary depending on research context and discipline (Table A2), which is unsurprising, given its wide use at various levels of governance from national to regional to local. Most climate action planning literature refers chiefly to the United Nation's Intergovernmental Panel on Climate Change (IPCC) (2014), Gupta (2010) and Carter (2015) as sources of information on adaptive capacity. These sources capture many of the salient characteristics that determine adaptive capacity explored (Table A2) in climate action planning literature.

The IPCC (2014) defines adaptive capacity as, "the characteristics of communities, countries, and regions that influence their propensity or ability to adapt." The IPCC conception of adaptive capacity considers multiple levels of governance for climate adaptation including international, national, regional, and local (IPCC, 2014). Factors of adaptive capacity from the IPCC (2014) definition (Table A2) include economic resources, technology, information and skills, infrastructure, and institutions.

Table A2. Adaptive Capacity Factors

IPCC (2014)	**Gupta et al. (2010)**	**Carter et al. (2015)**
Economic resources Technology Information and skills Infrastructure Institutions Equity	Variety Learning capacity Autonomous change Leadership Resources	Income levels Availability and access to resources Awareness and perceptions of climate change Technological capacity Environmental factors Institutional capacity Transparency of decision-making processes Society's ability to act collectively Human capital

The factors of adaptive capacity often used within planning literature (Carter et al., 2015; Gupta et al., 2010; IPCC, 2014).

Gupta et al. (2010) present an environmental policy-based framework that defines adaptive capacity as, "the inherent characteristics of institutions that empower social actors to respond to short and long-term impacts either through planned measures or through allowing and encouraging creative responses from society both ex ante and ex post." Under this definition, factors of adaptive capacity (Table A2) include a variety of problem frames and actors, learning

capacity, room for autonomous change, leadership, and resources. As an example, more specific factors under the larger category of fair governance include legitimacy, equity, responsiveness and accountability (Gupta et al., 2010). Gupta et al. (2010) recommend their framework be used to explore the functionality of institutions and society in adaptive capacity, as well as applied in research of the adoption of new policies.

Carter et al.'s (2015) review of literature of focuses on local governance and defines adaptive capacity as, "the ability of city governors, businesses and residents, and associated structures and systems to prepare for and moderate potential harm from climate change hazards and exploit any emerging opportunities." Factors of adaptive capacity from Carter et al. (2015) (Table A2) include income levels, availability and access to resources, awareness and perceptions of climate change impacts, technological capacity, environmental factors, institutional capacity, transparency of decision-making processes, society's ability to act collectively to develop and implement responses, and human capital. The focus of this conceptualization of adaptive capacity is on the role that planning plays in climate adaptation, due to the central role that planning has in shaping cities (Carter et al., 2015).

Methods

I conducted a systematic literature review in this study, to assess the current state of knowledge in the area of policy adoption of climate action planning at the local planning level. As discussed in Xiao and Watsons' (2017) guidance paper, lack of rigor in literature reviews can lead to bias in data collection and analysis. Systematic literature reviews, following a rigorous methodology, can increase the scholarly contribution of the study's quality, replicability, reliability, and validity (Xiao & Watson, 2017). This rigor and elimination of potential bias are

particularly important for a topic such as climate action planning, involving numerous disciplines, to ensure the full range of current knowledge is reviewed and analyzed (Biesbroek, Klostermann, Termeer, & Kabat, 2013). The findings of such papers in the planning field are critical, as they provide an overview to planning scholars and practitioners, providing insight for future decision-making in planning and research (Templier & Paré, 2015).

Study Design, Data Collection, and Analysis

I designed protocols for a rigorous selection of papers and data analysis (Figure A1). The scope of this study is on original research conducted on the policy adoption of climate action planning at the local planning level. The first step of the study was an initial assessment of literature within key planning journals, to determine the criteria for inclusion. In this initial assessment, I searched for papers with "climate change" in the title, abstract, or keywords from 2000-2016 from *The Journal of the American Planning Association* (JAPA) and *Journal of Planning Education and Research* (JPER), the top two journals in planning scholarship, as ranked by scholars in Goldstein and Maier's (2010) survey. I also searched for papers using the same criteria, from the *Journal of Environmental Planning and Management*, *Landscape and Urban Planning, and Environment and Planning B*, which were ranked in the top three journals of the environmental planning specialization of planning scholarship in the same study (Goldstein & Maier, 2010).

In the second step of the study (Figure A1), I generated keywords and inclusion criteria based on the initial assessment of papers from the five planning and environmental planning journals. The criteria for inclusion included: 1) peer-reviewed papers published 2000-April 2018, 2) original research conducted on policy adoption of climate action planning at the local planning

level, and 3) study samples within the United States (U.S.) or Canada. Keywords were utilized in search strings using Boolean "and" and "or", including ("climate change" OR "climate action") AND ("policy innovation" OR "barriers" OR "adaptive capacity") AND ("city" OR "county" OR "local" OR "planning"). I queried these search strings in Web of Science and Google Scholar, which generated two databases of papers to review.

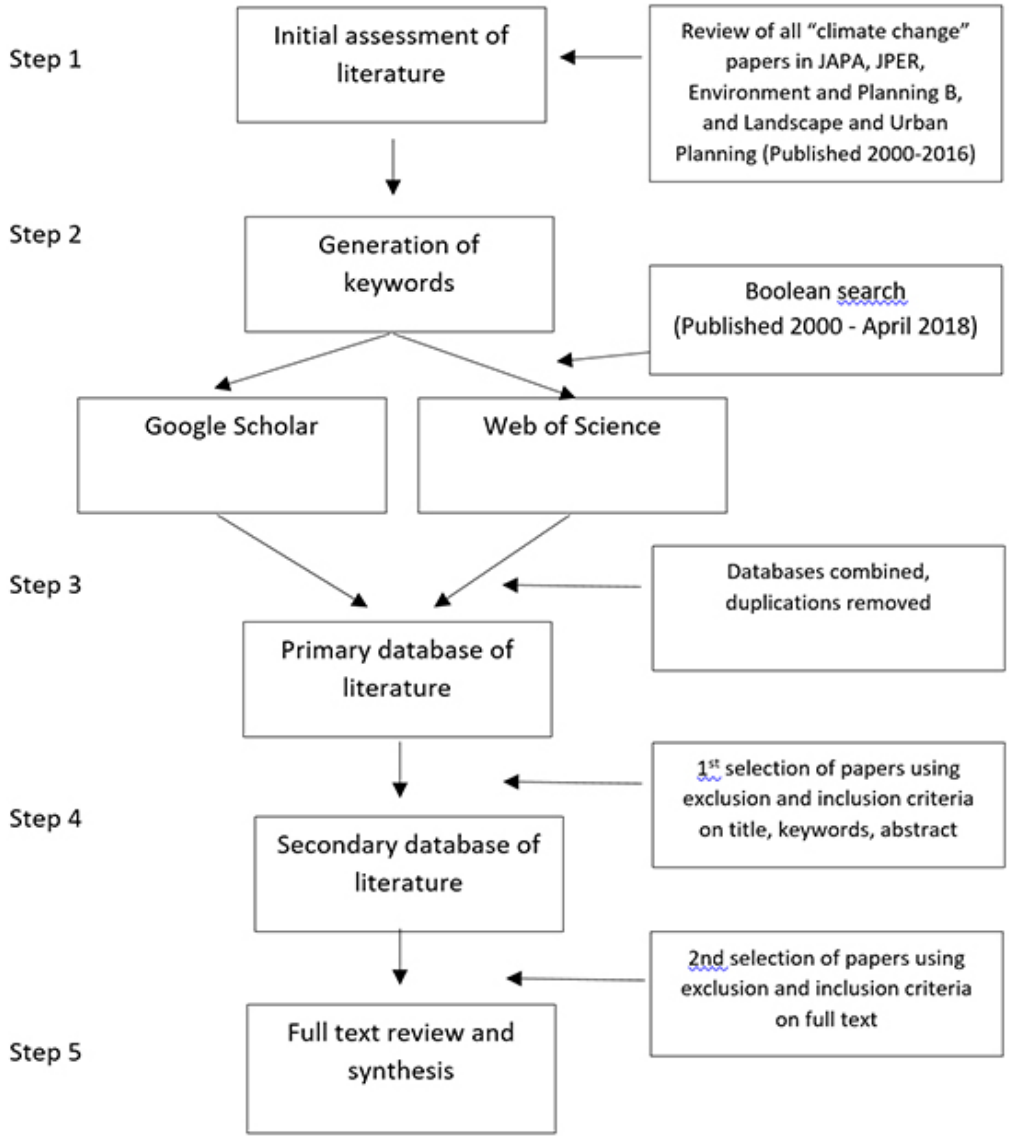

Figure A1. Systematic Literature Review Process: Diagram of systematic literature review process adapted from Biesbroek, Klostermann, Termeer, & Kabat (2013).

In step three of the study (Figure A1), I merged the two databases of papers and removed duplicate entries, resulting in one primary database of literature. I then screened the primary database, using the original criteria for inclusion, resulting in the secondary database. I further analyzed the secondary database in step four (Figure A1), based on an assessment of the full text, to ensure the original research criteria and inclusion criteria were met. This analysis resulted in a total of 22 papers meeting all of the study criteria. I also reviewed the bibliographies of these papers to ensure no relevant papers had been omitted and no additional papers were discovered.

Next, in step five (Figure A1), I reviewed and collected data from the 22 papers that met the stated inclusion and exclusion criteria. I coded and organized data from each paper in a systematic table that included information on the studies' theoretical background, research design, study sample, variables tested (if any), timeframe, study results, and summary of the author(s)'s interpretation of results. It is important to note that not all of the studies explicitly stated which theories they used. In these cases, I used the specific variables explored and references included in the studies to best determine the theoretical background. The 22 papers were a mix of qualitative and quantitative research, sometimes both within the same paper, which I noted throughout coding as well.

Once the data was coded, I consolidated it into a single matrix for analysis, using two methods described by Xiao and Watson (2017). The first method I used was a textual narrative synthesis, where I sorted the papers and their respective coded data into various subgroups by their characteristics (Xiao & Watson, 2017). For example, I sorted the papers by their theoretical foundations and then compared similarities and differences in the coded data across the papers. The second method I used was a scoping review, similar to a textual narrative but focused on the

research design elements of the papers (Xiao & Watson, 2017). In the scoping review, I analyzed the stated methodology, samples, variables, and results of each paper, again sorted by various relevant subgroups (Xiao & Watson, 2017). An example of this was sorting the papers by the information about the samples selected. I then compared and contrasted this data to ascertain themes in the city sizes, geographic locations, and other characteristics that the papers focused on. These analyses are presented within the results of this paper using descriptive statistics and narrative explanations for context.

One limitation of this study is the focus on planning within the U.S. and Canada, which precludes relevant lessons from local planning in other nations. I deemed this focus necessary after the initial assessment of literature, due to the different international approaches to planning practice and their implications for local policy adoption of climate action planning. Another limitation of this study is that I did not conduct a meta-analysis of the quantitative data presented within the papers, and as such, only limited comparisons can be made for some of the results due to differences in samples and analyses in each paper.

Results

In the following section, I will present results from the papers reviewed on the theories explored, samples selected and methods used, and the factors found relevant for policy adoption of climate action planning. The twenty-two papers reviewed were from a variety of disciplines and published in several journals. Fifteen of the papers were from journals traditionally central to planning scholarship, including the *Journal of the American Planning Association* (n = 7), *Journal of Planning Education and Research* (n = 2), *Journal of Environmental Planning and Management* (n = 2), *Environment and Planning B* (n = 1), *Journal of Urban Affairs* (n = 2), and

Urban Affairs Review (n = 1) (Goldstein & Maier, 2010). The other seven papers were published in *Environment Science and Policy* (n = 2), *Environment and Planning C: Government and Public Policy* (n = 2), *Global Environmental Change* (n = 1), *Renewable and Sustainable Energy Reviews* (n = 1), and *Urban Climate* (n = 1). This diversity in scholarship is important to note, as it has impacts on theoretical backgrounds of the papers, research methodology, and interpretation of results.

Concepts Explored in the Papers

The two dominant ways of exploring policy adoption of climate action planning in the papers reviewed (Figure A2) included policy innovation theory, through the internal determinants model (n = 12) and policy diffusion model (n = 5), and adaptive capacity (n = 7). Other theories and models were also used to explore policy adoption in the papers reviewed (n = 5), including planning capacity, environmental assessment capacity, public participation capacity, anticipatory governance, and institutional collective action. None of these other theories were used in more than one paper in this study sample. Through a visual assessment of Figure A2, there is a shift in time from papers published in the early 2010s that utilized the internal determinants model for exploring policy adoption in climate action planning, to the more recent papers which utilized adaptive capacity.

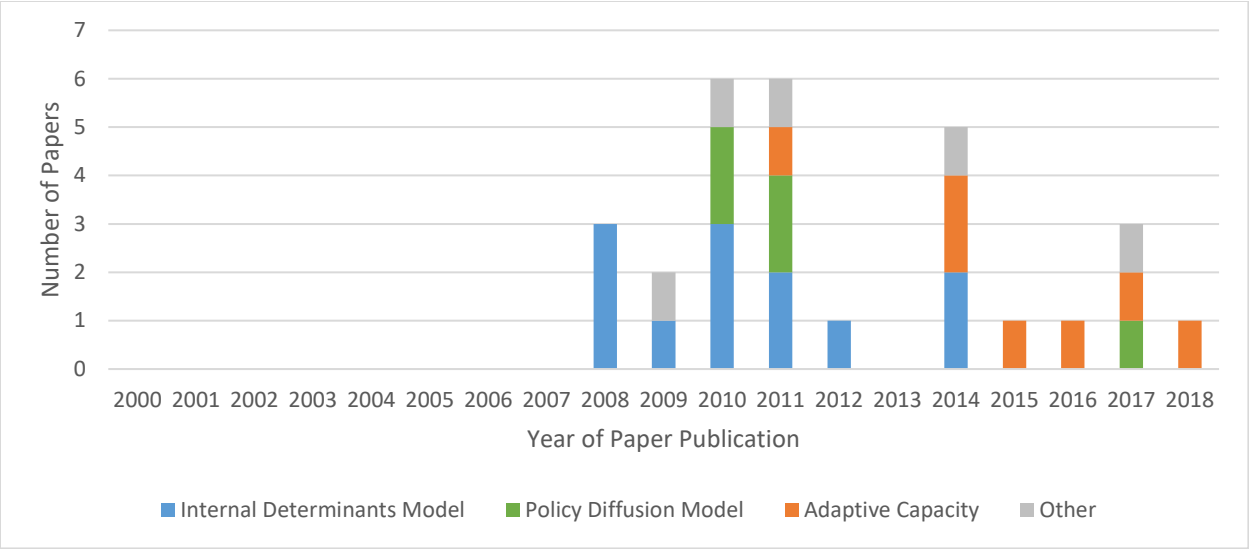

Figure A2. Concepts explored for policy adoption of climate action planning. Both the internal determinants and policy diffusion models are from policy innovation theory.

When the papers reviewed were sorted by year published and their stated research objectives (Figure A3), a visual assessment of data revealed an interesting divergence over time in how climate action planning was explored. The first wave of papers published in 2008 and 2009 was dominated by research exploring climate action planning in both its mitigation and adaptation aspects. This shifted from 2010 to 2012, with an increased focus on mitigation efforts at the local planning level. Starting in 2014 and continuing to April 2018, there is an increase of a focus on adaptation efforts at the local planning level. Notably, only one of the papers reviewed after 2011 explored both climate adaptation and mitigation.

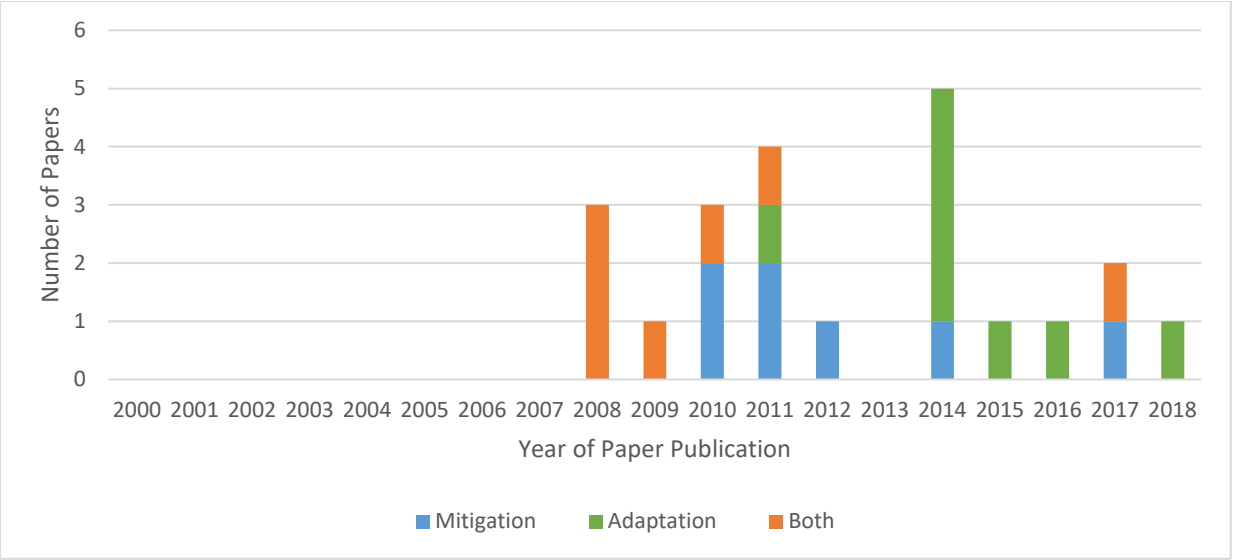

Figure A3. Focus on climate action planning research. Displays what part of climate action planning the papers reviewed focused on: both mitigation and adaptation, just mitigation, and just adaptation (2000-April 2018).

Methods and Samples Used in the Papers

The papers utilized a variety of methods for exploring policy adoption of climate action planning. The most utilized method was multi-level modeling (n = 9), operationalizing variables to explore why some cities took certain actions and others did not. The second most common was a mixed methods approach (n = 6), combining the multi-level modeling with either plan quality evaluation or original survey data. Plan quality evaluation is a well-established method in planning scholarship used to rate the quality of adopted policies systematically, often long-range plans, climate action plans (CAPs), or hazard mitigation plans (Berke & Godschalk, 2009; Lyles & Stevens, 2014). Finally, surveys of professional planners were utilized in several papers (n=4), as were interviews with professional planners (n = 3).

The samples studied in almost all papers reviewed were large cities (n = 10), coastal cities (n = 6), or cities chosen because they adopted a dedicated CAP (n = 3). Of those cities across the U.S., populations of over either 100,000 or 500,000 were common sample inclusion

criteria. Other studies utilized specific environmental or climate networks such as the Local Governments for Sustainability (ICLEI) or the Urban Sustainability Directors Network (USDN) for survey results. Many papers also noted their samples had statistically high participation from cities involved in initiatives like the Mayor's Climate Protection Program. As climate action planning is still an emerging topic in planning practice, it is logical that early adopter cities participating in climate initiatives would be a focus of climate action planning research.

While each paper noted its sample limitations and other biases, cumulatively, the current literature may be presenting a skewed view of how climate action planning is occurring in the U.S. and Canada. Cities which adopt dedicated climate action plans are likely to have leadership and public support for climate action planning, for instance. Hamin, Gurran, and Emlinger's (Hamin, Gurran, & Emlinger, 2014) research, in which they interviewed planners from communities of various sizes along the coast of Massachusetts, is notable for exploring perceptions from small and mid-sized communities. Both papers from Canada (n = 2) examined the metropolitan Vancouver, British Columbia area (Burch, 2010; Mitchell & Graham, 2017). No studies focused specifically on non-coastal communities, although several of the multi-level models included a nation-wide sample of cities.

Factors in Policy Adoption of Climate Action Planning

Despite the variety of methods used and variables tested throughout the papers reviewed, several salient factors of policy adoption in climate adaptation planning emerged through the textual narrative synthesis and scoping review. Some of these factors of policy adoption in climate action planning include access to resources, leadership and public support, information and communication, public participation and inclusive governance, and factors from policy

diffusion such as learning networks and influence of neighboring governments. These factors are detailed in Appendix A1, which also lists their theoretical origins, sample variables used in multi-level model testing or themes from qualitative interviews, and the study source.

As noted throughout the literature, access to resources plays a key role in climate adaptation planning. In some papers, this was generalized as "resources," but was also often broken out into the financial ability of the government, staffing and expertise, and time dedicated to particular projects (Barbour & Deakin, 2012; Hamin et al., 2014; Nordgren, Stults, & Meerow, 2016). Variables that papers used to test resources included population size, number of relevant staff, the timeframe for projects, and the percent of the population with various levels of education.

Leadership and public support were two other key factors in policy adoption, from the papers reviewed. Surveys and interviews of planning staff, in particular, revealed that leadership is a top barrier planning staff face when pursuing climate action policies (Hamin et al., 2014; Moser & Ekstrom, 2010; Nordgren et al., 2016; Shi et al., 2015). Public support was tested in several of the multi-level models and found to have a statistically significant relationship with the adoption of plans. Common variables used to test public support included: opinion surveys on climate change belief, percent registered Democrat, voting history, and those employed in carbon-intensive professions (Krause, 2011; Pitt, 2010; Shi et al., 2015; Wheeler, 2008; Zahran, Brody, Vedlitz, Grover, & Miller, 2008). Closely related to public support, every multi-level model that tested the impact of environmental organizations on climate action planning found a positive correlation with the number of organizations, or their influence, and the adoption of

CAPs (Pitt & Bassett, 2013; Sharp, Daley, & Lynch, 2011; Yi, Feiock, & Berry, 2017; Zahran, Grover, Brody, & Vedlitz, 2008).

The papers also explored information and communication and found that these factors were important in climate action planning, although the papers often diverged with respect to the level of information needed in climate action planning. Burch (2010) found that the lack of localized and city-relevant information was a barrier in climate action planning. Hamin et al. (Hamin et al., 2014) found the lack of information to be a secondary, not primary, barrier in climate action planning. The most recent study that discussed information, Mitchell & Graham (2017), found that planners had no difficulty obtaining information, but had challenges messaging it appropriately to a skeptical public. The papers reviewed span eighteen years, so it is possible there have been changes over time in the climate information available to planners.

In the results of the papers reviewed, public participation and inclusive governance had a mixed impact on the quality of plans, and on the adoption of climate action policies. Tang and Brody (2009) found no evidence that increased public participation results in higher quality environmental plans. Yi, Feiock, and Berry (2017) found that more inclusive district representation resulted in less climate action. Berke et al. (2014), however, found that plan quality increased with the involvement of diverse stakeholders. These results may be mixed because increased stakeholder input can compete with, and sometimes detract from, the technical or rational aspects of the planning process (Baum, 2015; Innes & Booher, 1999). Increased policy innovation does not necessarily equate to equitable plans, or to actions that benefit vulnerable populations (Yi et al., 2017). There may be factors that increase policy innovation but

also lead to the adoption of inequitable policies, or to policies that lack public support; and these factors merit further exploration.

In every paper where the policy diffusion model was explored, it corresponded to the adoption of climate action planning policies or was qualitatively noted as important. Nordgren, Stults, & Meerow (2016) reported, in their survey, that best practices or case studies and conversations with peer local planners were the two highest ranked resources used frequently by planners wishing to pursue climate adaptation action. They also found the two most desired formats for resources were websites and detailed case studies (Nordgren et al., 2016). Similarly, interviews conducted by Bassett & Shandas (2010) found that planners were paying close attention to what other cities were doing, downloading similar plans and examining strategies that were deemed relevant.

All papers reviewed that tested the importance of the influence of neighboring municipalities (n = 3), a spatial factor within the policy diffusion model, found statistical significance in the adoption of policies (Krause, 2011; Pitt, 2010; Yi et al., 2017). Krause (2011) found, in a multi-level model of 900 cities in the U.S., that cities with a larger number of neighboring cities participating in the U.S. Mayors' Climate Protection Agreement were also more likely to participate. Yi, Feirock, & Berry (2017) found similar results in a multi-level model of 376 cities in Florida, where the percent of jurisdictions in a county that already adopted a climate agreement strongly influenced a city's choice to adopt a climate protection agreement. According to their paper, "[d]iffusion appears to be one of the main drivers of this policy adoption." In Pitt's survey (2010) of 255 cities in the U.S., the influence of neighboring

jurisdictions was found to be the only external characteristic of a city that had a high correlation with the adoption of climate mitigation policies.

Discussion

While several of the papers utilized multi-level models with large city sample sizes, these tended to selected samples based on participation membership in environmental ICLEI and USDN. I found that of the papers focusing on specific geographic areas, non-coastal and small to mid-sized communities were underrepresented. The need for research on small to medium-sized cities is a common refrain in planning literature that is worth repeating, particularly in the case of climate action planning (Hamin et al., 2014). The factors constraining planning in rural communities, as identified by Daniels, Thomas & Lapping (1996), include differing views on government involvement, lagging economic development, and different resource needs; these hold today as well. Large metropolitan regions facing non-coastal climate risks, and small to medium-sized communities with less political support for climate-related planning, will also have different policy innovation paths than major cities leading climate action planning. I recommend continued climate action planning research across a wider scope of city sizes and geographic types to give the planning profession a complete picture.

It is also of interest that the focus of the papers reviewed shifted over time from exploring both the adaptation and mitigation of climate action planning to mostly one or the other separately. This may signal that climate action planning research is maturing and there are differences in the adoption of climate adaptation and mitigation policies that merit separate exploration. A potential consequence of this separation though is that when climate adaptation and mitigation are explored only in silos it creates more opportunity for maladaptation. Although

there are several types of maladaptation, the relevant one here is that if local action was taken for climate adaptation that does not take into account mitigation, GHG emissions may be unintentionally increased (Barnett & O'Neill, 2010). Climate action planning research that explores both mitigation and adaptation holistically is still needed, as is research on to what extent maladaptation is occurring in local policy adoption (Juhola, Glaas, Linnér, & Neset, 2016).

The internal characteristics of communities as a function of policy adoption were the primary focus of the majority of papers reviewed. These internal characteristics were explored in the papers most often through the use of the internal determinants model of policy innovation and adaptive capacity. Over time, adaptive capacity has gained prominence over the internal determinants model as a way to explore the impact of internal characteristics on policy adoption. While adaptive capacity has various definitions, it is interesting to note that in the papers reviewed, a very similar set of internal characteristics of communities were used irrespective of whether the internal determinants model of policy innovation theory or adaptive capacity were being explored. Several examples of factors explored by both (Appendix A1) include access to resources, financial base of the community, public support, staff, leadership, non-governmental organization support, and information availability.

One potential explanation is that as adaptive capacity has been adopted into climate action planning research, its broader uses to explore the capacity of governments to adapt to risks has been dropped in favor of a focus on planning processes and outcomes within planning literature. This leads additional credence to the caution offered by Meerow, Newell, & Stults (2016) that adaptive capacity within planning literature should not be conflated with the outcome

of being highly adapted to climate change. I also recommend that the use of adaptive capacity in planning literature to explore policy adoption of climate action planning not lose site of the broader meaning of adaptive capacity and its characteristics as they relate to the potential to adapt to climate change.

Within policy innovation theory, the papers that focused on the internal determinants model did so at the expense of co-exploring the policy diffusion model as recommended by Berry & Berry (1999). Only three papers reviewed looked at both the internal determinants and policy diffusion models within policy innovation theory. Despite being explored less in the papers reviewed, factors of the policy diffusion model factors, such as the spatial influence of neighboring cities and learning networks, were found to be important when tested for in models or explored in qualitative interviews.

Future research on policy adoption of climate action planning should not discount the importance of the policy diffusion model in policy innovation theory. Neighboring cities within the same region will likely have similar climate risk factors due to geographic, climatic, and ecological similarities. The reverse is also true, as many proposed solutions for climate risk focus on the increased use of urban ecological strategies like green infrastructure and urban forestry, which are also specific to regional geographic, climatic, and ecological conditions. Mason (2011) makes the case, in his paper on ecoregionalism, that regions and their networks of cities have a critical role to play in both the mitigation of greenhouse gases and reduction of climate risk.

Although the policy diffusion model was less frequently explored to explain policy adoption in the papers reviewed, the literature on regional innovation systems may provide new insights to planning literature (Asheim & Gertler, 2006). Asheim & Gertler (2006) argue that

geography is fundamental to the innovation process itself and that some forms of knowledge are seldom transmitted non-locally. An example they provide is the increased global phenomenon of economic and technological clustering by region, despite an increase in information availability and communication via the internet, which was predicted at one point to make clustering a thing of the past (Asheim & Gertler, 2006).

Finally, in the interest of continuing to advance planning theory, I recommend that future research on policy adoption of climate action planning very clearly state theoretical backgrounds and also articulate findings in terms of contributions to the theory. Many of the papers I reviewed only cited secondary sources for theoretical connections and missed opportunities to relate their findings to established theoretical work.

Conclusion

In this systematic literature review of original research on the policy adoption of climate action planning, I analyzed the qualitative and quantitative evidence for factors in the adoption of climate action planning policies. Based on these findings, I found that the current research has over-relied on the sampling of large cities involved in environmental networks and of cities in coastal areas. I recommend future research on policy adoption of climate action planning in these three areas: 1) non-coastal cities, 2) medium to smaller sized communities, and 3) cities not already involved in national climate action networks such as ICLEI and USDN. I also recommend that future climate action planning research more clearly articulate which established theories and factors of policy adoption are being tested to continue to advance climate action planning scholarship.

While the samples studied were not comparable in many of the papers I reviewed, community characteristics that often supported policy adoption of climate action planning included leadership, access to resources, public support, information and communication, past events, and risks. All papers that explored policy diffusion found evidence of the importance of learning networks and the influence of neighboring communities on policy adoption. This information is valuable for boundary organizations, climate information providers, and nonprofits who seek to advance climate action planning, to discern which communities may need additional support, based on their internal and external characteristics.

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Appendix A1. Factors in Policy Adoption in Climate Action Planning

Category	Factors	Description	Sample Variables	Conceptual Origins	Source
Socio-economic	Access to resources	Financial resources, staff, time devoted	Population size, % of population educated at various levels	Internal Determinants Model, Adaptive Capacity	Barbour & Deakin (2012), Ekstrom & Moser (2014), Hamin, Gurran, & Emlinger (2014), Nordgren, Stults, & Meerow (2016), Tang & Brody (2009)
	GHG emissions	Contribution to global greenhouse gas emissions	Vehicle miles traveled, % of economy based on carbon-activities	Internal Determinants Model	Tang et al. (2010)
	Financial base	Financial resources such as base wealth of community or special grants received	Spending per Capita, Income per Capita, Grants received, Infrastructure expenditures	Internal Determinants Model, Adaptive Capacity	Muller & Schulte (2011), Shi, Chu, & Debats (2015)
	Public support	Public support for policy through voting records or opinion surveys	Public opinion survey results, % registered, Democrat, Voting History, % employed by carbon-intensive jobs	Internal Determinants Model, Adaptive Capacity	Ekstrom & Moser (2014), Krause (2011), Pitt (2010), Shi, Chu, & Debats (2015), Wheeler (2008), Zahran, Grover, Brody, & Vedlitz (2008), Zahran, Brody, Vedlitz, Grover, & Miller (2008)
Institutional	Staff	Number of staff overall or those devoted specifically to the project area	# staff overall, # of staff devoted to project	Internal Determinants Model, Adaptive Capacity	Bassett & Shandas (2010), Muller & Schulte (2011), Nordgren, Stults, & Meerow (2016), Pitt (2010)
	Leadership	Leadership of elected officials or high level staff	Municipal participation in climate deal, Survey of staff	Internal Determinants Model, Adaptive Capacity	Bassett & Shandas (2010), Burch (2011), Ekstrom & Moser (2014), Hamin, Gurran, & Emlinger (2014), Nordgren, Stults, & Meerow (2016), Shi, Chu, & Debats (2015)
	Mandates	Federal or state mandates enacted	Federal or state mandates enacted, Enforcement strength of mandates enacted	Internal Determinants Model	Barbour & Deakin (2012), Berke, Cooper, Aminto, Grabich, & Horney (2014), Berke, Lyles, & Smith (2014), Muller & Schulte (2011), Tang et al. (2010)

	Network-based learning	Network-based peer learning	Membership or participation in professional organizations, Learning networks, Attendance at regional or national conferences	Policy Diffusion Model	Bassett & Shandas (2010), Woodruff (2018)
	Non-governmental organization support	Support from external organizations and institutions	# of environmental organizations	Internal Determinants Model, Adaptive Capacity	Mitchel & Graham (2017), Pitt (2010), Sharp, Daley, & Lynch (2011), Zahran, Grover, Brody, & Vedlitz (2008), Yi, Feiock, & Berry (2017)
	Public participation	Representation of diverse stakeholders in policy process	Representation by city district, # involved with planning process	Adaptive Capacity	Berke, Cooper, Aminto, Grabich, & Horney (2014)
	Information and communication	Both availability of information and the messaging of information	Survey of information-users	Internal Determinants Model, Adaptive Capacity	Burch (2011), Hamin, Gurran, & Emlinger (2014), Mitchel & Graham (2017), Nordgren, Stults, & Meerow (2016), Tang & Brody (2009), Wheeler (2008)
Geographic and Environment	Past events	Past climate events such as forest fires, floods	Past hazard damages, Past major event occurrence, Deaths or illnesses recorded due to events	Internal Determinants Model	Muller & Schulte (2011)
	Spatial-based learning	Spatial-based peer learning, includes imitation, normative pressure, and competition.	# of municipalities adopted policy within certain distance, Presence of large city with policy adopted in region	Policy Diffusion Model	Bassett & Shandas (2010), Cidell & Cope (2014), Krause (2011), Pitt (2010), Yi, Feiock, & Berry (2017)
	Climate risk	Perceived or actual risk to climate impacts	Projected risks, Survey data on perceptions	Adaptive Capacity	Zahran, Brody, Vedlitz, Grover, & Miller (2008), Tang et al. (2010)

APPENDIX B: Planning for Climate Risk in the U.S. Southwest: Reported Concerns, Policy Approaches, and Policy Innovation Catalysts and Barriers

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Abstract

The Southwest is the hottest and most arid region in the United States, with increasing climate risks to its cities due to climate change, yet there is little documentation on how planners in this region are responding. Interviews with 32 planners in six cities in Arizona and New Mexico were conducted in 2016 and 2017 to better understand: 1) Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking? 2) What catalysts and barriers do planners report in planning for climate risks? 3) How do planners report framing their responses related to climate change? The planners interviewed acknowledged anticipated climate risks to their communities, including drought, flood, heat, wildfire, and air quality, but in many cases discussed not framing their responses as climate change related due to the politicization of the issue. Planners reported mainstreaming approaches to integrating climate risk into existing development regulations and long-range plans, rather than dedicated planning approaches such as climate action plans. Planners also stated that significant climate events, future state or national mandates, and access to peer case studies were the most likely catalysts for action. Barriers to action included lack of resources, lack of assistance messaging the issue, and lack of both political leadership and public support. While the findings are limited to the responses of planners in one region, they contribute to the understanding of how cities are planning for climate risk and demonstrate a need for future research on inland climate adaptation planning.

Keywords

planning, mainstreaming, policy innovation, climate change, adaptation, climate risk

Introduction

While planners in the United States (U.S.) Southwest work in the most arid region in the nation, climate change has increased the region's climate risks and will continue to do so in the future (Garfin et al., 2014). The role the planning profession plays in preparing cities for climate risks is well documented and critical in the face of both chronic and acute threats (Bierbaum et al., 2013). To date, much of the planning literature on climate risk utilizes interviews and surveys focused on planners in environmentally progressive cities, that are already undertaking planning activities related explicitly to climate change (Nordgren, Stults, & Meerow, 2016; Shi, Chu, & Debats, 2015). Except for Hamin, Gurran & Emlinger (2014), planning studies have less frequently explored planning for climate risks in small to medium-sized municipalities within the U.S. and those within less environmentally progressive political contexts (Butler, Deyle, & Mutnansky, 2016; Pitt & Bassett, 2013). There is also a need for a better understanding of how planners in non-coastal communities, in regions such as the U.S. Southwest, are responding to increasing climate risks not associated with sea-level rise (Berke et al., 2015).

To further understanding of planning efforts for climate risks in the interior U.S. Southwest, we seek to explore:

1) Which climate risks are reported as worthy of consideration, by planners in the Southwest, and what planning efforts are their cities taking?

2) What catalysts and barriers do planners report in planning for climate risks?

3) How do planners report framing their responses related to climate change?

The following sections provide context for the study, with an overview of planning for climate risks and policy innovation theory as it pertains to urban planning. We then provide a

framework for our methodological choices and means of analysis. Finally, we explore the three guiding themes of the study and provide discussion on how the findings depict the current state of climate adaption planning in the Southwest and how it may influence future work.

Planning for Climate Risks

Planning for increasing climate risks is an emerging concern in the planning profession. Previously, the profession focused on climate mitigation, or the reduction of greenhouse gas emissions (GHG) at the local level (Bierbaum et al., 2013; Meerow, Newell, & Stults, 2016). Climate adaptation is the actions taken to reduce the experienced and anticipated impacts of climate change (Baker, Peterson, Brown, & McAlpine, 2012; Bierbaum et al., 2013). Mendelsohn (2000) discusses climate adaptation for agriculture, natural resources, and public health, and touches on hazard mitigation, but similar papers in the planning literature do not emerge until the 2010s (Bedsworth & Hanak, 2010). As recently as 2010, fewer than 25 publications cataloged in the Web of Science contained "climate," "urban," "adaptation," and "planning" in the title, keywords, or abstract; a number that increased to over 125 publications by 2016 (Meerow & Mitchell, 2017).

A 2016 global survey of 401 cities with populations over 1 million also reflects the emergent nature of planning for climate risks (Araos et al., 2016). Only 61 (15%) of these cities had developed climate adaptation measures, and 73 (18%) cities were in the process of planning climate adaptation measures (Araos et al., 2016). A survey of 156 cities in the United States, that participate in the ICLEI (Local Governments for Sustainability) network, found similar results, with 24% of respondents in early scoping stages of adaptation planning, 27% in planning and analysis stages, and 9% in the implementation stage of adaptation strategies (Shi et al., 2015).

These results are likely an over-reporting of actual adaptation efforts, as Shi et al. (2015) described their sample's bias towards large and environmentally progressive cities.

Impediments within the planning profession and processes can make it challenging to use climate information for planning. Planning practice strives to be rational; however, the public process is often politically driven and values-based, so policy outcomes can appear irrational when viewed from a strictly environmental or economic perspective (Baum, 2015). Understanding the emotional attachments of stakeholders to idealized planning outcomes for a community is a critical, and often overlooked, part of the planning process (Manzo & Perkins, 2006). Increased emphasis on evidence-based planning, such as the use of climate information to inform planning for climate risk, can also be at odds with the vision of the planning profession as a "reflective craft where skills of mediation, negotiation, listening, and framing are prominent," (Krizek, Forysth, & Slotterback, 2009). In a paper exploring the use of climate science by the planning profession, the authors concluded, "climate issues often have low impact on the urban planning process in practice," and, "all planning is a political activity which is not always based on or even related to scientific knowledge," (Eliasson, 2000).

Given that the planning profession uses public participation as a part of the decision-making process, the highly politicized nature of climate change science in the U.S. can also make it difficult to plan for climate risk (Maibach, Myers, & Leiserowitz, 2014). Many Americans misunderstand the science of climate change, with only one in seven understanding nearly all climate scientists concur on human-caused global warming (Leiserowitz, Maibach, Roser-Renouf, Rosenthal, & Cutler, 2017). While seven in ten think global warming is occurring, only 55% acknowledge it is human caused (Leiserowitz et al., 2017). Finally, 76% of Americans say

climate change is an environmental issue, which requires a different communication strategy than if they viewed it as a moral or economic issue (Leiserowitz et al., 2017).

Despite these challenges, planning for climate risk has become more of a prominent consideration in recent urban planning practice and literature. Two ways in which planners incorporate policies addressing climate risk are mainstreaming and dedicated planning (Butler et al., 2016; Uittenbroek, Janssen-Jansen, & Runhaar, 2013). In mainstreaming, planning actions are incrementally integrated into everyday processes, ensuring that they are weighed along with other considerations and community values (Uittenbroek et al., 2013). However, the focus on climate risk is diluted and possibly outweighed by more pressing community issues. Integrating climate risk into existing development regulations, comprehensive plans, and hazard mitigation plans are examples of mainstreaming. In the dedicated approach, climate risk planning is the sole focus, meaning there is more attention to the issue during the policy initiative (Uittenbroek et al., 2013). Unfortunately, dedicated approach plans risk being "a plan gathering dust on the shelf" and the documents often have no regulatory status and are not integrated with day-to-day planning decisions in the community (Butler et al., 2016). Stand-alone policies or documents, such as climate action plans (CAPs), sometimes also called resilience or adaptation plans, are examples of the dedicated approach.

Catalysts and Barriers in Planning for Climate Risk

Much of the current theoretical framework for exploring the catalysts and barriers to new policy adoption within the planning profession draws from policy innovation theory (Bassett & Shandas, 2010; Meerow et al., 2016). Policy innovation theory is one way to explain the catalysts, barriers, and paths for the adoption of new policies, such as those related to climate

risks, by a government entity for the first time (Berry & Berry, 1999; Krause, 2011). Two complementary models (Table B1) used within the policy innovation theory are policy diffusion and internal determinants (Bassett & Shandas, 2010; Berry & Berry, 1999).

Table B1. Policy Diffusion and Internal Determinants Models and Factors

Policy Diffusion Model	**Internal Determinants Model**
Learning Imitation Normative pressure Competition Coercion and incentives	Access to resources Information and communication Local leadership Mandated planning

The policy diffusion and internal determinants models and factors of policy innovation as described by Berry & Berry (1999) and later expanded upon by Bassett & Shandas (2010), Krause (2011), and Shi et al. (2015).

The policy diffusion model was popularized by Berry & Berry (1999) who coined "regional diffusion" and first explored the regional phenomenon of policy innovations that occurred in geographic clusters and had a strong spatial correlation to the distance between governments. This spatial focus was expanded over time in the literature, and now the policy diffusion model recognizes non-spatial influences, such as learning networks, in the adoption of new policies (Bassett & Shandas, 2010; Krause, 2011).

There are five factors of policy innovation within the policy diffusion model (Table B1), including learning, imitation, normative pressure, competition, and coercion (Bassett & Shandas, 2010; Berry & Berry, 1999; Krause, 2011). Urban planners in one municipality may learn or imitate a policy from another municipality they perceive as a leader and adopt it within their regulatory structure (Berry & Berry, 1999; Krause, 2011). Additionally, urban planners may give in to peer pressure to adopt a policy due to normative pressure (Berry & Berry, 1999). To gain a

competitive edge over peer cities, urban planners may adopt a policy for the advantage it gives their municipality (Berry & Berry, 1999). Finally, urban planners may adopt a policy due to coercion, such as a state mandate, or due to incentives, such as receiving funds from a grant program (Berry & Berry, 1999).

In the internal determinants model, policy innovation is a function of the political, social, and economic characteristics of the municipality in question (Berry & Berry, 1999; Shi et al., 2015). The factors of policy innovation within the internal determinants model (Table B1) include access to resources, local leadership, information and communication, and state policy framework (Shi et al., 2015). Within the internal determinants model, significant events are included in the information and communication factor of policy innovation (Bassett & Shandas, 2010; Berry & Berry, 1999). Access to resources, such as overall staffing, staff time, and funds to hire consultants, is one of the most studied and cited opportunities and challenges in policy innovation (Bassett & Shandas, 2010; Moser & Ekstrom, 2010; Shi et al., 2015).

Local leadership as a factor in policy innovation can be elected officials or urban planning staff. They can catalyze action through building political support for action and dedicating financial resources, or be a barrier to policy innovation if they prioritize other issues (Shi et al., 2015). In the context of planning for climate risk, leadership can particularly be a challenge in politically conservative communities, where officials or staff may lack incentives to support climate-related planning, due to the divisiveness of the issue (Bedsworth & Hanak, 2010).

Information and communication is another factor within the internal determinants model and relates to the ease or difficulty that planners have in obtaining, interpreting and

communicating data (Bassett & Shandas, 2010; Bierbaum et al., 2013; Ekstrom & Moser, 2014; Shi et al., 2015). Within information and communication falls the "window of opportunity" of public awareness and interest created by recent extreme climate events that have been directly experienced by the public (Bassett & Shandas, 2010).

The final factor in the internal determinants model is mandated planning, often in the form of state or federal requirements (Shi et al., 2015). A state mandate for climate risk planning can require climate change to be considered in long-range plans or development approvals, whereas the lack of such mandates can make it difficult for local municipalities to act on their own, due to the lack of policy guidance and the lack of political cover that mandates can provide (Bedsworth & Hanak, 2010).

Methods

Study Context and Design

The Southwest is considered the most arid region in the United States, with a history of climate variability projected to be exacerbated by climate change (Cayan et al., 2013; Garfin et al., 2014). While localized drought is projected to increase, snow-drought and earlier spring snowmelt in the region's mountains will also impact potable water supply of cities, particularly those that rely on the Colorado River (Wehner, Arnold, Knutson, Kunkel, & LeGrande, 2017). Increasing heat, due to climate change, coupled with the urban heat island effect, will also pose risks for public health and infrastructure (Berisha et al., 2017; Garfin et al., 2014). Flooding risk may also increase, due to short-duration atmospheric rivers (Demaria et al., 2017; Ralph et al., 2017). Finally, wildfires are projected to increase, due to interactions between rising

temperatures and drought (Abatzoglou & Williams, 2016; Barbero, Abatzoglou, Larkin, Kolden, & Stocks, 2015; Westerling, 2016).

To explore how planners in the Southwest are addressing these climate risks, we chose three pairs of case study communities in Arizona and New Mexico, six communities in total. The cities in the case study pairs (Figure B1) include Flagstaff, AZ and Santa Fe, NM; Yuma, AZ and Las Cruces, NM; and Tucson, AZ and Albuquerque, NM.

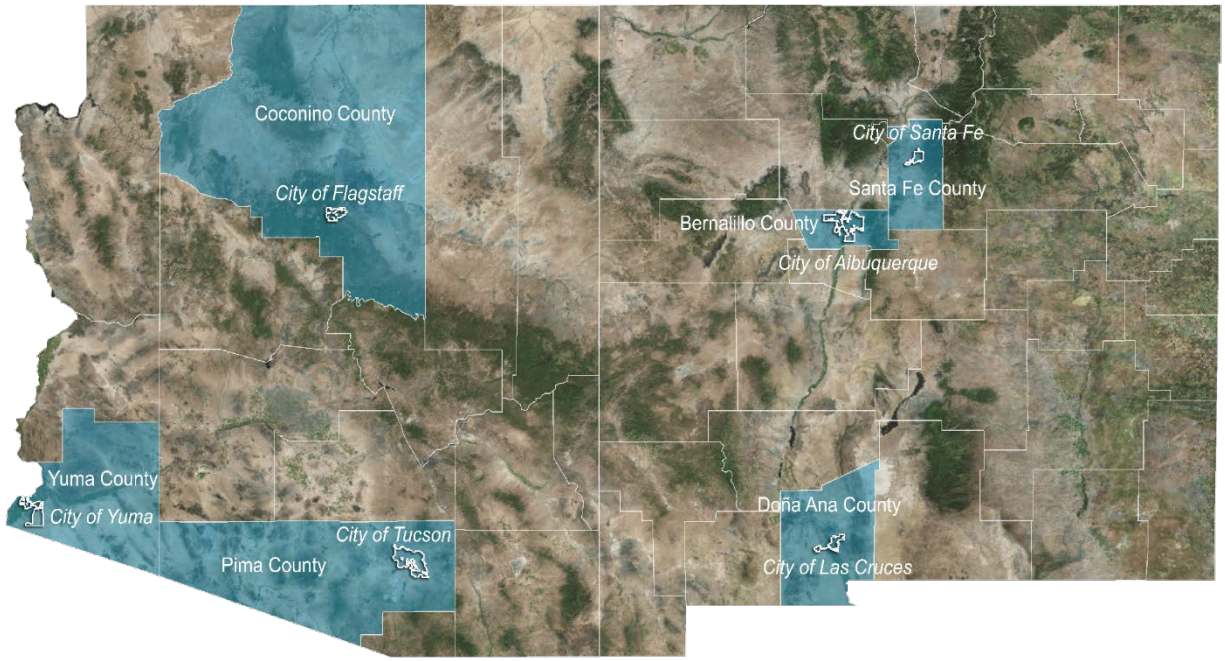

Figure B1. Case Study Cities: The six case study cities, along with their respective counties shaded in blue, represented in the semi-structured interviews with planners.

We chose each pair based on population size (Table B2) to explore potential differences in the range of climate risk planning activities taking place; as discussed earlier, most planning literature to date focuses on the climate planning activities of larger cities. Each city also serves as the county seat and is the largest city in its respective metropolitan region. The cities within

the case study pairs (Table B2) also represent a range of geographies, which encompass the range of present and projected climate risks to cities in the Southwest.

Table B2. Case Study City Characteristics

City and State	**City Population (2010 Census)**	**Respective County Seat**	**Geography**	**Elevation (ft)**
Flagstaff, AZ	65,870	Coconino County	Mountain, forest	6,910
Santa Fe, NM	67,947	Santa Fe County	Mountain, forest	7,199
Yuma, AZ	90,660	Yuma County	Desert	141
Las Cruces, NM	97,618	Doña Ana County	Desert	3,000
Tucson, AZ	520,116	Pima County	Desert	2,389
Albuquerque, NM	545,852	Bernalillo County	Desert	5,312

The planning profession has specializations in job functions, which could affect discussion of climate risk and, to our knowledge, few studies in this area have interviewed a cross-section of the planning profession for this purpose. In an attempt to explore this area, we interviewed a range of planners in each community (Table B3), including current planners, long-range planners, sustainability coordinators, and long-range planners in respective counties.

Based on these job function criteria, our goal was to interview two current planners, two long-range planners, one sustainability coordinator and one county long-range planner in each case study. We attempted to interview the same number of participants in each case study, but differences in city staff size and job function distribution meant each city's participation number was slightly different. We identified 32 interview participants, through a combination of municipal website department listings and discussions of job functions with participants and their

supervisors, to ensure as much consistency as possible across case studies. Our sample of interview participants included five in Las Cruces, two in Yuma, seven in Santa Fe, eight in Flagstaff, four in Albuquerque, and six in Tucson. The lower number of participants in Yuma that we were able to interview will be noted when discussed. When categorized by job function across the entire sample (Table B3), eight participants were current planners, twelve were long-range planners, five were sustainability coordinators, and seven were long-range county planners. The participants' experience in the planning profession ranged from three years to over thirty, and twenty-six of the thirty-two participants had been professional planners for ten years or longer.

Table B3. Interview Participant Job Functions

Job Function	**Definition**	**Participants**
Current Planner	Planner whose majority of duties focus on developing and enforcing regulations and in creating nonregulatory programs to implement long-range plans. (Bayer, Frank, & Valerius, 2010).	8
Long-Range Planner	Planner whose majority of duties are long-range planning activities, such as assessing how well the community is doing, identifying problems and opportunities, and creating plans to guide future decisions, which will be later made by current planners (Bayer et al., 2010).	12
Sustainability Coordinator	Interdepartmental change agents assigned tasks related to creating new partnerships and finding solutions to move sustainability and climate change related city goals forward (Johnston, Nicholas, & Parzen, 2013)	5
County Long-Range Planners	County planner whose majority of duties are long-range planning activities, such as assessing how well the community is doing, identifying problems and opportunities, and creating plans to guide future decisions, which will be later made by current planners (Bayer et al., 2010).	7
Total		32

We developed one set of ten semi-structured interview questions (Table B4), refined with feedback from three Southwestern city planning directors who had familiarity with all of the participants' job functions through their current role as supervisors. As noted by Bernard (2015), semi-structured interviews, "work[s] very well with high-level bureaucrats," who are used to efficient use of their time. We intentionally omitted terms such as "adaptation" and "resilience" from the semi-structured interview questions, to allow participants to use their language to define how they planned for climate risks. We also only referred directly to the term "climate change" at the end of the semi-structured interview, to allow participants to discuss planning for climate risks in their terms. The use of semi-structured interviews to research how planners use climate knowledge and information in decision making has precedent in planning literature, notably Eliasson (2000) and Carmin et al. (2012).

Table B4. Semi-Structured Interview Questions

1. In your experience, what are the primary concerns about environmental and climate risks in your community?
2. Where do you get information about climate and environmental risks to help inform planning and policy-making? What type of information is most often used?
3. What specific planning or policy decisions does your community make that incorporates climate information?
4. What events or circumstances might increase planning efforts around climate and environmental risks in your community?
5. What are the barriers to these actions?
6. What groups outside of your municipality do you work with to address environmental or climate risks?
7. At what level of government is environmental and climate risk planning or policy-making most likely? Most effective?
8. How does your community approach the role of climate change when planning and policy-making for environmental and climate risks?
9. What would help you better address climate and environmental risks in your community?
10. Any final thoughts or questions?

Data Collection

We conducted all semi-structured interviews over the phone. Twenty-six of the interviews were one-on-one, and there were two instances where participants requested a group interview of three participants each. In these two instances, we were careful to have the participants of the group interviews identify themselves as they spoke, and we used facilitation best practices to ensure each participant had the opportunity to answer every question (Creswell & Poth, 2007). We asked follow-up questions to allow participants to expand on or clarify topics and to ensure the topics were fully explored. We recorded all interviews and gave participants the opportunity to follow-up with additional thoughts after the interviews concluded. Two participants followed up with additional thoughts via email afterward. A research assistant then fully transcribed all interviews.

Data Analysis

We then organized and coded the data, in the process described below, using a qualitative data analysis software (MaxQDA) (Miles & Huberman, 1994). In some cases, we had pre-existing topics we were interested in exploring, including specific climate risks to the region, and catalysts and barriers from policy innovation theory. Code generation was not limited to these pre-conceived topics of interest, however, and was conducted bottom-up from the data collected. We also used several techniques to identify themes in the transcripts, including repetitions, topics that continually re-emerged in the discussion, like a specific climate risk; metaphors and analogies, such as “windows of opportunities”; and similarities and differences between the individual transcripts (Ryan & Bernard, 2003).

We collaboratively developed a codebook for the interview questions (Table B4) *a posteriori* based on a reading of the transcripts and analyzing responses across all questions (Bernard, 2006). Codes were given two possible numeric values (Bernard, 2006). One was the presence of the topic mentioned in the specific interview (presence of topic = 1, the absence of topic = 0) and the second was the frequency or the total number of mentions of that code within the interview. Two examples of codes generated for the codebook, *Drought* and *Events,* are listed in Table B5. None of the codes generated were mutually exclusive.

Table B5. Coding Examples

Code	**Category**	**Definition**	**Example Quote**
Drought	Climate risk	A period of excessive dryness long or intense enough to affect agriculture, habitats, or people (National Drought Mitigation Center, 2011).	"We haven't been getting as much rain, and outside the city limits the farmers have been utilizing groundwater because there's not a lot of irrigation water available."
Events	Catalyst	A significant event that creates a window of opportunity for policy action (Berry & Berry, 1999).	"I think emergencies, or catastrophes, or a specific incident can help drive the coalition necessary to take action on certain things."

We then iteratively coded each transcript across all answers within each transcript, utilizing the codebook. After each transcript was coded, we analyzed the codes by individual participant, by all participants within a single case study, by case study pairs, by job functions across all case study pairs and, finally, grouped by state. This process was iterative and required also re-examining the context of the codes multiple times as we proceeded. As mentioned before, codes were organized by the presence or absence of mention of the code, as well as the

frequency of code occurrence within each interview. Both singular presence and absence of code within each interview, as well as the frequency of codes within each interview, were used in the analysis. Finally, we also gathered additional information on the specific climate events, policies, organizations, and resources mentioned by participants, to add context and further our understanding of their statements during data analysis and discussion.

Plan Quality Evaluation

We used the results from a plan quality evaluation of two generations of comprehensive plans within each case study city (Keith & Garfin, in prep.) as a secondary data source in our analysis of the interview data. Plan quality evaluation is a content analysis subfield within planning literature, where the quality of a plan is coded systematically; higher quality plans receive higher scores, based on established criteria in planning literature (Berke & Godschalk, 2009). The two generations of plans roughly correspond to the past generation adopted in the early 2000s era and the current adopted plans, roughly from the mid-2010s. Indicators were used to evaluate the mainstreaming of climate action planning, both mitigation and climate adaptation, and the amount of explicit climate acknowledgment within the plans (Keith & Garfin, in prep.). These indicators were adapted from Baynham & Stevens (2013) and adjusted for local climatic and governance contexts. Collection of data, scoring of indicators, and analysis of data from the qualitative plan evaluation follow recommendations laid out by Lyle & Stevens (2014). This review included the use of three separate evaluators, review of scoring criteria, use of a pre-test evaluation, and ensuring the minimum 80% agreement convention was met (Krippendorff, 2012; Lyles & Stevens, 2014).

Results and Discussion

We will first present how participants framed climate change, as it provides insight into the rest of the interview results. Next, we will present the climate risks reported by participants. Finally, we will present the catalysts and barriers to policy innovation that participants reported. The participants may have awareness or concerns about other factors they did not discuss during the interviews. The ones that participants did reflect on were salient to them at the time of the interviews and can help deepen understanding of their awareness and practices.

Framing Planning as Climate Change Related

No participants reported any doubt in the science of climate change or its impacts on their communities. Almost all participants (30 out of 32) mentioned climate change before Question 8, which was the first question to state the phrase "climate change" directly. The participants' answers to Questions 1-7 demonstrates their acknowledgment of the existence of climate change and its relevance to planning.

Participants were split, however, in their discussion of how openly they could address the issue within their community, with 17 of 32 reporting openly addressing planning for climate risk as related to climate change. One participant stated, "You have to deal with the political realm in which you [live] and unfortunately we're living through some times where not everybody believes that climate change is real." The political nature of climate change is noted broadly in climate change literature, as it can be politically more acceptable to address current weather-related natural hazards rather than climate change (Berrang-Ford, Ford, & Paterson, 2011; Ruth & Coelho, 2007).

Current and long-range planners across all communities discussed having more success advancing climate change-related policies when the policies also addressed community concerns like economic development and public health. Both current planners (6 of 8) and long-range planners (9 out of 12) reported the co-benefits approach as better reflecting their community and political values. Regarding a climate risk-related policy, one participant stated, "Any policy I suggest, I'm going to look at it from a [climate] denier's point of view. And if I can justify doing it for reasons other than climate change, that's a stronger argument."

Some participants stated the importance of the opinions of elected officials in how openly felt they could discuss climate change. One planner relayed the following story of a Board of Supervisors hearing as an example of why they felt comfortable addressing climate change openly: "One of the Board of Supervisors made a comment saying, 'Are you sure you want to use that language? It is so contentious.' And one of the other supervisors said, 'Well what else are we going to call it? Shorter winters, longer summers? Let's call it what it is.'" The complex relationship between politics and planning becomes harder to navigate for divisive issues such as climate change. As described by Meerow & Mitchel (2017), "Current planning theory and practice does not adequately address how urban and regional planners should effectively navigate the political context of planning for climate change."

Participants from both Flagstaff (7 of 8) and Santa Fe (5 of 7) most often reported addressing climate change openly when planning for climate risk. Participants in these two communities attributed this to the combination of their communities' politically progressive elected officials and a public with a high understanding of climate change.

Discussion of Climate Risks in the U.S. Southwest

The five climate risks that participants discussed included drought, flooding, heat, wildfire, and air quality. Table B6 shows which climate risks were discussed by participants per city at least once during interviews. Within each case study community, participants were consistent in their descriptions of their community's climate risks, with no discernable differences in phrasing between planners of different job functions.

Table B6. Reported Climate Risks by City

City		**Drought**	**Flooding**	**Heat**	**Wildfire**	**Air Quality**
Pair	Flagstaff, AZ 8 participants	8/8	6/8	2/8	8/8	0/8
	Santa Fe, NM 7 participants	4/7	5/7	0/7	6/7	2/7
Pair	Yuma, AZ 2 participants	1/2	1/2	2/2	0/2	0/2
	Las Cruces, NM 5 participants	3/5	4/5	3/5	0/5	3/5
Pair	Tucson, AZ 6 participants	5/6	1/6	5/6	0/6	0/6
	Albuquerque, NM 4 participants	3/4	3/4	3/4	2/4	0/4

Dark gray shaded cells represent that a simple majority of participants within that city reported the topic at least once in an interview as climate risk. Light gray shaded cells represented that half of the participants within the city reported the topic.

Participants (24 of 32) in all communities discussed the impact of drought on municipal water supply. Participants within each community had consistent narratives on the increased risk to their community's water supply, whether it was from depleted aquifers, or risks to surface water supplies, such as the Colorado River, the Rio Grande, or Central Arizona Project.

Participants discussed drought as a long existing planning concern and as an increasing risk due to climate change. One participant stated, “I think one [climate risk] that is extremely topical and has been a focus of us for a long time is planning for the water resources we need for our community and how that's affected by climate change.” Other planners echoed similar concerns over water resources and availability. These results are consistent with their actual long-range planning efforts, with all communities having drought policies in both past and current generations of their comprehensive plans (Keith & Garfin, in prep.).

The second most frequently discussed climate risk, by participants in all communities, was increasing extreme storm events that result in severe floods. This risk was discussed in 20 of 32 interviews and every community. Similar to drought, participants discussed floods as a long existing planning concern in their communities that was increasing due to climate change. One participant stated, “We also have data that show increasing severity of storms. So although we get twelve inches of rainfall a year, it's coming in fewer storms that are more intense and shorter.” The concern for increased flood risks aligns with projected changes of fewer storms with increased rain amounts (Wehner et al., 2017). Concerns with flooding, mentioned by participants, are consistent with their communities’ long-range planning efforts, with all communities having flood-related policies in both generations of their comprehensive plans (Keith & Garfin, in prep.). Interestingly, only one of six participants from Tucson directly reported flooding as a concern, although all six discussed specific policies, such as increasing green infrastructure, which is related to the reduction of flood risk. Despite the acute impacts of flooding, for only one of the Tucson participants was it salient at the time of the interview.

The majority of participants in cities with desert geographies—Yuma (2 out of 2), Tucson (5 out of 6), Albuquerque (3 out of 4), and Las Cruces (3 out of 5)—reported concerns with rising temperatures, due to increasing temperatures from climate change and the urban heat island effect. Participants' expressions on heat were interesting, reported as increased daily high temperatures and more days over 100 degrees. One participant shared, "We're also concerned about temperature increases. We already have our share of 90 plus degree weather in the summertime, but I think we're noticing that we're hitting 100 more often." Heat was often reported as the "most critical risk" in their community; however, participants specifically mentioned the topic less frequently than any other climate risk. For example, heat was mentioned 11 times in the five interviews with participants in Las Cruces; whereas flooding was mentioned 31 times. While heat was described as a critical issue, flooding is more tangible, and flood impacts are visible and easy to describe when compared to heat. Finally, in only 3 of 32 interviews were specific impacts of heat identified, all three times related to public health.

The concern over heat, but less frequent discussion on it, may also be due to a lack of resources and information, with one survey finding only 4% of climate adaptation resources for planners contained information about heat (Nordgren et al., 2016). That participants mentioned heat as a critical issue was consistent with results from the quality plan evaluations; though none of the comprehensive plans in the previous generation addressed it, Albuquerque, Tucson, and Yuma's current plans now include heat-related policies (Keith & Garfin, in prep.). This finding suggests a growing awareness of heat as a climate impact in planning.

All Flagstaff participants (8 out of 8) and nearly all Santa Fe participants (6 out of 7) expressed concern over the risk of wildfire. Additionally, wildfire as a topic was mentioned at a

frequency of thirty-eight times in the Flagstaff interviews and thirty-four times in the Santa Fe interviews, more than double the frequency of any other climate risk discussed by the participants for each of those cities. This frequency could be interpreted as greater concern for wildfires over other climate risks at the time of the interview. The wildfire risk was discussed both as concern about the direct danger it posed to residents and structures, and concerning the post-wildfire risks of increased flooding and decreased water quality. Participants also expressed concern over how the changing natural environment would impact the character of their communities. This concern was expressed by one participant, "The ponderosa pine forest is rapidly changing as it suffers more and more from drought every year. What will our community look like? How will how we react to it? How [will] we change when we don't have those trees that are such a huge part of the environment in this community?" Flagstaff had long-range policies in both generations of their comprehensive plans for the wildfire risk, while Santa Fe did not in their plan (Keith & Garfin, in prep.). The inclusion of policies for wildfire risk, as well as the discussion by all participants, demonstrates the issue is at the forefront of planners' minds.

Participants in both Santa Fe (2 of 7) and Las Cruces (3 of 5) reported that climate change could have negative impacts on air quality and corresponding impacts on public health. The interviews were conducted shortly after the American Lung Association downgraded Santa Fe's air quality from an "A" to "B" rating due to revised standards issued by the Environmental Protection Agency, which may have been a factor in the salience of the climate risk to the Santa Fe planners at the time of the interviews (American Lung Association, 2016). The air quality rating for Santa Fe improved back to an "A" again for both 2017 and 2018 (American Lung Association, 2017, 2018).

Similar to how participants in other communities discussed the complexity of the climate risks related to wildfire, participants in Las Cruces spoke of the interconnected relationships between increasing heat, wind, and erosion leading to air quality issues. One participant reported, "Research shows that [winds] are carrying a lot of particulates, including fungus that can exacerbate health factors. And since we don't have much shade or any mechanisms to slow down the winds or capture the sediments… we can expect to see problems with peoples' health as a consequence." Public health policies focusing on dust and air quality are present in the Las Cruces comprehensive plan (Keith & Garfin, in prep.), consistent with the concern expressed by participants. Las Cruces does have significant air quality issues resulting from sources such as regional transportation, unpaved roads, the surrounding environment, and two climatic features in the region including low wind air stagnation in the winter and strong dust storms that occur in mid-April (Rodopoulou et al., 2014).

A Flagstaff participant discussed a concern we did not anticipate, that the increasing heat in Phoenix could lead to increased migration to their community. The participant stated, "People tend to come up here more because it's cooler. Do we have the capacity to deal with all the people that are trying to come here to be away from 120-degree temperatures in the Phoenix area?" This concern was unexpected because there are currently no studies on migration due to increasing heat in this context; however, climate migration from other areas impacted by disasters such as hurricanes in the U.S. has been documented (Myers, Slack, & Singelmann, 2008).

Finally, eight participants across the six communities discussed climate risk through the lens of social vulnerability and the need for planning responses to address existing inequity

issues. One participant shared, “Locally, we are also concerned with the social justice impact of the effects of climate change… and what are the implications to communities that are already vulnerable.” Several also discussed historical and cultural aspects of vulnerability, with a participant from Albuquerque stating, “Our environmental issues are absolutely and [inextricably] tied to community identity and to [Native Nation] sovereignty issues here.” Participants also discussed vulnerability regarding poverty, historic disparities for minorities, and tribal sovereignty. This finding is consistent with a finding that most of the current comprehensive plans of the communities address policies on vulnerability, including plans for Albuquerque, Flagstaff, Las Cruces, and Tucson (Keith & Garfin, in prep.).

Mainstreaming Approaches in Response to Climate Risks

All participants, from all communities and job functions, discussed planning for climate risk in terms of incremental adjustments that fit within their existing development regulations and comprehensive plans. They essentially described mainstreaming activities although none used that terminology. One participant detailed how their city was integrating climate information into an update of their comprehensive plan: “We are actually in the midst of updating our comprehensive or general plan and it is being informed by climate data. We have a specific goal to address climate change; we have a specific goal to address water supply and quality; we have a specific goal for natural hazards; another for natural resources; a goal for community health, all informed by data related to climate change.” Participants also discussed the specific planning strategies being incorporated incrementally into existing policies to address climate risks. Participants connected the goals of increased density and walkability to reducing vulnerability to various climate risks, such as drought and wildfire. Other strategies frequently

mentioned that minimize flooding and heat risk included increasing green infrastructure, urban forestry, and land conservation.

Only two of the thirty-two participants, both times in Flagstaff, described using a dedicated approach of planning for climate risk. This was somewhat a surprising finding, as each city, except for Yuma, has had some form of dedicated plan or report created related to climate risk. The planning literature may explain the lack of mentions of dedicated approaches, which suggests that they often risk being, "a plan gathering dust on the shelf," as they have no regulatory status and are not integrated into day-to-day planning activities (Butler et al., 2016).

While the absence of discussion on dedicated approaches to planning for climate risk cannot be interpreted as lack of participants' knowledge, experience, or interest with that form of planning, the participants' responses and focus on mainstreaming approaches is consistent with two other studies that have focused on a range of small to medium-sized municipalities within a region. These include Hamin's (2014) study of fourteen municipalities in coastal Massachusetts and Butler et al.'s (2016) study of fourty-two municipalities in coastal Florida. Hamin (2014) concludes that the planners in her study who reported mainstreaming did so when they, "faced political barriers, need to focus on benefits in the near term, and lacked resources to do a [dedicated] plan." The majority of other studies on climate action planning have either chosen dedicated plans as the sample focus or include a sample of large cities with the resources available to pursue dedicated climate risk planning (Keith, in prep.).

Catalysts and Barriers in Planning for Climate Risks

Through bottom-up coding, we identified several catalysts and barriers in planning for climate risks (Table B7) reported by participants. Participants reported catalysts for planning for

climate risk included significant events (13 out of 32), state or national mandates (7 out of 32), and peer case studies and examples (21 out of 32). Participants reported barriers to planning for climate risk included lack of resources (27 out of 32), need for assistance in messaging the issue of climate change (21 out of 32), and lack of leadership and public support (15 out of 32). No patterns emerged from the reported catalysts and barriers by the job functions of participants or by case study pairs (Table B7).

Table B7. Catalysts and Barriers to Policy Innovation by City

City		Catalysts			Barriers		
		Events	**State or National Mandates**	**Peer Cases and Best Practices**	**Resources**	**Messaging of Climate Change**	**Political Leadership and Public Support**
Pair	Flagstaff, AZ 8 participants	8/8	2/8	0/8	8/8	8/8	4/8
	Santa Fe, NM 7 participants	5/7	3/7	6/7	6/7	4/7	2/7
Pair	Yuma, AZ 2 participants	2/2	0/2	0/2	2/2	1/2	1/2
	Las Cruces, NM 5 participants	4/5	1/5	3/5	3/5	1/5	5/5
Pair	Tucson, AZ 6 participants	3/6	1/6	4/6	4/6	3/6	4/6
	Albuquerque, NM 4 participants	4/4	0/4	1/4	3/4	4/4	3/4
	Total	27/32	7/32	14/32	26/32	21/32	19/32

Dark gray shaded cells represent that a simple majority of participants within that city reported the topic at least once in an interview as a catalyst or barrier to policy innovation. Light gray shaded cells represented that half of the participants within the city reported the topic.

Thirteen participants discussed events, both past and potential future climate-related impacts, as having the most potential for spurring planning for future climate risk. One participant stated, “Wake up calls can catalyze the community’s attention and result in a call to action. We've seen that over the years, especially in the environmental realm, emergencies or catastrophes or a specific incident can help drive the coalition necessary, in order to take action on certain things.”

The 2010 Schultz Fire was a significant event characterized by all eight Flagstaff participants as catalyzing policy action related to wildfire, wildfire-related flooding, and future growth patterns. The Schultz Fire burned over 15,000 acres of forest in the Flagstaff area, caused the evacuation of over 700 homes, and resulted in severe flooding afterward (Combrink, Cothran, Fox, Peterson, & Snider, 2013). In relationship to the Schultz Fire, one participant stated, “Climate change struggles with messaging because it lacks immediacy until it is an emergency. That's why things like the Schultz fire were crystallizing moments for actions that are climate change related.”

This view is consistent with the literature and documented cases of transformational change after major disasters, such as Hurricane Katrina in New Orleans in 2005 (Olshansky, Johnson, Horne, & Nee, 2008) and Hurricane Sandy in the U.S. Northeast in 2012 (Berke & Stevens, 2016). In both cases, the disasters brought increased public attention, the impetus for a policy response from leaders, and an influx of outside financial and supportive resources not previously available (Berke & Stevens, 2016; Burby, 2006).

Another event, which catalyzed policy actions discussed by Las Cruces participants (4 out of 5), was heavy precipitation and flooding throughout the monsoon season of 2006. On

August 15, one storm, in particular, caused a breach of a levee and the flooding of the Village of Hatch, north of Las Cruces, leading the evacuation of 1,600 residents (Rogash, Alexander, Fausett, & Mcblain, 2006). A participant recounted that, "[f]looding events that happened in 2006 and really set off multiple alarms. The flooding of the Village of Hatch, which is [in] the northern portion of the county… after that it seemed that we have built up some steam in terms of county commissioners and state representatives and district representatives, saying we need to look at community development and flood mitigation. We have to start looking at these things differently."

Several participants (7 out of 32) across all communities and by all job functions also mentioned state and national mandates as a potential catalyst for planning for climate risk. They also often pointed to past state mandates that changed the way planning was done at the local level during their careers. One participant stated, "To see things happening at the state level would be huge… We need to have a stronger policy in unison all together, and it would be great if there were policies out there supporting what we're doing." This finding is consistent with planning literature, which has shown that state mandates can have a positive impact on the quality and strength of plans addressing climate risks and natural hazards (Berke & French, 1994; Nelson & French, 2002).

Participants lamented that there were no new mandates in either state to plan for climate risks posed by climate change. Both Arizona and New Mexico do have mandates to plan for natural hazards, but neither state requires local planning specifically for climate change, so this finding is not a surprise (Arizona Revised Statutes. 9-461.05 General plans; authority; scope, n.d.; New Mexico Statutes 3-19-9 Master plan; purposes., 1970). Participants were also

pessimistic that any new mandates would emerge from the state or national level soon, leaving it to local governments to plan for climate risk on their own. As one participant stated, “Ultimately, I don't really see the federal government playing a major role in this. I think it's going to have to be dealt with at the local level.” Mandates as coercion and incentives are a component of both regional diffusion and internal determinants models (Bassett & Shandas, 2010; Berry & Berry, 1999).

Fourteen participants also discussed the importance of case study examples and success stories from similar cities as helping with planning for climate risk. Participants framed case studies as offering both best practices and as a way to give reassurance to political leaders and the public for new policy actions. “If you see something that works, and it makes sense, and it addressed the need, then you're going to be much more willing to replicate a similar strategy,” stated one planner. Best practices and case studies are the most frequently used resource, as indicated by 80% of local climate adaptation planners in a 2016 survey of 291 practitioners (Nordgren et al., 2016). These findings are also consistent with established planning literature on policy innovation theory (Bassett & Shandas, 2010; Berry & Berry, 1999).

Participants most frequently discussed lack of resources (27 out of 32) and leadership (15 out of 32) as barriers to planning for climate risk. The lack of resources was framed by participants as the interconnected issues of lack of time, lack of financial support, and more pressing community concerns that diverted available resources. The importance of these interconnected resources are essential for any municipal action but are especially important in endeavors such as planning for climate change with more science translation and technical guidance not yet integrated into municipal functions (Moser & Ekstrom, 2010). One participant

stated, “I think most local governments are no different than your household. We have limited bandwidth. There's only so many hours in the day to do all of the things we want to do and because of that… we spend our time and energy and resources on those higher priority needs.”

The discussion of lack of political leadership and public support as a barrier for pursuing planning for climate risk is consistent with past studies, which show local leadership, such as publically elected officials, provides important direction and backing for more meaningful climate risk planning (Nordgren et al., 2016). If the public elects leaders who do not acknowledge climate change, little support may be given for climate adaption planning. One planner stated, “My job is to serve the community. We see them as our boss and if the community is not ready to commit to these sort of things, we won't be doing it.” Many participants stated similar sentiments about the importance of serving the community.

Both the lack of resources and political support is consistent with findings from Shi et al.’s (2015) paper, which found a high correlation between these two factors and climate risk planning in their survey of 156 environmentally progressive cities. Availability of both resources and leadership are also two key characteristics within the internal determinants model in explaining the adoption of new policies (Bassett & Shandas, 2010; Berry & Berry, 1999). While participants most often spoke of their local leadership, many also discussed the role that state and national leadership played at their local level. This view was true in Flagstaff and Santa Fe, where participants stated their communities were more progressive on planning for climate risk than their respective states. One planner stated, “Barriers for us are the political aspects at the state level. Locally and in the county leadership, we are greatly supported in sustainability and adaptation.”

Participants (21 out of 32) also specifically discussed the difficulty in messaging information on climate change to the public as a barrier to action. This finding is consistent with interviews of planners conducted by Hamin et al. (2014), who also found that it was not the access to climate information that was the barrier to action, but the ability to connect it to local values and beliefs. One participant stated, "I think people are aware of climate change, but it's like that conversation seems so all over the place." Many participants also discussed the public confusion over the topic and how it was their role to communicate climate risk. Several even mentioned feeling a personal responsibility for the poor messaging on the connection between risk and climate change. As one planner reflected, "I think as local government, we bear some of the responsibility for not messaging that [climate change] very clearly to people." Another similarly stated, "Our inability to manage and tell stories with data hurts our ability to move policy forward," concerning climate change.

The federal government was cited by over half the participants (21 of 32) as the top source for retrieving climate information. Professional organizations were also mentioned, although less frequently, with 9 of 32 participants citing the American Planning Association (APA). Several themes also emerged, based on participant job functions. Long-range planners, 8 of 19 from both cities and counties, also cited climate information from local universities. The source of information is consistent with their defined job function, requiring them to do more information gathering to write policies (Bayer et al., 2010). No sustainability coordinators mentioned APA, but 3 of 5 cited the Urban Sustainability Directors Network (USDN), and 3 of 5 cited local universities as important climate information sources. While illuminating, a limitation to these results as discussed previously is that absence of response during the interview does not

mean that participants are not aware of the aforementioned information sources. The interview timeframes also did not allow for further discussion on what information was gathered from the sources, or the usefulness of the information, which is an additional area for future research to explore.

Table B8. Catalysts and Barriers Compared to Factors from Policy Innovation Theory

Influence on Policy Innovation	**Emergent Themes**	**Relevant Factors from the Policy Diffusion Model**	**Relevant Factors from the Internal Determinants Model**
Catalysts	Events (27 out of 32)	N/A	Information and Communication
	State or National Mandates (7 out of 32)	Coercion and Incentives	Mandates
	Peer Cases and Best Practices (14 out of 32)	Imitation and Learning	Information and Communication
Barriers	Resources (26 out of 32)	N/A	Resources
	Messaging of Climate Change (21 out of 32)	N/A	Information and Communication
	Political Leadership and Public Support (19 out of 32)	N/A	Leadership

The table above depicts catalysts and barriers, reported at least once in an interview, for planning for climate risks. Those themes are compared to factors from the policy diffusion and internal determinants models.

Finally, the catalysts and barriers reported by participants (Table B8) were consistent with factors from the policy diffusion and internal determinants model of policy innovation

theory. From the policy diffusion model, only the coercion and incentives factor and imitation and learning factor were aligned with the themes from the interviews. Furthermore, neither the competition nor the normative pressure factor aligned with any of the themes from the interviews. All factors from the internal determinants model were aligned with themes from the interviews. Interestingly, the information and communication factor was aligned with both a catalyst, events, and a barrier, messaging of climate change, based on participant responses.

Conclusion

Our study contributes to planning literature by focusing explicitly on the climate risks facing communities in the U.S. Southwest and demonstrating how planners are responding and preparing to climate impacts such as wildfires, droughts, flooding, heat, and air quality. The findings of our study build upon the planning studies of on planning for climate risk in small to medium-sized communities in the U.S., most notably those in coastal Massachusetts (Hamin et al., 2014) and those in coastal Florida (Butler et al., 2016). Much of the current planning literature on how planners address climate risk still focuses on large and coastal cities, which have more access to resources than the majority of small to medium-sized cities in the U.S (Keith, in prep.; Meerow & Mitchell, 2017).

Our study also provides evidence on the catalysts and barriers, as reported by participants, to the adoption of policies related to climate risk, in a region that has been not well represented by research on climate risks thus far (Bassett & Shandas, 2010; Burch, 2010; Hamin et al., 2014; Krause, 2011; Yi, Feiock, & Berry, 2017). Consistent with the existing literature, planners in these case study cities stated the main catalysts for adopting new policies addressing climate risk as events, state and national mandates, and access to peer case studies and best

practices. They stated the main barriers to be a lack of resources (such as time, funding, expertise), lack of assistance messaging climate change information, and lack of political leadership and public support.

It is important to note that thirty out of thirty-two participants mentioned climate change in their own terms, prior to the interview question that explicitly mentioned the phrase "climate change." This framing demonstrates planners are aware of climate change and that they associate climate change with the impacts on their community. Participants in these interviews reported weighing the pros and cons of using politically charged language and chose to highlight other benefits better aligned with community values when necessary. Meerow & Mitchell (2017) also note the need in the planning profession for a better understanding of the practice of adapting to climate change, given local political constraints of addressing climate change. This study demonstrates that the planners interviewed reported being aware of the risks of climate change to their communities and pursued mainstreamed policy actions to address these risks.

A topic for further research is the exploration of counter-examples for the catalysts and barriers to policy innovation. While the research presented in this paper demonstrated that two events did catalyze policy innovation, this finding prompts the question "what characteristics of these two events made them catalysts when other climate events that occurred in the case study cities did not catalyze policy innovation?" A better understanding of the characteristics of events and their relationship to policy innovation would help advance the theory.

We also recommend more climate information messaging assistance to planners. Similar to responses from our participants, a survey of practitioners by Nordgren et al. (2016) found, "there is already a bounty of scientific information available." The technical expertise needed to

translate that bounty of scientific into locally relevant and usable climate information is still not available within most cities though (Ekstrom & Moser, 2014). Other recent studies on climate adaptation planning at the local level have highlighted the need for messaging and translation (Butler et al., 2016; Hamin et al., 2014). The existing literature on the coproduction of climate science knowledge offers a potential solution to help planners with this issue, by bringing together climate researchers and planners to develop the climate information and the style of messaging they need (Meadow et al., 2015).

Our interviews with participants also revealed the diversity of climate information sources they turn to, based on their job functions, including several professional organizations, local universities, and federal agencies. This suggests to climate information service providers that those who plan for climate risk are not a homogenous group and receive their information from multiple sources. Our study presents a unique contribution in this area that merits further research. Future research on the climate information needs of the planning profession should continue to explore the impact that differing job functions within the planning profession have on information needs.

A critical research direction lacking in planning literature is an examination of planning for extreme heat, which participants from Albuquerque, Las Cruces, Tucson, and Yuma reported as a serious concern, but then discussed in much less detail than the other climate risks. As shown in the quality plan assessment study, heat was also documented an emergent planning topic within only the 2010s generation of their city's comprehensive plans (Keith & Garfin, in prep.). The lack of a legal framework or state and federal mandates for planning for heat sets it

apart from other climate risks, such as drought, flooding, wildfire, and even air quality; participants discussed the complexity and impacts of these other risks in much more detail.

Finally, there is a need for future planning research on how best practices for mainstream climate risk into existing development regulations and comprehensive plans is taking place in the U.S. This is supported by the responses from participants in this study, as well as building on evidence from Hamin et al. (2014) and Butler et al. (2016). Given that half of the interview participants reported not framing climate risk issues openly as climate change-related when working with the public, future research should carefully explore the climate risks that are being planned for and the planning mechanism being used. It is no longer sufficient to frame research in terms of whether policies are merely associated with climate change.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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APPENDIX C: Evaluating How Climate Action Planning Is Being Mainstreamed into Comprehensive Plans in the U.S. Southwest

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Abstract

Local climate action planning has the potential to mitigate greenhouse gas emissions and decrease vulnerability to climate impacts. Addressing these impacts is particularly important for U.S. Southwest cities, where climate change is projected to increase the severity of drought, heat, rainfall events, and wildfires. We use plan quality evaluation to analyze the mainstreaming of climate action planning in the current and past generation of comprehensive plans to explore changes over time. We paired six cities in Arizona and New Mexico to explore the impact of state mandates on comprehensive plans. While the current plans acknowledge climate change to a greater extent and incorporate more climate action policies than earlier plans, they do not include climate information in the fact base of the plans. The impact of state mandates is consistent with the literature, with stronger mandates in Arizona correlated with more frequent updates and higher plan scores than in New Mexico. We recommend strengthening state comprehensive planning mandates and stating climate information in the fact base of the plans to inform climate action planning policies. Planners should include relevant climate information, both past and projected risks, in the fact base of comprehensive plans to inform climate action planning policies.

Keywords

climate action planning, plan quality evaluation, comprehensive plans, mainstreaming

Introduction

Climate action planning in the U.S. Southwest has the potential to mitigate greenhouse gas emissions of the quickly growing region and decrease vulnerability to climate impacts (Garfin et al., 2014). No studies have specifically investigated how climate action planning is being mainstreamed into comprehensive plans in Southwest cities, and as such, we seek to answer two primary questions:

1) How are cities in Southwest mainstreaming climate action planning into comprehensive plans?

2) To what extent are cities in the Southwest addressing relevant climate risks in comprehensive plans?

We analyzed how climate action planning is mainstreamed and which climate risks are addressed in comprehensive plans, through established plan quality evaluation criteria (Berke & Godschalk, 2009; Lyles & Stevens, 2014). We paired six case study cities in Arizona and New Mexico to explore the impact of state mandates and analyzed current and past plans to explore changes in policies. Arizona's stronger mandates correlated with higher scored plans. Current plans in both states demonstrated greater acknowledgment of climate change and more climate action planning policies, but do not use climate information in the plans' fact bases. We recommend states update and strengthen their planning mandates and planners use climate information to prioritize climate action planning.

In the following sections, we will first review planning literature on climate action planning, including the roles the planning profession plays in both the reduction of greenhouse gas emissions as well as the adaptation to increasing climate impacts. We will then review the

overreliance of research on dedicated climate action planning and the need for more research on mainstreamed climate action planning. We will introduce the research method used within this paper, quality plan evaluation, and the evidence demonstrating that higher quality plans are associated with better planning outcomes. We will detail findings related to the study context for this paper, which includes six cities paired across Arizona and New Mexico, chosen to explore the impact of mandates as well as encompass the range of environment types found in the Southwest. Finally, we will discuss the implications for planning practice and scholarship.

Climate Action Planning

Cities are on the front lines of climate change, with local planning efforts potentially both reducing greenhouse gas (GHG) emissions causing climate change and reducing vulnerability to the impacts of climate change already occurring (Baynham & Stevens, 2013; Bierbaum et al., 2013). Climate action planning is the collective term for local planning efforts to mitigate GHG emissions and reduce climate risk (Bassett & Shandas, 2010).

Globally, between 71-80% of GHG emissions originate from cities and planning decisions made at the local level have the potential for meaningful contributions to GHG mitigation efforts (Hoornweg, Sugar, & Gómez, 2011). These efforts relate to local control over the development of land uses that shape the urban form, with more efficient and compact urban form decreasing building- and transportation-related GHG emissions (Bulkeley, 2010; Ewing et al., 2007). Cities can also decrease GHG emissions caused directly by their municipal operations (Bulkeley, 2010). These climate change mitigation efforts at the local level are essential, as nation-level action will likely fall short of voluntary Paris Agreement actions to keep temperature increases under 1.5°C (Castán Broto, 2017).

Climate adaptation, or the actions taken in anticipation of or response to climate-related impacts, will play a key role in how prepared cities are for climate change impacts (Baker, Peterson, Brown, & McAlpine, 2012; Bierbaum et al., 2013). Climate adaptation is a newer focus in the planning profession than GHG mitigation efforts (Nordgren, Stults, & Meerow, 2016). A well-cited paper by Mendelsohn (2000) discusses climate adaptation for agriculture, natural resources, public health, and touches on hazard mitigation, but similar papers in urban planning literature do not emerge until the 2010s (Bedsworth & Hanak, 2010; Mendelsohn, 2000).

A 2016 global survey of 401 cities with populations over 1 million reflected the recent emergence of climate adaptation in local planning activities (Araos et al., 2016). In the survey, only 61 (15%) of these cities had enacted adaptation policies, but 73 (18%) cities indicated interest in beginning planning for climate adaptation (Araos et al., 2016). Another survey of 156 U.S. cities participating in the ICLEI (Local Governments for Sustainability) network found similar results, with 24% of respondents in the early scoping stages of climate adaptation planning, 27% in planning and analysis stages, and only 9% in the implementation stage (Shi, Chu, & Debats, 2015). These results likely represent an over-reporting of actual climate adaptation planning in the U.S., as member cities of ICLEI would probably be more predisposed to act on climate change than non-member cities (Shi et al., 2015).

Another study included a national survey of climate adaptation services and tools used within 85 organizations related to urban planning found that fact sheets (17.6%) and best practices or case studies (16.6%) were the two most widely available resource (Nordgren et al., 2016). These resources were aimed at the earliest phases of climate adaptation planning,

including vulnerability assessments (29.5%) and adaptation planning (26.7%) (Nordgren et al., 2016). The survey also found 54.5% of the climate adaptation resources for urban planners did not focus on addressing local or regional climate impacts, only offering national climate impact trends (Nordgren et al., 2016). Of those that did contain information about specific climate vulnerabilities, 20.9% addressed flooding impacts, 13.6% addressed sea level rise, with only 4% addressing extreme heat (Nordgren et al., 2016). In a related phone survey in the study, the top two climate planning needs identified by urban planners were assistance in integrating adaptation into current plans, and regulations (Nordgren et al., 2016).

Much of the current research on how the planning profession is addressing climate change has focused on early adopter cities and climate action plans (CAPs) (M. Stevens & Senbel, 2017). CAPs are dedicated and stand-alone policy documents that were often the first to address climate action planning in cities (M. R. Stevens & Senbel, 2017). The focus on early-adopter cities and available CAPs has led several papers documenting climate adaptation planning in coastal cities facing sea-level rise and in larger cities with the resources and political support to address climate change (Berke et al., 2015). There is also a need to address the need for research on climate action planning taking place in non-coastal cities and those with less political support for the topic (Berke et al., 2015).

As the field of research on climate action planning matures, an emerging area of research examines mainstreaming of climate action planning or the integration of climate action planning into existing planning processes. Mainstreamed climate action planning occurs across multiple regulatory and planning activities and is deliberated by the community along with other economic, environmental, and social concerns (Bierbaum et al., 2013; Uittenbroek, Janssen-

Jansen, & Runhaar, 2013). Mainstreamed climate action planning is incorporated into existing land use regulations and comprehensive plans as opposed to only in dedicated CAPs. The mainstreaming approach can address the experience that some municipalities have had after adopting CAPs and then having difficulty implementing desired actions. This is due to the lack of connection CAPs have to existing planning processes and regulatory documents (Bierbaum et al., 2013; Uittenbroek et al., 2013). To better understanding how climate adaptation planning is occurring, Runhaar, Wilk, Persson, Uittenbroek, & Wamsler (2018) call for research that more explicitly measures, "climate mainstreaming in terms of policy outputs and outcomes."

Plan Quality Evaluation

Plan quality evaluation is an established subfield within planning research where the quality of a plan is systematically coded based on the recognized principles within planning scholarship of well-made plans (Berke & Godschalk, 2009). These principles include the plan's fact base, goals, policies, and implementation measures (Berke & Godschalk, 2009; Berke, Roenigk, Kaiser, & Burby, 1996; Lyles & Stevens, 2014). The fact base is the relevant information presented at the beginning of the plan that sets the stage for subsequent goals, policies, and implementation measures. Goals are the broader vision of the plan, with policies being the specific ways that goals can be accomplished. Plans most often conclude with the implementation measures that include information on coordination, funding, timeframes and who is ultimately responsible for action. Plan quality evaluation uses indicators within these principles that are then coded, scored, and analyzed (Berke & Godschalk, 2009; Berke et al., 1996; Lyles & Stevens, 2014). These principles are recognized to be applicable across planning areas and different governance scales (Berke & Godschalk, 2009; Lyles & Stevens, 2014).

State mandates play an important role in shaping local plan quality (Berke & French, 1994). State mandates result in higher rates of comprehensive plan adoption in communities that would otherwise not make long-range plans and result in higher quality plans than in communities who plan voluntarily (Berke & French, 1994; Berke et al., 1996). The level of plan quality depends on the particular requirements of the state mandates, but strong state mandates help overcome local political and economic challenges to planning (Berke et al., 1996). State mandates can also increase local government attention paid to public participation, and states with higher participation requirements for local comprehensive plan processes have higher levels of public participation (Brody, Godschalk, & Burby, 2003).

Studies show that plan quality has a positive impact on a range of local planning outcomes (Berke & Godschalk, 2009; Berke et al., 1996). Berke et al. (1996) found that higher plan quality reduced damage to the built environment from natural disasters. Nelson & French (2002) found, in their case study of the 1994 Northridge, California earthquake, that municipalities with comprehensive plans containing higher scores for fact base, goals, and regulatory policies related to seismic activity and public risk communication had fewer homes damaged after the event. A study by Guyadeen (2018) demonstrated that practicing planners value plan quality, and perceive that higher plan quality facilitates implementation, inspires the community, and adds credibility and legitimacy to the planning process and profession.

A less explored area of plan quality evaluation is in using the research method to examine changes over time in adopted plans. Lyle & Stevens (2014) found that only one of forty-five plan quality evaluation studies looked at longitudinal plan changes (Brody, 2003). The other forty-four studies looked at plans adopted within the same time range across communities as opposed

to looking at generations of plans within the same community (Lyles & Stevens, 2014). Longitudinal plan quality evaluation could prove to be useful to explore how plans change when new ideas and topics, such as climate action planning, enter the awareness of the planning profession and city decision-makers.

Study Context

Climate action planning in the Southwest is under-researched compared with other regions in the nation, which has consequences in the current understanding of both GHG mitigation and climate adaptation. The region is one of the fastest growing in the nation, with the U.S. Census Bureau estimating 60% of the nation's population growth from 2010-2017 occurred in the South and West regions (U.S. Census Bureau, 2017). The West region is also the most urbanized region in the nation, with 76.7% of its population living in incorporated cities (U.S. Census Bureau, 2017). This duality of a highly urbanized and growing population means that efficient land use planning in cities can help reduce future GHG emissions as the urban growth continues in the Southwest.

The Southwest has a history of climate variability that is projected to be exacerbated by climate change (Cayan et al., 2013; Garfin et al., 2014). Temperature- and precipitation-related changes consistent with climate change projections have already been observed in the region (Garfin et al., 2014). The years since 1950 have been the warmest period of its length in the last 600 years, with the average daily temperatures in the 2001-2010 decade being the warmest in the last century (Garfin et al., 2014). It is projected that heat waves in the region will increase in intensity, frequency, and spatial area (Gershunov et al., 2013). While it is projected that average precipitation will decrease across the region, rising temperatures will lead to drier soils, and

earlier snowfall melt will contribute to more drought conditions (Gershunov et al., 2013). Tree-ring analyses have shown that many conifer tree species endemic to woodlands and higher-elevation forests of the region are particularly sensitive to rising temperatures and drought, making them more prone to insect outbreaks and wildfires (Barbero, Abatzoglou, Larkin, Kolden, & Stocks, 2015; Westerling, 2016; Williams et al., 2010). While precipitation is expected to decrease overall in the southern half of the region, extreme precipitation events are likely to increase, as the moisture holding capacity of the atmosphere increases with higher temperatures (IPCC, 2014). These changes all have economic, environmental, and social implications for the cities within the region.

As discussed previously, state mandates on comprehensive planning have implications for the quality of plans developed within those states. Arizona and New Mexico contrast in the strength of state mandates for comprehensive planning, as Arizona has several requirements that New Mexico lacks as of 2018. Neither state requires climate mitigation or climate adaptation policies, so in both states, the municipalities voluntarily pursue climate action planning in their long-range planning.

Arizona's requirements for comprehensive planning, Growing Smarter and Growing Smarter Plus, include a larger number of topics, regular plan updates, and a vote by residents (Arizona Revised Statutes. 9-461.05 General plans; authority; scope, n.d.). In 1998, these were passed by the state legislature and governor and revised in 2000, based on input from a community planning committee. The number and scope of planning elements required increases based on the local government's population. Public participation is also required for the comprehensive planning process, including a community majority vote for the plan to be

officially adopted. Based on these mandates, most municipalities adopted new or updated comprehensive plans in the early 2000s. The next required 10-year update was delayed by the state because of economic difficulties due to the Great Recession and occurred in the mid-2010s.

New Mexico, compared to Arizona, has much fewer requirements for comprehensive planning, with less required topics, and no regular plan updates or vote by residents. The New Mexico statutes date back to 1976, and enable the development of comprehensive plans, referred to as master plans, as was more common at the time (New Mexico Statutes 3-19-9 Master plan; purposes., 1970). The statutes offer broad suggestions for plan element coverage, lack requirements for public participation and planning elements, and do not mandate plan update timeframes (New Mexico Statutes 3-19-9 Master plan; purposes., 1970).

Methods

Sample Selection

We chose six cities (Table C1), paired in Arizona and New Mexico, based on comparable population size. Each case study city serves as its respective county seat and is the largest municipality in its metropolitan region. We chose the two-state pairing to explore potential the impacts of different state mandates on the mainstreaming of climate action in comprehensive plans, as Arizona has strong state mandates and New Mexico does not. The pairs are also geographically diverse to explore potential differences in climate adaptation policies. Based on geography, all of the cities are projected to be impacted by increasing climate risks for flooding, drought, and heat. While all the cities could also be indirectly impacted by wildfire, through reduced air quality and increased post-fire flooding and debris flows, the direct risk from wildfire is highest in the higher elevation and more forested cities, Flagstaff and Santa Fe. We

intentionally excluded the metropolitan Phoenix region and its cities from the case study pairs as there is no comparable metropolitan region in New Mexico.

Table C1. Comparative Case Study Cities

Pair	City and State	City Population (2010 Census)	Geography	Adoption Year of Plan	
				Past Generation	Current Generation
A	Tucson, AZ	520,116	Desert, valley	2001	2013
	Albuquerque, NM	545,852	Desert, valley	2002*	2016
B	Yuma, AZ	90,660	Desert, river	2002	2012
	Las Cruces, NM	97, 618	Desert, river	1999	2013**
C	Flagstaff, AZ	65,870	Mountain, forest	2001	2015
	Santa Fe, NM	67,947	Mountain, forest	1999	-***

* Section update to comprehensive plan adopted in 1988
** Administrative update to comprehensive plan adopted in 1999
*** No comprehensive plan update.

Plan Quality Evaluation Protocol

We chose two generations of comprehensive plans in the six case study communities to analyze for mainstreaming of climate action, through plan quality evolution, the "process by which plan content analysis data is linked to normative criteria of what constitutes a better plan" (Lyles & Stevens, 2014). The past generation of plans from each city provides a baseline for comparison against the current generation of plans to see change over time in climate action planning. These two generations of plans (Table C1) are divided into the early 2000s era of plans, and the latest adopted plans, in the mid-2010s. The current Las Cruces plan, adopted in 2013, was an administrative update of their previous plan and not a full update. Santa Fe has not yet adopted a new plan, so its current plan is the one adopted in 1999. A research assistant

obtained all plans from municipal websites, except Yuma's past plan, which was obtained electronically from planning staff.

The plan quality evaluation protocol followed established methodology, where indicators within the following four categories are used to evaluate plans, including fact base, goals, policies, and implementation (Berke & French, 1994; Berke & Godschalk, 2009; Lyles & Stevens, 2014). We followed best practices from Lyles & Stevens (2014), whose study assessed the methods used in plan quality evaluations of plans from 1994-2012.

We adapted plan quality evaluation indicators from the Baynham & Stevens (2013) evaluation of climate change policies in British Columbia municipality long-range plans; they, in turn, had drawn indicators from the Tang et al. (2010) plan quality evaluation study. We used an iterative grounded theory analyses approach (Robert, 2012) to make revisions to the Baynham & Stevens (2013) indicators, based on the difference in governance structures and to make the climate adaptation indicators more appropriate for the study area climate. We made revisions and clarifications in the descriptions of scoring criteria related to governance to make them more appropriate for the legislative context of municipalities in the U.S. We also contextualized the climate adaptation indicators for the relevant climate risks of the study area, which included a review of relevant hazard mitigation plans, the National Climate Assessment regional projections, and the NOAA (U.S. National Oceanic and Atmospheric Administration) Storm Event Database for past climate events (Garfin et al., 2014; "NOAA Storm Events Database," n.d.; Robert, 2012). After the grounded theory analysis, we removed several indicators the literature had shown not relevant to the climate context of the study, such as adaptation policies

for sea-level rise, and added several new indicators, such as adaptation policies for heat, non-sea level related urban flooding, and wildfires.

This process resulted in a total of seventy-two plan quality evaluation indicators (Appendix C1), all with descriptions for coding as used in this study and for replicability in future studies. As applicable, indicators are listed as mitigation, adaptation, or both mitigation and adaptation, drawn from Baynham & Stevens (2013). As recommended by Krippendorff (2012), we wrote the descriptions of the seventy-two plan quality evaluation indicators for mutually exclusive scoring options, so that all indicators would be scored either "Yes" (1) present or "No" (0) absent. Indicators for the Fact Base, Goals, and Implementation categories are all independent indicators. Indicators under the Policies category are set up in groups of three, including 1) policy is included, 2) policy is climate acknowledged, and 3) mandatory language is used. This follows the convention set by Baynham & Stevens (2013) to determine if a policy is present, whether it is also mandatory or not, and whether there is climate acknowledgment or not (Baynham & Stevens, 2013).

We trained two research assistants in how to conduct plan quality evaluation and reviewed all scoring criteria together, to clarify indicator descriptions and all related terms and concepts, by recognized best practices (Lyles & Stevens, 2014). We conducted a pre-test plan quality evaluation of the plan of a city in the Southwest, not part of this case study, to ensure consistency and familiarity with the protocol (Lyles & Stevens, 2014). None of the evaluation criteria were changed based on the pre-test results, which exceeded the 80% agreement threshold convention, with an intercoder agreement of 93.1%; however, we further clarified and refined plan evaluation criteria descriptions to improve coding agreement (Krippendorff, 2012; Miles &

Huberman, 1994). The two research assistants and first author then independently coded the plans and documented policy reference numbers and page locations (Lyles & Stevens, 2014). Throughout the coding process, we met, discussed, and resolved any discrepancies in the coding results, resulting in a final agreed upon master set of codes for analysis (Lyles & Stevens, 2014). At no time were any discrepancies in coding agreement, before the discussion, below the 80% agreement convention (Krippendorff, 2012; Miles & Huberman, 1994).

We then compiled all indicator scores for the plans in a single codebook for analysis. We analyzed the results of the plan quality evaluation both qualitatively and with descriptive statistics by sorting the indicator scores by plan (a) individually, (b) groups from past to current generation, (c) an Arizona group and New Mexico group, and (d) based on the pairing of cities across both states. We collected additional quantitative data from the plans to provide further insight for trends that emerged through the analysis, including word frequency and usage through keyword searches for words, phrases, and concepts. We also recorded how climate data is used in the plans and what information sources were cited. Climate adaptation policies were also compared to the projected climate impacts for the region from the 3rd National Climate Assessment to assess how the cities are planning for relevant climate change impacts.

Finally, results from the plan quality evaluation were compared with the results of interviews of thirty-two planners within the same case study cities, conducted from 2016-2017, on addressing climate risks in their communities (Keith & Iuliano, in prep.).

Findings

We first present results from the plan quality evaluation related to the influence of state mandates on comprehensive plans. We then present findings related to the mainstreaming of

climate action planning and determination of which climate risks are addressed in the comprehensive plans. Finally, we present the findings related to the source and use of climate information and the changing nature of comprehensive plans related to the strength of mandates.

Influence of State Mandates

The frequency and completeness of updates of the comprehensive plans in Arizona and New Mexico are consistent with established planning literature, regarding the strength and influence of state mandates on plan quality (Berke & French, 1994; Lyles & Stevens, 2014; Nelson & French, 2002). All three case studies in Arizona had both past generation and fully updated current generation plans, as by state requirement (Arizona Revised Statutes. 9-461.05 General plans; authority; scope, n.d.). The three cases in New Mexico were much less consistent in update frequency in both generations of plans, which corresponds to findings in the literature and which was anticipated, given the lack of state requirements for update frequency requirements (Berke et al., 1996; New Mexico Statutes 3-19-9 Master plan; purposes., 1970).

During interviews with planners in the same case study cities in both Arizona and New Mexico, new state or national mandates were listed as the second biggest catalyst for addressing climate risks in their communities, behind only the occurrence of a major climate event (Keith & Iuliano, in prep.). Interviewees also cited the lack of state mandates specifically to plan for climate risk as a hindrance in pursuing climate action planning; state policies provide justification for climate planning in communities where the topic is less politically acceptable (Keith & Iuliano, in prep.).

Mainstreaming of Climate Action Planning

The plan quality evaluation of the past and current generations of plans provided evidence that many climate action planning policies have been mainstreamed into the comprehensive plans, although the majority of those same policies do not acknowledge climate change. From past to current generation, the indicator scores increased across the case studies (Table C2), in all but one category. Indicator mean scores for all plans, from past to current generation, increased for Fact Base indicators from 18.6% to 42.2%, Goal indicators from 13% to 60%, Policy indicators from 77.5% to 90.6%, policies explicitly connected to climate change from 0% to 24.7%, and Implementation indicators from 31.3% to 71.4%. The only category that decreased was policies that included mandatory language, from 39.2% to 22.4%.

Table C2. Summary of Plan Quality Evaluation Results

	# of Indicators	**Past Generation**			**Current Generation**		
		Mean Score (%)	**Highest Score (%)**	**Lowest Score (%)**	**Mean Score (%)**	**Highest Score (%)**	**Lowest Score (%)**
Fact Base	9	1.7 (18.6%)	3 (33.3%)	0 (0%)	3.8 (42.2%)	8 (88.9%)	0 (0%)
Goals	4	0.5 (13%)	1 (25%)	0 (0%)	2.4 (60%)	4 (100%)	1 (25%)
Policy	17	13.2 (77.5%)	15 (88.2%)	12 (70.6%)	15.4 (90.6%)	17 (100%)	15 (88.2%)
Policy – Climate Acknowledged	17	0 (0%)	0 (0%)	0 (0%)	4.2 (24.7%)	8 (47.1%)	0 (0%)
Policy – Mandatory	17	6.67 (39.2%)	14 (82.4%)	0 (0%)	3.8 (22.4%)	15 (88.2%)	0 (0%)
Implementation	8	2.5 (31.3%)	4 (50%)	1 (0.1%)	5 (71.4%)	7 (87.5%)	2 (50%)

Increase in score from past to current generation is represented with dark gray shading, no change in score from past to current generation is represented with light gray shading, and decrease from past to current generation is represented with no shading.

Almost all of the current generation plans included more mitigation and adaptation policies (Table C3). This finding is consistent with findings in the literature on the

mainstreaming of climate action planning, due to consideration of GHG mitigation entering the planning profession earlier and climate adaptation later (Bedsworth & Hanak, 2010; Bulkeley, 2010; Nordgren et al., 2016). For mitigation indicators, Tucson increased from 6 to 17 and Yuma increased from 16 to 18. Both Flagstaff and Las Cruces scored the same for mitigation indicators at 11 and 12, respectively. Only Albuquerque declined from 17 to 16. More substantial increases were seen in the number of adaptation policies, with almost all cities showing an increase in indicator scores. Tucson increased from 8 to 21, Albuquerque from 14 to 24, Yuma from 17 to 20, and Flagstaff from 11 to 21, and Las Cruces remained at the same number with 11. Some indicators refer to both mitigation and adaptation policies and are double counted.

Table C3. Mitigation and Adaptation Indicator Comparison

Community	**Past Generation**		**Current Generation**	
	Mitigation Indicators (32)	**Adaptation Indicators (42)**	**Mitigation Indicators (32)**	**Adaptation Indicators (42)**
Tucson, AZ	6	8	17	21
Albuquerque, NM	17	14	16	24
Yuma, AZ	16	17	18	20
Las Cruces, NM	12	11	12	11
Flagstaff, AZ	11	11	11	21
Santa Fe, NM*	11	11	11	11

Increase in score from past to current generation is represented with dark gray shading, no change in score from past to current generation is represented with light gray shading, and decrease from past to current generation is represented with no shading. Some indicators fall into both mitigation and adaptation categories and are counted as both in this table.
*Note: Santa Fe's current generation plan is the same as their past generation plan.

Policies with an explicit acknowledgment of climate change (Table C4) increased noticeably from the past to the current generation of plans. This is mirrored in a keyword search of the term "climate change" which resulted in only one instance in all of the past generation of plans analyzed, in Santa Fe's plan. While Santa Fe did not have a plan update, the other cities

went from no occurrence of the term "climate change" in the past generation of plans to 20 occurrences in Tucson's current plan, 37 in Albuquerque's, and 21 in Flagstaff's.

The combination of indicator scores for policies, and explicit climate acknowledgment, provides insight into which topics planners in the case study cities have linked to climate change. This is important for policies related to GHG mitigation, because it may indicate if cities have made the connection between their local planning actions and reducing emissions. For GHG mitigation policies, Tucson, Albuquerque, and Flagstaff linked *Energy* to climate change. Somewhat surprisingly, *Transportation*, which plays a large part in GHG emissions, was not linked to climate change by any of the case study cities. *Efficient Land Use*, also key in reducing GHG emissions, was addressed in all current plans but only acknowledged as a climate change connection in Albuquerque's current plan.

Climate Risks and Climate Adaptation Policies

Overall, all of the current comprehensive plans (Table C4) scored higher for addressing their anticipated climate risks in policy topic coverage and scored higher in acknowledging links to climate change. The explicit acknowledgment of climate change within climate adaptation policies could be important, because it can indicate an awareness of increased risk factors due to climate change (Baynham & Stevens, 2013). A counter-argument is that climate adaptation policies may be included, while intentionally not acknowledging climate change due to lack of public support or leadership on the issue.

Table C4. Indicator Scores for Policies, Climate Acknowledgement, and Mandatory Language

	Past Generation						Current Generation					
Policy Indicators	**Tucson, AZ**	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM**	**Tucson, AZ**	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM***
Communication							C				C	
Efficient Land Use								C				
Energy							C	C			C	
Financial Tools												
Food and Agriculture												
Hazard Reduction – Built Environment								C			C	
Hazard Reduction – Land Use								C			C	
Hazard Reduction – Heat							C					
Hazard Reduction - Flooding								C				
Hazard Reduction - Fires												
Hazard Reduction - Drought							C	C				
Resource Management							C					
Transportation												
Waste												
Water							C	C			C	
Vulnerability							C				C	
Public Health												

Light graded shaded cells indicate the topic was addressed, dark gray shaded cells indicated the topic was addressed and used mandatory language. “C” indicates climate acknowledgment.
*Note: Santa Fe’s current generation plan is the same as their past generation plan.

The *Water Resource Availability* indicators were present in the past generation of plans and were linked explicitly to climate change in at least three of the current plans (Table C4). The *Reduction of Hazards in the Built Environment*, *Reduction of Hazards in Land Use*, *Hazard Reduction of Flooding* and *Hazard Reduction of Drought* indicators also scored topic coverage in all past and current plans, but were each explicitly connected to climate change in only two of the current generation of plans. This is an interesting result, considering the projected impact of climate change on both flooding and drought (Garfin et al., 2014). The focus on droughts and flood risks in the current plans is consistent with interviews results of planners in the same six cities, where drought and flood were the most frequently discussed climate risks (Keith & Iuliano, in prep.).

The *Hazard Reduction of Heat* indicator was the only climate adaptation indicator in none of the previous plans that appeared in the current generation of plans. The indicator was scored for Tucson's, Albuquerque's and Yuma's plans. Only Tucson explicitly connected the *Hazard Reduction of Heat* to climate change. The emergence of heat as a topic in the current generation of plans is significant as the impacts of heat are projected to increase in the Southwest (Garfin et al., 2014). The recent emergence of heat as a planning topic was also reflected in the interviews of planners, where participants in all cities except for Flagstaff indicated heat was a serious concern, but was also discussed in much less detail than more explicit risks like drought and flood (Keith & Iuliano, in prep.). A recent survey of climate adaptation resources found that only 4% included information on extreme heat, the climate impact reported with the least available resources (Nordgren et al., 2016).

The current Flagstaff plan scored for the *Hazard Reduction – Fires* indicator, as anticipated, but there was no acknowledgment of connection to climate change. The long-range planning for wildfire was consistent with interview results of planners in Flagstaff, who cited it as the top climate risk for the city (Keith & Iuliano, in prep.). While current planners in Santa Fe also expressed concern over wildfire during the interviews, the past Santa Fe plan did not score for wildfire, which may indicate a growing awareness of the threat of wildfires overall in the community since the last plan (Keith & Iuliano, in prep.). Considering Flagstaff experienced a major wildfire event, the Schultz Fire in 2010, between the two generations of plans, this would be consistent with planning innovation theory, where a major event acts as a catalyst for policy innovation (Berry & Berry, 1999; Keith & Iuliano, in prep.)

All current plans received a score for the *Public Health* indicator, but none explicitly connected it to climate change. All current plans also scored for *Food and Agriculture*, although with no climate acknowledgment. Encouragingly though, the *Vulnerability* indicator scores also increased from past generation (2 plans) to the current generation (4 plans), with both Tucson and Flagstaff connecting the vulnerability topic to climate change.

Source and Use of Climate Information

The inclusion of climate information in the plans' Fact Base category increased from the past to the current generation of comprehensive plans. Out of the four plans that had complete plan updates, Tucson, Albuquerque, Yuma and Flagstaff, all but Yuma had an increase in climate information used and referenced in the plan fact base (Table C5). Tucson and Albuquerque both had the greatest number of indicators, scoring 7 out of 13 possible and 12 out of 13 possible, respectively. Both current plans in these cities directly addressed climate change as

anthropogenic, as a community issue, addressed GHG emissions, and discussed impacts of climate change. Flagstaff scored the next highest, with 6 out of 13 possible, addressing climate change as an issue and addressing impacts from climate change. Yuma's plan was an outlier, addressing vulnerability generally, but not anthropogenic climate change in the Fact Base.

While the Fact Base category indicators scored higher in the current generation of plans, a qualitative review of plans revealed multiple sources of information cited and used in the plans Tucson referenced the most climate information resources, including the 3rd National Climate Assessment (2014), the Assessment of Climate Change in the Southwest United States (2013), and a report on the effects of global change and welfare by the U.S. Climate Change Science Program (2008). Albuquerque referred to a Bureau of Reclamation regional water management report (2011), the *West-Wide Climate Risk Assessment*. Yuma referred to a State of Arizona Climate Change Action Plan (Arizona Climate Change Advisory Group, 2006) and Flagstaff referred to the Intergovernmental Panel on Climate Change (2007).

In all cases, the plans cited climate information references only to strengthen general facts about climate change, such as its existence, or global trends like temperature increases. None of the current generation of plans contained information on national or regional climate projections, and, therefore, no fact base included the magnitude of temperature or precipitation projections or timeframes of changes that could impact local adaptation efforts. The climate information sources were all either federal agency reports or federally funded, except for Flagstaff plan's reference to the IPCC and Yuma's reference to the state plan. The use of climate information produced by the federal government in these local planning efforts suggests that federally produced climate change information is considered to be credible (Cash et al., 2002).

Table C5. Indicator Scores for Fact Base and Goals

	Past Generation						Current Generation					
	Tucson, AZ	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM**	**Tucson, AZ**	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM***
Fact Base												
Climate Change Anthropogenic												
Climate Change as Issue												
Emissions Inventory – General												
Emissions Inventory – Specific												
Emissions Trend Forecast - General												
Impacts of Climate Change – General												
Impacts of Climate Change – Specific												
Vulnerability Assessment – General												
Vulnerability Assessment - Specific												
Goals												
Adaptation – General												
Adaptation – Specific												
Mitigation – General												
Mitigation - Specific												

Light graded shaded cells indicate the topic was addressed, dark gray shaded cells indicated the topic was addressed and used mandatory language.
*Note: Santa Fe's current generation plan is the same as their past generation plan.

The difference in climate information use from other more traditionally familiar data sources in the planning profession is important, as it may represent an information gap between

climate information useful to local planning efforts, lack of familiarity with credible sources of climate information, or the usability of climate information in documents like comprehensive plans. This is consistent with the literature, with planners citing the lack of information on translating climate impacts into policies, plans, and ordinances as the top challenge in addressing climate change (Nordgren et al., 2016). Past studies on the use of climate information by planners showed a low understanding of climate science and its relationship to the city by the profession as a whole (Eliasson, 2000). Interestingly, in interviews with the planners from the same cities, lack of information was not cited as a top barrier to climate adaptation as they instead focused on the need for translating and messaging available climate information (Keith & Iuliano, in prep.).

Changing Nature of Comprehensive Plans

Another change in the comprehensive plans was an increase in implementation indicators across all cases examined (Table C6). Measurable objectives, in particular, increased from not being present in any of the past plans to be present in almost all current plans. The implementation of plans to ensure they impact cities has been a focus of planning researchers and practitioners over the last few decades, so the results from these case studies indicate that the education efforts on the importance of implementation may be achieving their desired results (Berke & Godschalk, 2009; Brody, 2003). Findings were consistent with previous studies such as Lyles et al. (2014) which showed that comprehensive plans often fail to identify cost estimates for implementation; only the current Tucson plan achieved an indicator score for addressing costs. In the previous generation of plans, only one of the case study cities referenced a separate mitigation plan and none referenced any adaptation plans. In the current generation, four cities

referenced separate mitigation plans and two referenced adaptation plans. Again, the larger number of separate mitigation plans (4) to adaptation plans (2), is consistent with findings from the literature that point to adaptation being the newer topic in the planning profession (Nordgren et al., 2016).

A shift from more traditional text-based regulatory-style plans, to visionary and visually communicative plans, was an unexpected finding during the plan quality evaluation. The shift to visionary and visually communicative plans also coincided with less use of mandatory policy language. This was true of all the case study cities except Yuma, AZ, which lacked attention to visuals and plan layout, and Sante Fe, which had no new plan. The mean score of policies that used mandatory language (Table C6), out of 17 possible mandatory policy indicators, declined from 6.7 to 3.8 (Table C2). Yuma, AZ was also the outlier in this case, and had an increase of one mandatory policy indicator.

The change in the nature and focus of comprehensive plans from generation to generation supports the argument made by Connell and Daoust-Filiatrault (2017), that in addition to evaluating the plan quality of goals, fact bases, policies, and implementation, plan quality evaluation should also consider communicative aspects of the plans such as policy focus and discourse. Comprehensive plans are designed to be dynamic, with regular updates, so as they evolve with the needs of cities and the planning profession, research should adjust accordingly. Addressing the documented lack of research on changes over time may reveal how and why plans are changing (Lyles & Stevens, 2014). Future research could explore more of these changes in communicative aspects in multiple generations of comprehensive plans across a greater number of cases, in a wider geographic area.

Table C6. Implementation Indicator Scores

	Past Generation						Current Generation					
	Tucson, AZ	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM**	**Tucson, AZ**	**Albuquerque, NM**	**Yuma, AZ**	**Las Cruces, NM**	**Flagstaff, AZ**	**Santa Fe, NM**
Cost Estimates - General												-
Inter-Organization Coordination – Specific												-
Measurable Objectives												-
Monitoring – General												-
Priorities – General												-
Related Adaptation Plan												-
Related Mitigation Plan												-
Roles and Responsibilities - General												-

Light graded shaded cells indicate the topic was addressed and no mandatory language was used in the implementation indicator scores.

Implications for Practice and Scholarship

The two primary questions we explored in this study were 1) How are cities in Southwest mainstreaming climate action planning into comprehensive plans? and 2) To what extent are cities in the Southwest addressing climate risks in comprehensive plans? While the results of this study are only applicable to the specific cases analyzed, there are several relevant findings and recommendations for planning practitioners and scholars.

The results of this study show that many policies in climate action planning are being mainstreamed in comprehensive plans, but that these policies often do not explicitly acknowledge climate change. Consistent with the literature, GHG mitigation policies were adopted in the 2000s-era plans with climate adaptation policies only emerging in the most recent mid-2010s era plans (Berke & Stevens, 2016; Nordgren et al., 2016). Many of the GHG mitigation policies do not acknowledge a link to climate change, meaning they might be pursued for other reasons, or there is no benefit in explicitly connecting them to climate change. For example, several current plans explicitly connect the reduction of municipal energy use with climate mitigation, whereas in most cases efficient land use and transportation was not explicitly connected to climate mitigation.

While the current comprehensive plans have policies that address the climate risks anticipated for their respective cities, the acknowledgment of climate change within those policies is again mixed. All current plans examined in Arizona and New Mexico have policies that address drought and flood risks, although only a few plans acknowledged the connection between these risks and climate change. Wildfire was addressed in both Flagstaff and Albuquerque's current plans, although it was not connected to climate change in either plan. An

emergent topic in three of the current plans was the mitigation of heat; only Tucson acknowledged a connection between heat risk and climate change. Importantly, the climate information used within the Fact Base of all the plans was only used to strengthen arguments that climate change is occurring, or referencing general trends like global warming. None of the plans that we reviewed included either regional climate information or climate projections; this suggests that local climate impacts may not be fully understood, may not be adequately explained to the public through the plans, and that the respective climate adaptation actions may not be prioritized accordingly.

While the role of state mandates on plan quality has been established in the planning literature by Berke and French (1994), among others, this paper contributes to the literature by demonstrating that state mandates also matter in the context of climate action planning. Based on the results of this study, and consistent with the literature, we recommend that states strengthen comprehensive planning mandates. Arizona cities registered higher plan scores than cities in New Mexico; this coincides with stronger state mandates in Arizona, which require frequent updates, more topic coverage, and public participation. Evidence from interviews (Keith & Iuliano, 2019) backs up our surmise about the impact of state mandates on the quality of comprehensive plans. Since climate action planning has emerged more recently in the history of the planning profession, we recommend that states update their comprehensive planning mandates with climate action planning requirements to reflect the important role of cities in climate mitigation and adaptation efforts.

We also recommend that the planning profession strive to include at least basic climate information and projections in the Fact Base of comprehensive plans, as routinely as the

profession includes demographic and economic trends. Without this information, the plans do not adequately provide the decision-makers who use the plans the background information required for the prioritization of climate mitigation and climate adaptation policies. Place-specific climate projections, from the same dataset used in the 4th National Climate Assessment, are available for every county in the U.S. as well as for many cities (USGCRP, 2018).

Finally, we recommend that researchers interested in climate action planning consider more nuanced approaches to the mainstreaming of climate in existing plans and processes. As demonstrated by the results of this study, climate action planning policies can be mainstreamed without explicitly referring to climate change. This makes it difficult to discern that mainstreaming of climate action planning is taking place if explicit climate acknowledgment is the focus of the research. A more nuanced research approach necessary to understand climate action planning, as some planners may not explicitly connect policies to climate change in favor of planning rationales more in line with their community's values.

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The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix C1. Plan Quality Evaluation Indicators

Fact Base	Description for Coding	Policy Type	Source
Climate Change Anthropogenic	If climate change is acknowledged as at least partially anthropogenic and/or the plan speaks specifically to the kinds of human activities that cause climate change	Mitigation	(Baynham & Stevens, 2013)
Climate Change as an issue	If climate change is framed as an issue facing the local or global community	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Emissions Inventory – General	If there has been or will be an emissions inventory conducted	Mitigation	(Baynham & Stevens, 2013)
Emissions Inventory – Specific	If the results of the inventory is broken down by sector and/or current per capita emissions are provided	Mitigation	(Baynham & Stevens, 2013)
Emissions Trend Forecast – General	If the plan mentions an emissions forecast has been or will be conducted (business as usual OR for emission reductions)	Mitigation	(Baynham & Stevens, 2013)
Impacts of Climate Change – General	If the plan states there will be impacts of global climate change or names broad areas where impacts might be expected (e.g. Sea level rise, increasing temperatures, increased storms)	Adaptation	(Baynham & Stevens, 2013)
Impacts of Climate Change – Specific	If the plan identifies the expected impacts specific to the municipality.	Adaptation	(Baynham & Stevens, 2013)
Vulnerability Assessment – General	If the plan mentions certain geographic areas, demographic populations or industries that will be disproportionately affected and/or has or will complete a vulnerability assessment as part of an adaptation / climate change plan	Adaptation	(Baynham & Stevens, 2013)
Vulnerability Assessment – Specific	If the plan gives more detail on 1 or more key vulnerability indicators and how it will affect the vulnerability of the population (e.g. Access to resources, wealth, inequality within a population, degree of communal resource allocation, degree of risk sharing, income diversification, institutional context)	Adaptation	(Baynham & Stevens, 2013)
Goals	**Description for Coding**	**Policy Type**	**Source**
Adaptation – General	If the plan has broad goals related to adaptation or reducing vulnerability to climate change	Adaptation	(Baynham & Stevens, 2013)

Adaptation - Specific	If the plan has specific goals related to adaptation or reducing vulnerability to climate change (e.g.. reducing development in hazard areas)	Adaptation	(Baynham & Stevens, 2013)
Mitigation – General	If the plan has broad goals related to mitigation to climate change (e.g. reduce GHG emissions)	Adaptation	Grounded Theory
Mitigation – Specific	If the plan has specific goals related to mitigation to climate change (e.g. reduce GHG emissions)	Adaptation	Grounded Theory
Policies	**Description for Coding**	**Policy Type**	**Source**
Communication	If the plan includes at least 1 policy for public communication, behavior change, education or participation on climate issues	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Communication - Climate Acknowledged	If the plan includes at least 1 policy for public communication, behavior change, education or participation on climate issues with the connection to climate change made explicit.	Mitigation / Adaptation	Added for consistency in coding
Communication - Mandatory	If at least 1 communication policy is written in mandatory language (“will”, “shall”, “require”)	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Efficient Land Use	If the plan includes at least 1 policy for efficient/ compact land use (e.g. mixed use/compact development, infill, brownfield development, control of urban service/growth boundaries)	Mitigation	(Baynham & Stevens, 2013)
Efficient Land Use - Climate Acknowledged	If the connection between efficient land use and climate change, energy use or GHG emissions is made explicit.	Mitigation	(Baynham & Stevens, 2013)
Efficient Land Use - Mandatory	If at least 1 land use policy is written in mandatory language (“will”, “shall”, “require”)	Mitigation	(Baynham & Stevens, 2013)
Energy	If the plan includes at least 1 policy for energy reduction strategies (e.g. renewable or solar energy, energy efficiency or energy star, green building, energy efficiency standards, or urban heat island mitigation)	Mitigation	(Baynham & Stevens, 2013) Added UHI
Energy - Climate Acknowledged	If the connection between energy and climate change or GHG emissions is made explicit.	Mitigation	(Baynham & Stevens, 2013)

Energy - Mandatory	If at least 1 energy policy is written in mandatory language ("will", "shall", "require")	Mitigation	(Baynham & Stevens, 2013)
Financial Tools	If the plan includes at least 1 policy for financial mechanisms to incentivize action or collect revenue for capital projects (e.g. GHG reduction fee, carbon/gas tax, development cost charges, offsets or funding for GHG reduction projects)	Mitigation	(Baynham & Stevens, 2013)
Financial Tools - Climate Acknowledged	If the connection between financial tools and climate change or GHG emissions is made explicit.	Mitigation	Added for consistency in coding
Financial Tools - Mandatory	If at least 1 financial policy is written in mandatory language ("will", "shall", "require")	Mitigation	(Baynham & Stevens, 2013)
Food / Agriculture	If the plan includes at least 1 policy for food security or agriculture (e.g. conservation of agricultural lands, support programs for farmers, support for organic farming, CSAs, community gardens or farmers' markets)	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Food / Agriculture - Climate Acknowledged	If the connection between agriculture and climate change, energy or GHG emissions is made explicit.	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Food / Agriculture - Mandatory	If at least 1 food policy is written in mandatory language ("will", "shall", "require")	Mitigation/ Adaptation	(Baynham & Stevens, 2013)
Hazard Reduction - Built Environment	If the plan includes at least 1 policy for hazard reduction through the built environment (e.g. hazard-resistant building code, low-impact design for impervious surfaces, green building/green infrastructure, retrofitting existing infrastructure, FEMA)	Adaptation	(Baynham & Stevens, 2013) Added reference to FEMA
Hazard Reduction - Built Environment - Climate Acknowledged	If the connection between hazards and climate change, energy or GHG emissions is made explicit.	Adaptation	(Baynham & Stevens, 2013)
Hazard Reduction - Built	If at least 1 built environment policy is written in mandatory language ("will", "shall", "require")	Adaptation	(Baynham & Stevens, 2013)

Environment - Mandatory			
Hazard Reduction - Land Use	If the plan includes at least 1 policy for hazard reduction through land use planning (e.g. location of development to reduce risk, alternative uses for hazard-prone areas, land acquisition strategies)	Adaptation	(Baynham & Stevens, 2013)
Hazard Reduction - Land Use - Climate Acknowledged	If the connection between hazards and climate change, energy or GHG emissions is made explicit.	Adaptation	(Baynham & Stevens, 2013)
Hazard Reduction - Land Use - Mandatory	If at least 1 land use policy is written in mandatory language (“will”, “shall”, “require”)	Adaptation	(Baynham & Stevens, 2013)
Hazard Reduction - Heat	If the plan includes at least 1 policy for hazard reduction through land use planning (e.g. urban heat island mitigation, increasing tree canopy, green infrastructure, etc.)	Adaptation	Grounded Theory
Hazard Reduction - Heat - Climate Acknowledged	If the connection between hazards and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory
Hazard Reduction - Heat - Mandatory	If at least 1 policy is written in mandatory language (“will”, “shall”, “require”)	Adaptation	Grounded Theory
Hazard Reduction - Flooding	If the plan includes at least 1 policy for hazard reduction through land use planning (e.g. stormwater mitigation strategies, low impact development techniques, etc.)	Adaptation	Grounded Theory
Hazard Reduction - Flooding - Climate Acknowledged	If the connection between hazards and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory
Hazard Reduction - Flooding - Mandatory	If at least 1 policy is written in mandatory language (“will”, “shall”, “require”)	Adaptation	Grounded Theory
Hazard Reduction - Fires	If the plan includes at least 1 policy for hazard reduction through land use planning	Adaptation	Grounded Theory

	(e.g. defensible space policies, FireWise building code, etc.)		
Hazard Reduction - Fires - Climate Acknowledged	If the connection between hazards and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory
Hazard Reduction - Fires - Mandatory	If at least 1 policy is written in mandatory language (“will”, “shall”, “require”)	Adaptation	Grounded Theory
Resource Management	If the plan includes at least 1 policy for resource management (e.g. creation of conservation zones/protected areas, watershed- or ecosystem-based land management, vegetation protection, drought protection)	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Resource Management - Climate Acknowledged	If the connection between resource management and climate change, energy or GHG emissions is made explicit.	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Resource Management - Mandatory	If at least 1 resource management policy is written in mandatory language (“will”, “shall”, “require”)	Mitigation / Adaptation	(Baynham & Stevens, 2013)
Resource Management - Drought Preparedness	If the plan includes at least 1 policy for drought preparedness (e.g. xeriscaping, smart growth strategies, infrastructure maintenance / upgrades, etc.)	Adaptation	Grounded Theory
Resource Management - Drought Preparedness - Climate Acknowledged	If the connection between drought preparedness and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory
Resource Management - Drought Preparedness - Mandatory	If at least 1 drought preparedness policy is written in mandatory language (“will”, “shall”, “require”)	Adaptation	Grounded Theory
Transportation	If the plan includes at least 1 policy for transportation (e.g. alternative transportation strategies, transit-oriented development, parking standards adjustment)	Adaptation	(Baynham & Stevens, 2013)

Transportation - Climate Acknowledged	If the connection between transportation and climate change, energy or GHG emissions is made explicit.	Adaptation	(Baynham & Stevens, 2013)
Transportation - Mandatory	If at least 1 transportation policy is written in mandatory language ("will", "shall", "require")	Adaptation	(Baynham & Stevens, 2013)
Waste	If the plan includes at least 1 policy for waste reduction strategies (e.g. zero waste targets, strategies to increase recycling or composting, waste management)	Adaptation	(Baynham & Stevens, 2013)
Waste - Climate Acknowledged	If the connection between waste and climate change, energy or GHG emissions is made explicit.	Adaptation	(Baynham & Stevens, 2013)
Waste - Mandatory	If at least 1 waste reduction policy is written in mandatory language ("will", "shall", "require")	Adaptation	(Baynham & Stevens, 2013)
Water	If the plan includes at least 1 policy for water supply/demand or conservation strategies (e.g. water metering, greywater reuse, water restrictions, stormwater management, water availability, drought plan, etc.)	Adaptation	(Baynham & Stevens, 2013) Added drought plan
Water - Climate Acknowledged	If the connection between water and climate change, energy or GHG emissions is made explicit.	Adaptation	(Baynham & Stevens, 2013)
Water - Mandatory	If at least 1 water policy is written in mandatory language ("will", "shall", "require")	Adaptation	(Baynham & Stevens, 2013)
Vulnerability	If the plan includes at least 1 policy for resiliency and vulnerability planning	Adaptation	Grounded Theory
Vulnerability - Climate Acknowledged	If the connection between vulnerability and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory
Vulnerability - Mandatory	If at least 1 vulnerability policy is written in mandatory language ("will", "shall", "require")	Adaptation	Grounded Theory
Public Health	If the plan includes at least 1 policy for the public health risk related to climate change (e.g. vector borne diseases, respiratory issues such as dust and pollution, etc.)	Adaptation	Grounded Theory
Public Health - Climate Acknowledged	If the connection between public health risk and climate change, energy or GHG emissions is made explicit.	Adaptation	Grounded Theory

Public Health - Mandatory	If at least 1 public health policy is written in mandatory language ("will", "shall", "require")	Adaptation	Grounded Theory
Implementation	**Description for Coding**	**Policy Type**	**Source**
Cost Estimates	If general cost estimates for GHG emission reductions and/or some financial or budget commitment is made	-	(Baynham & Stevens, 2013)
Inter-Organizational Coordination	If 3 or more climate related policies/actions have reference to inter-organizational or inter-governmental coordination OR if a few actions have detailed coordination procedures including timelines	-	(Baynham & Stevens, 2013)
Measurable Objectives	Is there at least 1 measurable objective (other than GHG emission reductions) related to climate change (e.g. urban heat island reduction, decrease in runoff volumes, flash flood reduction)	-	(Baynham & Stevens, 2013) Added UHI, flash floods, runoff volumes
Monitoring	If 1-2 actions have timelines and actions for monitoring OR monitoring is referred to but in general terms	-	(Baynham & Stevens, 2013)
Priorities	If 1-2 actions are prioritized for action	-	(Baynham & Stevens, 2013)
Related Adaptation Plan	If the comprehensive plan makes reference to an adaptation plan that has been or will be developed by the community	Adaptation	(Baynham & Stevens, 2013) Revised for legislative context
Related Mitigation Plan	If the comprehensive plan makes reference to a mitigation, climate action, or energy plan that has been or will be developed by the community	Mitigation	(Baynham & Stevens, 2013) Revised for legislative context
Roles and Responsibilities	If 1-2 actions have departments, individual or other parties responsible for implementation assigned	-	(Baynham & Stevens, 2013)