NSF SUSTAINABLE URBAN SYSTEMS (SUS) CONFERENCE

2019 CURES CONNECTIONS WORKSHOP

REPORT

NEW VOICES AND PATHS TO URBAN SUSTAINABILITY

AUGUST 7-8, 2019
CENTER FOR URBAN RESILIENCY AND ENVIRONMENTAL SUSTAINABILITY (CURES)
DISCOVERY PARTNERS INSTITUTE, CHICAGO, IL

UNIVERSITY OF ILLINOIS SYSTEM

Report on the workshop: A Proposed Workshop on Interdisciplinary Sustainable Solutions for Urban Systems in a Changing Climate

This work is licensed under a Creative Commons
Corresponding author: Don Wuebbles; email: wuebbles@illinois.edu

Authors (Alphabetical):
Amy Ando*, UIUC
Anne-Marie Hanson, UIS
Elizabeth Kocs, UIC
Cynthia Klein-Banai, UIC
Dean Massey, UIC
Carolee Rigsbee, UIS
Ashish Sharma*, UIUC
Don Wuebbles*, UIUC
Moira Zellner, UIC
Lei Zhao*, UIUC

* Co-Principal Investigators

Acknowledgments:
The CURES Connections Workshop was the result of effective collaboration between the University of Illinois system universities, Northwestern University, University of Chicago, Argonne National Labs, the Metropolitan Mayors Caucus, Greenleaf Advisors, and Green Diamond. The U.S. National Science Foundation funded the workshop.

Executive Summary

The Center for Urban Resilience and Environmental Sustainability (CURES) at the University of Illinois organized the one-and-a-half-day "***CURES Connections Workshop: New Voices and Paths to Urban Sustainability"*** on August 7-8, 2019, at the Discovery Partners Institute in Chicago, IL. This National Science Foundation (NSF) supported workshop (Award #1929856) aimed to explore the concepts for advancing Sustainable Urban Systems Research Networks. The workshop explored important dimensions of convergent sustainability science to establish the foundation for a new multi-disciplinary multi-stakeholder research network that can deliver actionable research-based and cost-effective solutions to the problems that communities of many sizes really face. This workshop brought together over 130 stakeholders from across the United States representing researchers and experts from many disciplines (e.g., engineering, natural and social sciences, arts, and humanities) from universities and national laboratories, municipalities, agencies, private industries, non-profit organizations, and utilities. Involving a range of voices from these many different societal sectors, we identified critical gaps in the implementation of solutions for sustainability challenges in energy, water, and climate in a range of different types of urban systems – urban, suburban, rural – and across city sizes from small to large.

The workshop was designed using a participatory modeling approach. Based on the insight gained from keynotes speakers, and from experts in panels (from municipalities; private industry, non-profit organizations and utilities; social science, arts and humanities; and technical, earth and natural sciences) and the outputs from carefully designed workshop activities, the workshop successfully achieved the following four objectives:

1. Identifying factors differentiating sustainability solutions for communities of different sizes — participants summarized commonalities and differences in critical problems, causes, and consequences, lever points, facilitators, and barriers to change for water, energy, and climate-related issues among cities of different sizes.
2. Integrating researchers with municipal and industry stakeholders on research — the workshop brought together more than 50% of participants from non-academia. Such a large stakeholder presence led to broadening the perspectives of participants on issues (including causes and impacts) and solutions (including barriers and enablers).
3. The inclusion of neglected disciplines in sustainability research — provided a unique perspective through the lens of arts and humanities and human dimension which is traditionally neglected in urban sustainability discussions.
4. Developing implementable strategies supporting a large scale multi-stakeholder research network to tackle sustainability issues — participants developed problem-solution pairs for convergence research around green infrastructure, decision support, renewables/solar, building coalitions between cities/regional planning, and building new business models/economic models.

1. Introduction

This report summarizes the findings from the ***CURES Connections Workshop: New Voices and Paths to Urban Sustainability*** held on August 7-8, 2019, at the Discovery Partners Institute in Chicago, IL. This National Science Foundation (NSF) supported workshop brought together over 130 stakeholders from across the United States, representing municipalities, private industry, non-profit organizations, utilities, universities, and national laboratories. ***The goal of the workshop was to explore important dimensions of convergent urban sustainability science and establish the foundation for a new multi-disciplinary multi-stakeholder research network that can deliver actionable research-based and cost-effective solutions to the challenges that urban communities of many sizes face***. By involving a range of voices from these many different societal sectors, the aim was to identify critical gaps in the implementation of solutions for sustainability challenges in energy, water, and climate in a range of different types of urban systems – urban, suburban, rural – and across city sizes from small to large.

1.1 Background

The areal extent of cities and their impacts on the environment and human well-being are strongly disproportional. Occupying only 3 to 4% of the Earth's land surface (Schneider et al. 2009), urban areas currently accommodate more than 50% of the world's population, and this percentage is projected to increase to 70% by the year 2050 (Heilig 2012). Many globally-recognized problems such as heat stress, energy security, air quality, water quality and availability, flooding, and sea-level rise are amplified in urban areas (Grimm et al. 2008), and are experienced disproportionately by diverse communities within cities (Tessum et al., 2019). Absent measures to ameliorate them, these problems and their impacts are expected to intensify due to continuing rapid urban development. At the same time, cities face additional stresses from ongoing and projected climate change (IPCC 2014; USGCRP 2017, 2018; Krayenhoff et al. 2018; Zhao 2018). Under the business-as-usual scenario, some and possibly many cities are projected to be nearly uninhabitable by the end of this century due to a combination of sea-level rise and increasing intensity and frequency of weather extremes. Thus, there is a pressing need for convergent science to advance fundamental understanding of climate-driven sustainability challenges in urban areas of all sizes as integrated social-ecological-technological systems, and to inform cost-effective solutions for water management, energy supply and transition, and climate change adaptation.

Furthermore, we have a time-sensitive opportunity to improve environmental and human well-being. With large concentrations of the world population living in cities, urban areas are the fundamental foci of climate adaptation and sustainable development. Development decisions can either significantly exacerbate or reduce the impacts of climate change and projected risks. Half of the urban infrastructure that we will need in 2050 has not yet been built. Recent unprecedented economic, health, and life losses due to climate extremes and our unpreparedness have closed the gap for readiness.

Given the grand challenges that cities of multiple sizes are facing now and in the projected future, it is imperative to bring interdisciplinary scientists and other experts together to create coordinated planning efforts among cities and to generate sustainable development programs applicable to cities of different sizes and to networks of urban systems. Considerable efforts have been invested in devising infrastructure-based schemes for climate adaptation and advancing urban sustainability (Rosenzweig et al. 2009; Stone et al. 2013; Zhao et al. 2017; Sharma et al. 2018b). However, current strategies and actions occurring in urban areas such as

green infrastructure, policies for white roofs and surfaces, and using a plethora of energy technologies can be ineffective under certain social, economic, or climate conditions (Krayenhoff et al. 2018). These strategies also have complex socio-ecological trade-offs (Cao et al. 2016; Sharma et al. 2018b) and may trigger unintended climatic and socioeconomic consequences (Zhao et al. 2017). For example, cool roofs may induce precipitation reduction in urban areas (Georgescu et al. 2014); green infrastructure requires irrigation for cities in dry climates where water is already scarce and becomes scarcer in the projected future under climate change (Li et al. 2014; Zhao et al. 2017). Despite concerns for how technologies will impact ecosystems and diverse human communities within cities, new technologies, design changes and infrastructure innovations are being introduced into urban systems at an unprecedented rate. These include electric vehicles, stormwater infrastructure, intelligent buildings, new construction materials, smart sensors, renewables, smart grids, and information technologies. These innovations disrupt existing energy flows, water cycles, social dynamics, and surface biophysical and biogeochemical processes, etc., and hence have unknown consequences, negative and positive. Their interaction with and impacts on climate change are poorly understood. Nor have their effects in advancing urban sustainability been evaluated under present-day and projected conditions on a large scale. Contributions from the arts and humanities have not been fully integrated into this realm, leaving potentially valuable tools and insights undeveloped. More research in many disciplines (e.g., earth and natural sciences, engineering, social sciences, arts and humanities, design, and urban planning) is needed to guide these innovations occurring in urban areas to advance multiple sustainability outcomes, locally and globally.

Research on sustainable urban systems is not new, and it often engages multiple disciplines. However, work in this sphere is often limited in two important dimensions. First, most research on urban sustainability tends to largely focus on solutions that work for very large urban systems. While such areas are home to billions of people, this work leaves the problems of people in small communities unaddressed, and may not involve stakeholders and decision-makers in towns on the fringes of the large cities which themselves are critical parts of the urban system. Second, scholarly researchers often carry out work without adequately engaging with community stakeholders in ascertaining the problems are that need to be solved and without collaborating with people in the businesses that may often be critical players in actually delivering sustainability solutions.

Thus, this workshop-style conference was aimed at exploring several important dimensions of convergent sustainability science to establish the foundation for a new trans-disciplinary multi-stakeholder research network focused on the delivery of actionable research-based solutions to the problems that communities of many sizes face now or into the future. The organizing committee has deep integration between researchers in multiple disciplines in the University of Illinois system, groups that represent and connect to urban areas of all sizes (e.g., the Metropolitan Mayors' Caucus and the Community and Economic Development division of Illinois Extension), industry, national leaders, businesses (e.g., Greenleaf Advisors) and non-profit organizations with track records of broad engagement with researchers and industries in sustainability (e.g., Resources for the Future). This conference explored solutions to sustainability challenges in water, energy, and climate adaptation; studied how sustainability solutions must vary with the scale of an urban system; worked to integrate researchers from arts and the humanities into sustainability research teams; and studied how research could be enhanced by deep integration of researchers with stakeholders from businesses, communities, and NGOs.

1.2 Sustainability challenge foci

Urban systems face a host of challenges, but an effective conference can focus on only a few. Collaborators in the University of Illinois system have a strong working relationship with many municipalities through the Metropolitan Mayors' Caucus (MMC), and organizations such as Greenleaf Advisors, which facilitate the identification of challenges that municipalities are struggling with the most and that organizations are most interested in tackling. With this in mind, the workshop focused on energy and climate issues, urban water issues, and challenges in creating and implementing sustainability solutions.

1.2.1 Energy and climate: Urban areas are major drivers of multisector environmental change. Built environments, infrastructures, and everyday human activities modify and modulate energy flows and dynamics and processes in urban areas, shaping energy production and consumption patterns for decades. Urban energy use significantly contributes to climate change. According to the most recent Intergovernmental Panel on Climate Change (IPCC, 2014) report, urban areas currently account for about 67-76% of global energy use and 71-76% of global CO2 emissions (Seto et al., 2014). Assuming current urbanization trends continue, urban energy use will increase more than threefold by 2050 (Creutzig et al. 2015), resulting in even more pressure on energy security and contributions to climate change. Cities are also hot spots of climate hazards and risks. Many studies have suggested that cities also suffer even more due to the combination of climate change and their unique built environments (Li et al. 2013; Zhao et al. 2014). For example, the conversion of undeveloped land to urban infrastructure is known to generate local warming effects, adding to the non-local greenhouse gas-induced warming. The combined effects considerably intensify stresses on human health (Oleson et al. 2015; Zhao 2018), on energy use (Creutzig et al. 2015), and on the urban infrastructure itself (Stone and Jr 2012) (Stone 2012). Cities in the Great Lakes region are projected to undergo significant warming induced by the interactive combination of urban growth and climate change (Krayenhoff et al. 2018; Wuebbles et al. 2019). Compounded by the humidity effects in these regions, the heat risks pose threats to human communities and natural ecosystems (Zhao et al. 2014).

Climate extremes such as heatwaves, hurricanes, floods, and tornadoes are another set of threats that cities are facing under climate change, causing significant socioeconomic and humanitarian damage. For example, heatwaves are the deadliest climate extreme events in the United States (Klinenberg 2015). Extreme heat stress in a changing climate has the potential to cause a substantial increase in human mortality (Anderson and Bell 2011; Huang et al. 2011; Patz et al. 2005), morbidity (McGeehin and Mirabelli 2001), and energy demand ((Isaac and van Vuuren 2009; Sailor and Pavlova 2003), and perhaps civil conflicts (Burke et al. 2009; Hsiang et al. 2011). The infamous Chicago heat wave in 1995, for example, caused many deaths in the region (Semenza et al. 1996). Climate models consistently project that the frequency, severity, and duration of climate extremes will increase markedly over this century, calling for an urgent need of coordinated and collaborative efforts from multiple ends (municipality-industry-academia) to help shape urban sustainability in the face of climate change.

Cities are at the center of sustainable development and climate adaptation. However, the actions, plans or solutions may require large amounts of energy and water, and optimal solutions vary across city sizes, urban systems and forms. For instance, although indoor cooling can effectively reduce heat-related mortalities (Romero-Lankao et al. 2012), the share of cooling in building energy use will nearly triple from 2,020 TWh now to 6,200 TWh by mid-century (IEA

2018). Lower urban density leads to a weaker urban heat island effect (Chen et al. 2006), but a 50% reduction in density increases transportation energy use by 66% (Kennedy et al. 2009). Urban vegetation can reduce the temperature by 1–2°C, but the required irrigation consumes a considerable portion of urban water usage, more than half in arid/semi-arid cities (Guhathakurta and Gober 2007). These challenges reaffirm the significance of our topics focused on energy, climate and water, our approach of investigating them in a nexus among cities of varied sizes, and our emphasis on engaging multiple disciplines (technical science, earth and natural science, social science, arts and humanities) and multiple sectors (academia, industry, business, NGO, local community, and municipality). At the same time, we would like to note that there are other drivers and barriers to sustainable development and climate adaptation that line in the realm of urban planning, economics, and sociology but we refrain from covering all aspects of urban sustainability.

1.2.2. Urban water issues: Many urban areas in the United States., and particularly in the Midwest, face impacts from climate change-related to sudden changes in precipitation leading to flash floods and droughts. Increasing precipitation extremes from summer convective storms have produced unprecedented damage to cities in the Midwest and Northeast, and also in Southern Canada (CA). According to Illinois State Water Survey estimates, there were nearly 150,000 flood damage insurance claims paid, and another 200,000 payments from the federal government to individuals affected by flooding in Midwest urban areas between 2007 and 2014 – and these numbers are just the reported damages. The number of people suffering from flood damage is much higher. Overall, the extreme storms experienced by the cities in the last 30 years or so have far exceeded the current design standards for infrastructure and have caused extensive damage. Damages in and around Calgary, Alberta exceeded $1.7B (CA $), and Toronto sustained more than $900M (CA $). While the damages are extreme for larger cities, the wrath of extreme precipitation affects large cities and small towns alike. However, their impacts vary in magnitude based on how well different size cites are prepared, both in terms of their infrastructure and the readiness to respond. Small cities such as Champaign, Illinois have limited stormwater budgets and struggle to interact strategically with homeowners to reduce flood risks, but residents would gain great value from improved stormwater management in these communities (Cadavid and Ando 2013).

In addition to impacts from urban flooding, regulation of combined sewer overflows (CSOs) has become an increasingly important concern for a large number of cities with combined sewers (which carry sewage and stormwater runoff in the same piping system). Under current water quality legislation, municipalities are charged by the U.S. Environmental Protection Agency (EPA) with reducing the number of CSO events to acceptable levels either by more effectively maintaining and managing existing stormwater infrastructure, or by designing and installing new infrastructure (e.g., increased stormwater storage facilities, green infrastructure, or separated sewer and stormwater piping systems) to cope with these problems. These requirements have affected both large and small cities alike across the country, especially in the Midwest. Chicago, for example, has invested more than $3 billion to date in the Tunnel & Reservoir Plan (TARP) Project (https://www.mwrd.org/irj/portal/anonymous/tarp) to reduce stormwater damage in the city and CSOs to Lake Michigan. Smaller municipalities across the country with combined sewers are also profoundly affected by the need to effectively manage existing sewer systems to meet water quality standards. Quantitative assessments of the performance of various available technologies that could be used to cope with projected

increases in storm intensity in the future are urgently needed to guide long-term planning towards sustainable infrastructure and management approaches that will remain effective over the long haul.

Identifying feasible and sustainable strategies for coping with these impacts in the future has become a very high priority, especially in cities that have experienced these kinds of extreme storms first hand. For example, the city of South Bend, Indiana, in partnership with a private sector company, is currently evaluating and implementing changes in its stormwater management system, including infrastructure approaches designed to reduce combined sewer overflow events. They are also constructing and evaluating a new stormwater management model for the city's runoff producing areas, combined sewers, and wastewater treatment systems.

Mounting urban impacts in the historical record suggests that storm statistics are changing and that these changes represent an important sustainability challenge. In addition, appropriate tools for quantitatively assessing the current and future performance of stormwater infrastructure are frequently unavailable to urban stormwater planners, designers, and managers (Winters et al. 2015; Sharma et al. 2018a). Therefore, inputs from different intellectual centers (academia, industry, and municipalities) are needed to understand the issues and challenges related to extreme precipitation and to develop and assess sustainable adaptation strategies at city and neighborhood scales for cities of various sizes. Overall, enhanced engagement with local communities and municipalities in integrated urban planning, such as evaluating the performance of green infrastructure choices along with open spaces into comprehensive land use planning, would improve resilience to extreme storm events.

These research topics and challenges—climate, energy, and urban water issues—provide the foundation for the discussions at the conference. Identifying and informing pathways to attacking and solving these challenges, in a way that recognizes the critical role of stakeholder engagement in establishing and delivering effective solutions, is a key goal of the conference.

1.2.3 Challenges in creating and implementing sustainability solutions

Given the current climate, energy and environmental crisis, increasing inequity and rapid urbanization, now is the time for collaborations and partnerships across sectors and municipalities to tackle critical sustainability challenges facing cities of all sizes. Interactive planning and decision-making processes already exist, through methodological systems, harnessed collective will and people interactions. Yet more support is needed for private and non-profit sector participation in urban governance, and to coordinate with municipalities to identify holistic pathways forward. A gap still remains between the diagnosis of urban challenges and execution, including securing necessary funding and implementing partnered solutions. Local government and urban practitioners typically tend to take one or two parts of projects and implement piecemeal. A holistic system is needed for building capacity, forming partnerships and developing projects from end to end, and engaging resources across sectors that allow for collaborative opportunities with non-traditional partners to address critical issues in innovative ways.

This conference was designed to discuss solutions to the challenge foci identified above. But more importantly, it was also designed to explore how sustainability research and implementation would be carried out, towards laying the foundation for a uniquely effective research network to solve problems and address sustainability.

First, researchers have grown to understand the value of multidisciplinary research on sustainability, but fully integrated research remains rare. Disciplines in the arts and humanities are often not fully integrated into this realm, but they could play powerful roles in better understanding what problems cities really face and in devising successful strategies for implementation. This workshop was aimed at identifying critical roles that these disciplines can play in developing and implementing sustainability solutions in rich collaboration with technical, natural, and social sciences. For example, clues to community priorities and concerns can be found in the stories and music that emerge from them, history can teach lessons about how people cause or adapt to environmental changes, and environmental writing and communication can be vital in engaging policymakers, voters, and community actors in responding to environmental threats. Those roles will be modeled with examples from the domains of water, energy, and climate that are the focus of the event.

Second, traditional approaches have research experts developing solutions and communicating those proposed solutions in a unidirectional manner to communities and other stakeholders, even though the process may be more effective if researchers have iterated interactions with other groups engaged in the work of sustainability. Community groups and municipal leaders have a direct understanding of the problems that need to be solved and the municipal settings in which solutions must work. Business individuals and enterprises, especially those engaged in social entrepreneurship (Rahdari et al. 2016), are also key to solution success. Beyond providing insight into finance and feasibility issues, they can help drive the design, development, and delivery of scalable solutions (e.g., using key technologies such as blockchain, Power over Ethernet, the Internet of Things). Moreover, NGOs often have extensive experience working with multiple stakeholders to affect environmental change. Through this workshop, we explored how views of sustainability problems and solutions vary among researchers, community leaders and members, industry representatives, and NGOs and how sustainable urban systems should be analyzed together with their surrounding rural areas.

Third, most research on urban sustainability is focused on very large urban systems. However, billions of people live in smaller communities, and one solution for a given problem is unlikely to fit cities of all sizes. This conference was hosted in part by a new Center for Urban Resilience and Environmental Sustainability (CURES) in the three campuses of the University of Illinois system that is dedicated to solving sustainability problems in urban systems of all sizes. This breadth of study raised interesting research questions about how infrastructure, technology, policy, and management for sustainability needs to be tailored for the size and stage of development of a given community, and to make it possible to improve the lives of people in less densely populated areas that are often neglected in conversations about sustainability in human settlements. The workshop focused attention on vulnerable urban systems of contrasting sizes. The state of Illinois provides a useful set of case studies for urban sustainability in the central part of the United States with cities ranging from very large (e.g., Chicago) to medium (Peoria and Springfield) to “micro-urban” (Champaign-Urbana), to towns that some would not call cities but which face many of the same problems in a future under climate change. These places have historically displayed pronounced sensitivity to climate extremes, faced continuous challenges related to energy and water, and have diverse and varying socioeconomic and demographic populations. This region is an ideal case study for a focused workshop-style conference of national experts and stakeholders that can lay the groundwork for a research network that studies cities of multiple sizes in other regions as well.

The remainder of this report further discusses how the workshop was organized and summarizes the workshop activities, outcomes, lessons learned, and steps needed to be taken to keep the momentum going for the projects that came out of the workshop and with the network that formed as a result of the workshop.

1.3 The Design of the Workshop

This workshop examined interdisciplinary sustainability solutions for municipalities struggling with problems related to water (stormwater management and drinking water supply) and energy (energy efficiency, cost, and renewable transition) in the face of climate change. However, such solutions cannot be fully explored and certainly not fully developed in a one-and-a-half-day workshop. Instead, the primary goals and intellectual contributions of the workshop were:

Objective 1: Identify important dimensions along which urban sustainability solutions related to water, energy, and climate adaptation must vary for urban areas of varied sizes and at different stages of growth.

Objective 2: Identify how research on urban sustainability solutions is altered by integrating researchers with both municipal and industry stakeholders.

Objective 3: Identify compelling roles for neglected disciplines such as arts and humanities to play in truly multidisciplinary research on urban sustainability.

Objective 4: Develop implementable strategies to create and sustain a large scale research network that tackles urban sustainability in cities of varied sizes with deep integration between researchers, municipalities, and business partners.

The workshop was proposed by and harnessed the expertise and leadership of the new Center for Urban Resilience and Environmental Sustainability (CURES) at the University of Illinois. The mission of CURES is to deploy the capacities of the University of Illinois system – research coupled with applied education and public engagement – to generate the capabilities that cities will need to be more livable, prosperous, resilient, and sustainable. This workshop linked the CURES network with researchers and other stakeholders around the country to identify critical gaps in research methodology and knowledge for solving sustainability problems in energy, water, and climate adaptation in a range of different types of urban systems. Lessons learned from this workshop should be relevant for sustainability research and action in other vulnerable cities.

This workshop distinguished itself from and advanced the work from other urban meetings in multiple ways: 1) This conference focused attention on vulnerable urban areas of varied sizes, rather than emphasizing large cities alone; 2) The thematic foci of this conference were urban sustainability challenges related to water, energy, and climate adaptation; 3) This conference studied how to accomplish deep collaboration and integration across multiple disciplines including ones often neglected in this work such as arts and humanities; 4) This conference studied deep integration between researchers, municipalities, NGO's, and business partners.

Table 1 lists the members of the organizing committee, who together have extensive networks of connections that assisted in organizing the logistics, speakers and panelists for the workshop. The committee includes a set of researchers representing several types of disciplines that study the challenge areas, including people from areas of arts and humanities that are not

often included in such multidisciplinary efforts. The organizing committee also has members linked to municipal, industry and NGO stakeholder groups. "Connectors" include a faculty member at the University of Chicago to further link this team to universities other than the University of Illinois, a former director of a regional EPA office, and members from service firms and non-profit organizations Greenleaf Advisors (Chicago) and Resources for the Future (Washington DC) that have extensive experience connecting researchers with stakeholders in research and outreach related to sustainability.

The organizing committee includes at least two members from each of three important stakeholder groups: communities, businesses, and NGOs. Both the Metropolitan Mayors' Caucus and Illinois Extension work with many municipalities of varied sized on sustainability challenges. The other stakeholder members of the organizing committee have broad perspectives on the businesses and NGOs involved in urban sustainability and will be well-positioned to recruit participants from those sectors.

Table 1. Organizing Committee (* indicates PI or Co-PI on the proposal to NSF)

Type	Names
Connectors	John Andersen, Greenleaf Advisors James Boyd, Resources for the Future Mary Gade, environmental law, former director of EPA Region V Sabina Shaikh, University of Chicago
Research	
Arts and humanities	Michael Silvers, eco-musicology Gillen Wood, environmental writing
Technical sciences	Ashlynn Stillwell, environmental engineering Lei Zhao*, civil engineering
Earth & natural sciences	Ashish Sharma,* urban modeling and environmental sustainability Don Wuebbles,* atmospheric sciences
Social sciences	Amy Ando*, environmental economics Moira Zellner, participatory modeling and urban planning
Municipalities & community groups	Edith Makra, Metropolitan Mayors' Caucus Lisa Merrifield, Illinois Extension's Sustainable Communities Initiative
Business	Peter Mulvaney, Jacobs Engineering LLC Timothy Lindsey, Smart Energy Design Assistance Center (formerly Caterpillar and Exxon)
NGOs	Dick Munson, Environmental Defense Fund Brian Richter, Director, Sustainable Waters Michelle Carr, IL Director, The Nature Conservancy Steve Frenkel, Director, Current
CURES advisory team	Julie Cidell, human geography Anne-Marie Hanson, political ecology Cynthia Klein-Banai, organizational sustainability Elizabeth Kocs, energy systems and urban planning Carolee Rigsbee, organization and management studies Thomas Theis, civil and materials engineering Shaowen Wang, cyber geographic information systems

The researchers on the committee are, unless otherwise specified, affiliated with CURES, a new center at the University of Illinois connecting more than 90 researchers and educators in the University of Illinois system with urban communities of all sizes to solve problems of urban sustainability and resilience. CURES has seed funding from the new Discovery Partners Institute in Chicago (a partnership of university, government, and private industry), and can harness researchers from many different disciplines to study sustainability problems that integrate multiple facets of urban systems. CURES has held three successful organizational planning meetings that led to many of the connections represented on this conference planning committee and is poised to begin work on research and education to advance sustainability solutions.

Invited conference participants were chosen strategically by the organizing committee. Representatives from municipal, industry and NGO stakeholder groups are critical to the success of this work, and research of this complexity requires a large scale convergent research agenda in which researchers from across the disciplinary spectrum are engaged. This includes technical sciences such as engineering, material science, and landscape architecture; earth and natural sciences like ecology, climate science, and hydrology; social sciences such as economics, psychology, and business administration; and arts and humanities such as language arts, visual arts, and music.

2. Workshop Agenda: Putting the "Work" into the Workshop

CURES approached the one-and-a-half-day workshop with an effort to bring expert speakers that were followed by interactive small group activities to engage the 130+ participants to identify and prioritize sustainability challenges for cities of all sizes. The workshop agenda is provided in Appendix A, while Appendix B provides a list of all participants.

The engagement of participants on the topics of the workshop was a critical element. Keynote talks started off each morning presenting unique ideas on approaches to urban sustainability challenges. Four expert panels were dispersed throughout the first day followed by intensive working group activities focused on specific tasks and deliverables for four city sizes (rural, small urban, medium urban, large urban).

Each working group activity was designed to build on prior activities. Briefly, the group activities in this workshop were as follows.

Activity 1: ***Prioritizing and Diagnosing Sustainability Challenges*** – Following the Panel of Municipal Leaders, each group discussed and decided on top critical problems for each challenge (water, energy, climate) in the context of the size city the group represents, to help ground the activity. For each of the challenges, they discussed and noted on a diagram the following: (1) What are some critical causes?, (2) What are some critical impacts?, and (3) What are the lever points (policy, technology, behavior) for effecting change (causes or effects)?. The groups marked the most interesting problems and lever points on the "Causes & Consequences Diagram with Interesting Levers" and then reported back to the entire workshop.

Activity 2: ***Understanding Actors and Organizations*** – Following the NGO and Business Leaders Panel, the groups added to the causes/consequences diagram how different types of actors and organizational factors influence the causes and impacts of the water, energy and climate challenges. Two different colors were used to distinguish between facilitators and barriers. The groups discussed the following question: What are some key roles that stand out as

facilitators of change, or barriers to change? The groups noted the more critical ones on each "Causes & Consequences Diagram with Interesting Levers and Actors" diagram.

Activity 3: ***Concrete Pathways to Sustainability*** – Following two additional panels – "Looking at sustainability challenges in cities of different sizes through the lens of arts and humanities and human dimension" and "Engineering perspective to urban woes and potential solutions across scales," the groups continued to work on the diagrams to identify promising solutions towards water, energy, and climate sustainability in cities of the size they represented. The diagrams were then reviewed by the conference organizers in order to set up a poll of challenge – solutions pairs for the next day.

Activity 4: ***Choosing actions towards sustainability*** – The following morning, the polling began. Each new group met around a specific solution for which they signed up. The goal of this working group activity was to identify and prioritize actions, projects to undertake, and deliverables (e.g., papers, pilot projects, feasibility studies).

Activity 5: ***Identifying steps to support actions towards sustainability*** – Each group completed worksheets with the following information: resources available/needed including key technology, point people, institutional and funding sources, other collaborators, etc.; and issues, concerns, barriers that need to be overcome. The goal of this working group activity was to identify specific plans to implement actions.

Activity 6: ***Constructing the network for sustained progress*** – Finally, groups brainstormed how to design the collaborative network, define ways to ensure regular and effective collaboration among teams, set initial deadlines and goals, and identify point people for each project to ensure work continues.

Activity 7: ***Wrap up and next steps*** – Over lunch, each group provided a summary of plans that indicates the big picture for the challenge – solution pair for various city sizes, the main actions and plans for moving forward, the point person for the group, ongoing communication, and collaboration plans, and immediate next steps.

The next three sections provide more details on the activities that occurred at the workshop. More specifically, the keynote presentations and panel discussions (Section 3), results from the group activities (Section 4), and progress against the objectives (Section 5) are each summarized.

3. Summary of Keynote Talk and Panel Discussions

Each day of the workshop commenced with a keynote presentation. The first day's keynote presentation, delivered by Suzanne Malee-McKenna, Interim CEO of Great Lakes and St. Lawrence Cities Initiative, set the tone for the urgency of conducting the workshop. The second day's keynote presentation, by Rachel Switzky, Director of the Siebel Center for Design at the University of Illinois at Urbana-Champaign, provided helpful insight into best practices in multi-disciplinary thinking.

Four-panel sessions also took place, interspersed among the group working activities. The first panel included municipal leaders from cities of different sizes who were asked to talk about water, energy, and climate-related problems in their city. The second panel included

leaders from business and from NGOs who were asked to discuss the role private and non-profit sectors can play in urban sustainability. The third set of panelists included scholars from the social sciences, arts, and humanities, which are underrepresented in the discussion on climate-related solutions design and implementation. These panelists were asked to explain their perspective on ways forward in addressing water, energy, and climate-related issues in general. The fourth panel was made up of technical, earth, and natural science scholars, who brought science and engineering perspectives on the issues.

3.1 Keynote talk: Suzanne Malec-McKenna, Interim CEO of Great Lakes and St. Lawrence Cities Initiative

Suzanne Malec-McKenna's presentation was aimed at waking everyone up to the need for addressing climate change and the many other stresses affecting urban areas. Suzanne was "speaking to the choir" as she noted in her opening discussion. She was well aware that all in the room were there because they know how critical it is to address climate, energy and water challenges NOW. She noted, based on recent United Nations statements that we have less than 11 years (to 2030 when the Paris agreement noted was necessary to be able to keep climate change below 2 degrees C) to seriously address climate change if we are going to avoid much larger impacts on human society.

She also felt that cities would be the places where things happen. She discussed the importance of dealing with water issues to the Chicago area economy – especially the concerns of increasing concerns about large rainfalls under a changing climate leading to more concerns about local flooding. In discussing the issues faced by cities of all sizes, she found that the only differences were simply of scale. Small cities just do not have as much infrastructure.

A major outcome of this workshop was to demonstrate the importance of bringing our expertise together. Participants were called to figure out what everyone's niche is and work together, while also creating priorities. Ms. Malec-McKenna stressed that communication is really important. Her vision was that "every person, every business, every community, and every ecosystem, has the right, and access to healthy and safe water, land, air, and food. A Chicago region that embraces environmental justice will prioritize the reversal of damage to natural assets and humans and ensure a resilient future." Suzanne Malec-McKenna provided a realistic call for action to all participants, setting the foundation for the workshop.

3.2 Opening day 2 plenary talk: Best practices in engaged multidisciplinary research Rachel Switzky, Director of the Siebel Center for Design at the University of Illinois at Urbana-Champaign

Rachel Switzky's presentation aimed to inform the workshop participants of the need to foster multidisciplinary collaborations and use design thinking as an approach to promote human-centered design, reflection, and iteration. She discussed that we scientists and disciplinary experts in higher education have failed many times to engage vast human and technical resources available in a university environment to seek answers to sustainability questions. Generally, we collaborate with a few disciplines, but high-education institutions and universities provide expertise in many sub-disciplines of engineering (computers, systems, industrial, electrical, etc.), liberal arts (economics, philosophy, natural resources, history, etc.), and education (curriculum and instruction, learning and education), interdisciplinary health and emerging media. With such a vast resource, we can develop systems-design thinking to solve urban sustainability problems. For this we need to be vigilant of the following aspects: (i) understand our users, (ii) understand

their journeys, (iii) map out their ecosystem, (iv) determine opportunity areas for design, and finally (v) prioritize, plan, and pilot. Rachel stressed that while working on the above interdisciplinary designs, we should learn from and leverage from analogous settings. For example, the situation in the emergency room and race car pit stop tire change are analogous as they both are highly stressed time-sensitive environments with parallel processing of multiple tasks efficiently. At the same time, we should learn from the software development process that utilizes decision tree approach to design their projects, beginning from feasibility study -> requirements and specification -> design -> testing -> integration -> maintenance. Likewise, she stressed on borrowing from agile software development methodologies based on iterative development, where requirements and solutions evolve through collaboration between self-organizing cross-functional teams. Such techniques are normally missed and/or not incorporated in urban sustainability discussions and engagements.

3.3 Panel of Municipal leaders: Water, energy, and climate problems at different urban scales

Panelists: Brant Walker, Mayor, City of Alton
Cara Bader, Chief Sustainability Officer, City of Chicago
Kevin Burns, Mayor, City of Geneva
Kim Stone, Councilwoman, City of Highland Park
Scott Tess, Environmental Sustainability Manager, City of Urbana

Moderator: Don Wuebbles, UIUC

Municipal leaders represented the opening panel for the workshop, representing cities of all sizes. The panelists brought the challenges front and center. Larger cities like Chicago already have a lot happening to deal with water, energy, and climate issues, but still need championing and there is a need to assemble coalitions to make progress. Smaller urban and rural cities, although more resource-limited, can often adapt more quickly to stresses, also often feel left out when sustainability issues are discussed. Developing the right plans to address climate change remain a struggle for cities of all sizes. Surveys in some of these cities have shown that while economic development is their top priority, sustainability ranks much lower, around fifth, even though sustainability may have huge impacts on their abilities for economic development.

The small and mid-size cities are located in the boundary of economics, and one of the biggest challenges is the absence of technological expertise. Cities near Chicago would want to use the sustainable technologies implemented in the city, but they don't have the same kind of funding available. Mayor Burns felt that smaller cities "just sometimes feel left out". Also, the absence of technological expertise in the administrative departments leads to the implementation of policies which doesn't keep up with sustainable measures.

The suggested way to work around these problems is to work with community-level programs. Homeowners associations sometimes can be a better place to address how individuals in the community can practice sustainability in their homes. The autonomy or independence of each community is strong, so regional work is important. One of the important aspects that came up in the conversation was the individual's incentive to work towards a sustainable option. The costs of sustainable alternatives are most often higher than the conventional options and also needs a lifestyle change. In the absence of any kind of tax incentives, it becomes difficult to

implement these changes. So how to convince people to pay for something that will help them five years down the line? For example, in Chicago many coalitions have been around crime and violence. By making things personal, people adopted newer options. In these scenarios, finding personal connections and starting with the asset-based approach can help move the needle on making these changes. More advocacy at the community level will raise awareness in the residents, who in turn can put pressure on the government units to take steps to work in the direction of sustainability. Another approach is to engage with the city's corporate leadership. Engaging with civically informed corporate stewards can also help cities move toward sustainability. When asked at what level scientists could provide data for effective changes at the community level, the panel wanted more data at the neighborhood level. According to the panel, the neighborhoods are very different from each other and implementing any changes will depend on the nature of the differences between neighborhoods.

3.4 Panel of NGO and Business Leaders: Roles of Private and Non-Profit Sectors in Urban Sustainability

Panelists: Hilary Pearson, Exelon
Nancy Cole, Union of Concerned Scientists
Naomi Davis, Blacks in Green
Raj Rajan, Inunext
Steve Frenkel, CURRENT

Moderator: Elizabeth A. Kócs, UIC

Given the current climate, energy and environmental crisis, increasing inequity and rapid urbanization, there has not been a more critical time for collaborations and partnerships between the private and non-profit sectors to tackle the critical global challenges facing cities. Interactive planning and decision-making processes are needed to support private and non-profit sector participation in urban governance, and to coordinate with municipalities.

The goal of the panel of *NGO and Business Leaders: Roles of Private and Non-Profit Sectors in Urban Sustainability* was to build upon the preceding panel of municipal leaders, lay the foundation for the panels to follow, and most importantly to provide industry and sector-specific insight, including best practices and lessons learned, on the roles of both private and non-profit organizations for urban sustainability challenges. Each panelist highlighted work from their respective organizations on energy, water or climate challenge and concluded with a response to the prompt - "*the most successful role and most unsuccessful roles my organization/sector has played in sustainability challenges are…"* with the objective to provide insight on and build upon best practices and lessons learned by the representative organizations.

Critical topics for the panel discussion included how to engage and mobilize urban sustainability networks locally and globally, the role of facilitation to leverage and build upon shared values and local realities, specific challenges in Chicago and other cities in Illinois, and key industry insights to inform pathways forward. Hilary Pearson from Exelon noted the importance of realizing the economic impact of doing nothing or failing to act, the role of clean, renewable energy policy, and the critical nature of building partnerships for the transition to address known challenges in the community. Naomi Davis from Blacks in Green highlighted the significance of a resident-driven approach to developing and owning the message about

sustainability and environmental stewardship to not only hold gentrification at bay but also sustain community cohesion. Raj Rajan of Inunext introduced the application of doughnut economics to urban sustainability challenges and noted a common thread for all cities is understanding unintended internalization of externalities through careful documentation and tracking of consumption-based environmental footprints. Nancy Cole from the Union of Concerned Scientists heralded the critical role of NGOs for ensuring accountability and transparency to safeguard equity, protect resources, mobilize support, and make the invisible visible to the greater public. Steve Frenkel from CURRENT highlighted the critical role of new technologies to address water sustainability challenges, bringing those new technologies to market to address urban sustainability challenges through partnerships and pilots to demonstrate, validate and scale those technologies for the greater good.

Three critical areas for urban sustainability collaborative efforts to be successful emerged from the panel discussion overall: the need to balance tensions, conflicting uses, and/or fragmented industries; the importance of developing scalable solutions; and the removal of systemic social and equity barriers. Some specific challenges noted by the panelists included: lack of policy or policy lagging (i.e., policies can also squash innovation/deployment; also policy typically lags technology and innovation; and at times wait time for policy to catch up can be the end for a technology application); inability to scale up if obsessed with local conditions; the need for local perspectives, data and measurement, subsidy-created inequities; common systemic problems locally and globally; and balancing reality with sustainable goals. The overwhelming agreement amongst the panelists concluded on an "all hands-on deck" approach, working together to facilitate and implement scalable and equitable sustainability solutions.

Although processes do already exist, gaps remains between diagnosis of urban challenges and execution, from securing funding to implementing partnered solutions. Ultimately, what is needed is a holistic system for building capacity, forming partnerships and developing projects from beginning to end, and engaging resources for cross-sector, non-traditional partners, collaborative opportunities to address critical issues in innovative ways.

3.5 Panel of social science, arts, and humanities scholars: Looking at sustainability challenges in cities of different sizes through the lens of arts and humanities and human dimension

Panelists: Devin Hunter, University of Illinois, Springfield
Ladd Keith, University of Arizona
Mario Longoni, Field Museum
Patricia Romero Lankao, NREL and UChicago

Moderator: Anne-Marie Hanson, University of Illinois, Springfield

Panelists for the arts, humanities, and social sciences panel represented scholars of history, anthropology, urban planning, and sociology. The goal of this panel was to discuss the water, energy, and/or climate challenges and potential solutions from perspectives in the arts, social sciences, and humanities. Panelists addressed the specific ways in which the arts, humanities, and social sciences can contribute to urban sustainability within broader interdisciplinary research initiatives. Panelists gave examples from their own research that focused on: (1) the main drivers of water, energy, and/or climate challenges in the urban communities in which they

work, (2) the social science and humanities approaches that are useful for framing these challenges in Great Lakes/Midwestern urban environments, and (3) the key interactions between the humanities and other sectors (municipal leadership, sciences, businesses, etc.) that need to occur in the search for solutions to water, energy, and climate challenges.

Each panelist brought up important aspects of humanities and social sciences that are too often relegated to advisory or non-essential status within large-scale sustainability research endeavors. Devin Hunter began by describing the role of historians and histories of urban planning and neighborhood studies for understanding the social drivers of current urban infrastructure. He described that for many cities, public history, heritage studies, and museum studies have much to contribute to sustainability research, because they connect with local people, past and present, and may lead to more community involvement in planning for futures that connect to local histories. Ladd Keith and Mario Longoni discussed the relevance of community-based and participatory research for urban sustainability. Keith described work linking urban planning and climate change. He suggested that interviewing urban planners through participatory research is one way to better incorporate known infrastructure risks with climate/water/energy needs and projected future problems. He suggested that there are several barriers to collaboration between these sectors, due to shifts in political leadership and public support; there are also many issues related to climate communication within cities of different sizes and rural areas. Longoni advanced these ideas through descriptions of participatory research in nine Chicago communities. Of particular importance are communities who do not feel represented in municipal politics and urban planning. He described the need to use language and frames that are meaningful to communities. This can include cultural traditions such as art, poetry, storytelling, or culinary arts. Participatory and community-based research linked to municipal and urban planning can be a key way to connect research and practice, by incorporating the views of those who are most affected by poor urban planning and poor climate change preparations. Patricia Lankao finished the session by describing that the systems-thinking often used in studying climate and energy concerns needs to expand to include social systems, not just anecdotally, but in practice, right now.

The audience had many questions that revolved broadly around topics of behavior change, policy change, and the scaling up of community-based studies. The discussion was lively and pointed to gaps in understanding among different sectors at the conference. This discussion also alluded to future opportunities for convergence research that more effectively links participatory, community-based work in arts and humanities, with climate science and fast-paced technology and business sectors to promote urban climate action within a short time-frame.

3.6 Panel of technical, earth and natural science scholars: Engineering perspective to urban woes and potential solutions across scales

Panelists: Aaron Packman, Northwestern University
Alan Hamlet, University of Notre Dame
Luis Bettencourt, University of Chicago
Xuhui Lee, Yale University

Moderator: Ashish Sharma, UIUC

In the final panel in the series, technical experts offered an "Engineering perspective to urban woes and potential solutions across scales". Panelists included Aaron Packman, Northwestern University; Luis Bettencourt, University of Chicago; Alan Hamlet, University of Notre Dame; Xuhui Lee, Yale University. Ashish Sharma (UIUC) held the role of moderator.

Aaron Packman argued that engineering solutions require collaborations and partnerships between researchers, governments, and communities to predict and reduce extreme weather impacts for urban areas. At the same time, there is a need for improved climate predictions to enable urban design for resilience, especially to reduce disparities in flooding and air pollution impacts in urban areas. Finally, he proposed that new sensing, simulation, and data analysis approach can enable real-time forecasting for disaster response.

Alan Hamlet discussed the need for sustainable adaptation measures to urban heat impacts and urban hydrometeorological extremes. He illustrated with pictures and examples of how green infrastructure and solar air conditioning can be used to minimize heat impacts without increasing the greenhouse gas footprint from urban environments. He also discussed the need to manage our current non-stationary environment which has already expressed itself in unprecedented extreme precipitation in many cities (e.g., stormwater flooding in Toronto 2005, 2013, a 1000-year rainfall in South Bend, IN in 2016, and a recent 2500-year flood event in the St. Joseph River in 2018 that produced extensive flooding and infrastructure damage.)

Luis Bettencourt stressed that as residents of cities, we are a part of urban problems and solutions. We should change our perspective and do not consider cites as a series of issues, but opportunities. We should put efforts to understand how cities are operating, what commitments are already in place and then discuss future challenges and designing solutions. Urban areas face three critical ingredients, viz., climate, continued growth, and equity, and it forces the residents and institutions to work in different ways. He argued that with the current rate, we will reach peak CO2 emissions by 2020 and with focused efforts we may be able to reduce emissions by 50% by 2030 and reach zero emissions by 2050. To achieve this goal, as engineers we need to build pathways with traction for full transformations. The pathways need to be aggressive. We need to seize commitments at national, city and community levels, give targets, localize goals in ways that make them personal in nature, and capitalize on the natural churn of infrastructure to create change.

Xuhui Lee reminded the participants that with increasing global and urban temperatures, some cities across the globe will likely become uninhabitable by the year 2100. We are seeing this trend with the hottest year records over the last 10 years. Hot and muggy weather is bad for humans. He argued that the physiological stress of heat humans is perhaps the biggest climate threat to urban sustainability. Therefore, climate adaptation must become a central part of any urban resilience strategy, particularly in parts of the world where a substantial portion of the population works outside. Urban habitability calls for innovative solutions to re-engineer the global urban landscape.

Moderator Ashish Sharma initiated a discussion with the panelists on the ways in which the engineers and technical experts can help design future urban infrastructure and/or provide pathways that can improve resilience to climatic shocks and also improve robustness. This is particularly important as cities are different in sizes and have different available resources. At the same time, engineers and technical experts need to think about urban interactions within different subsystems and identify engineering tipping points to improve resiliency and the overall urban metabolism occurring at different spatial scales. The panelists confirmed that this is a critical point and they think we need i) better information, ii) local high-resolution real-time monitoring

and iii) innovative approaches to support engineering design for the future. This is critical as we humans have a reactionary response to a crisis. For example, before the Toronto stormwater event in 2005, climate change impacts were not on the city's radar screen, and after the event adaptation was inadequate to avoid impacts in 2013. We need to change our approach so that adapting to a non-stationary environment is business as usual, rather than crisis management.

Everyone agreed on the idea of integrating human and natural systems in urban engineering solutions, but the solution pathways are not fully established. Adaptive natural systems would require the integration of natural and engineered systems. For example, facilitating surface-groundwater interactions for water storage and flood reduction, and reducing surface evaporation could be tied to the concept of designing and integrating green infrastructure for multiple ecosystems services in cities. The panel also discussed the use of solar energy in multiple urban applications. Lastly, the panel along with workshop participants acknowledged that there are not only technical gaps in urban sustainability discussions and that while progress is being made in closing the language gaps between urban disciplines, these still hinder the speed of solutions and integration of interdisciplinary urban solutions.

4. Summary of Breakouts / Group Activities

4.1 Overview of Day 1 Working Group Activities

Day 1 of the workshop included three working group activities. In the first two, participants identified critical problems, causes and consequences, lever points, facilitators, and barriers to change for water, energy, and climate-related issues. These activities formed the basis for the third activity focused on identifying and recommending some solutions.

Activity 1: Participants were split into small groups, with each group assigned a specific city (represented by the panel, rural, small urban, medium urban, large urban) and a critical problem (energy, water, climate). Each group self-selected a facilitator and a scribe. They discussed the issues raised during the panel discussions and the word cloud prepared for each group, and as a group, decided on one issue related to their city size and critical challenge. Each group developed a diagram of critical causes and consequences, and identified lever points (policy, technology, behavior) for effecting change. The facilitators reported back to the entire group.

Activity 2: Working in the same groups, participants expanded upon their group's diagram from the prior activity by including facilitators and barriers to change. They drew on how different types of actors and organizational factors influence the causes and impacts of the water, energy, and climate challenges in the causes/consequences diagram.

Activity 3: The groups then expanded their diagrams by adding promising solutions towards water, energy, and climate sustainability in a city of the size they represented. Results are shown in Figure 3.

The physical output of the working group activities was a series of large diagrams, one for each group. The diagrams contained the following layers of information. The base diagrams identified critical problems, causes, and consequences related to the city size and major challenges for each group discussed. The next layers consisted of color-coded post-it notes representing facilitators, barriers to change, and potential solutions. Groups took different

approaches in recording this information, and while there was some leeway given and variation in the forms of the diagrams, the overall objectives of the activity were met.

4.2 Overview of Day 1 Activity Output Diagrams

Below are descriptions of the diagrams, as a collective and relative to each other, focusing on commonalities and discrepancies across city size (large urban, medium urban, small urban, rural) and critical problem addressed (climate, water, energy). The descriptions are first provided based on commonalities and differences across city sizes, followed by the critical problem being addressed.

4.2.1. Commonalities and Differences Based on City Size

4.2.1.1 Large Urban

Three groups completed diagrams for large urban areas. One group focused on engagement about climate change issues and two focused on water quality. The water quality groups are combined in one diagram in the panel figure. Condensed figures are included in Figures 1 and 2.

Commonalities: The large urban groups agreed on the following common set of causes and consequences: climate change and extreme weather combined with complexity, difficulty engaging people, fragmented governance, poor infrastructure, and inadequate regulations result in impacts on public health and animals, loss of recreation, and more inequality. Education, engagement, transparency, data availability, green technologies, and integrated, regional management were identified as levers. A variety of NGOs, advocates, politicians, government bureaucracies, and residents were identified as potential facilitators of change, while conflicting interests, short-termism, politics, and funding needs were the identified barriers. A wide range of common solutions were noted, and many related to better information and engagement, lower energy use in buildings, and using new approaches to water management. Other recommendations included a "green new deal" approach, new incentives to change behavior, and specific proposals for unified water management and banning single-use plastics. A logical reason for the seeming overall agreement is that Chicago tends to dominate as the one large urban area in Illinois, and is central to the conventional narrative for climate change, energy, and water in Illinois, rendering its issues well known.

Discrepancies: Specific issues relating to the challenges each group focused on emerged. The climate change engagement group had fewer items overall in their diagram, while providing additional variables such as risks to businesses and barriers posed by private industry groups. Solutions proved to be the most wide-ranging from efforts related to engagement, such as banning special interest lobbying, remembering it's not essential to convince everyone before making decisions and using social media, to more general climate change solutions including ways to incentivize public transit and to price carbon. The water quality group provided some water-specific causes (including zoning, dependence on groundwater, and lead service lines), barriers (the perception there's no water problem in Chicago), and solutions (decentralized treatment, buyouts).

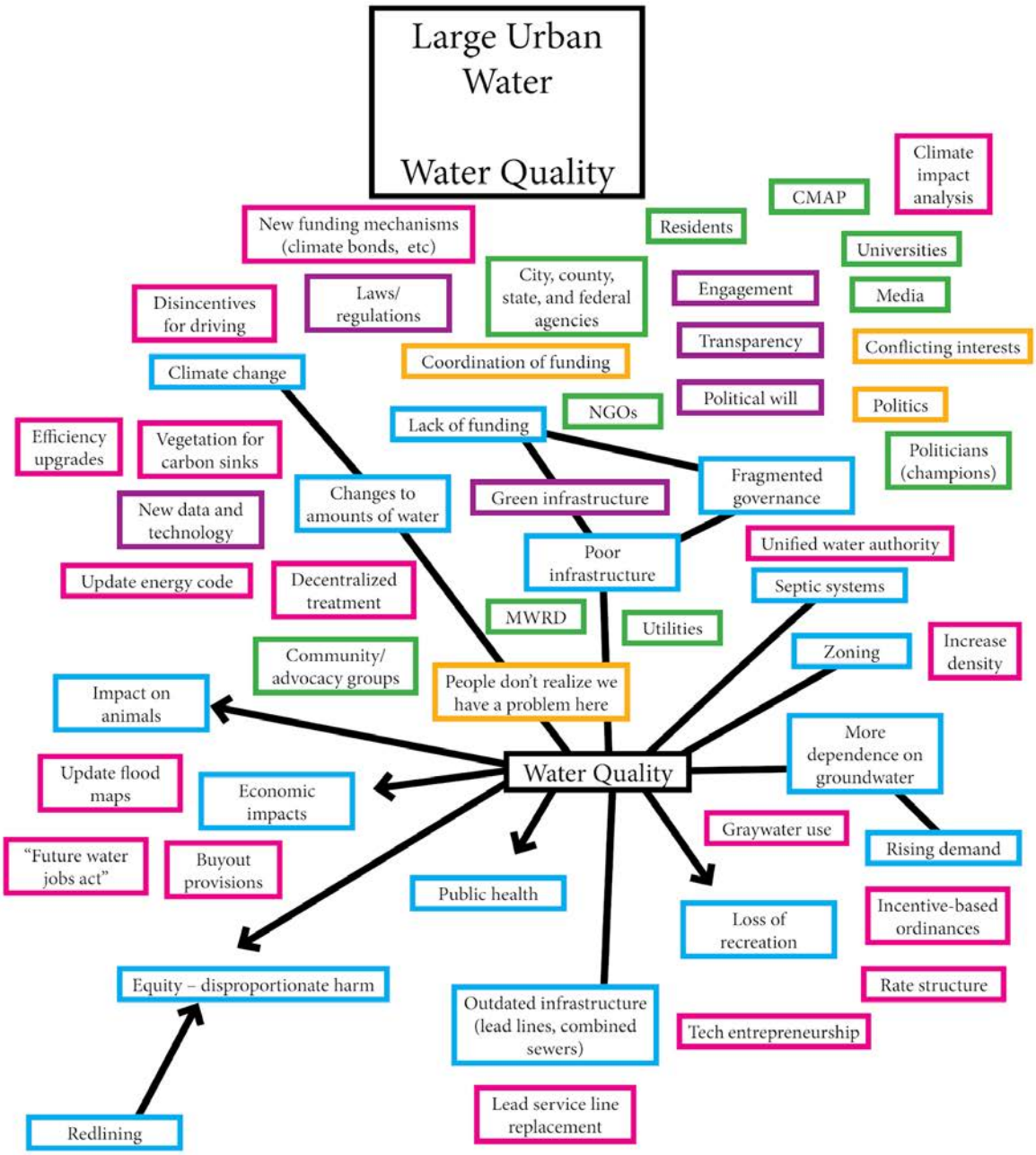

Figure 1: Condensed Diagrams - Large Urban Cities (Water Quality)

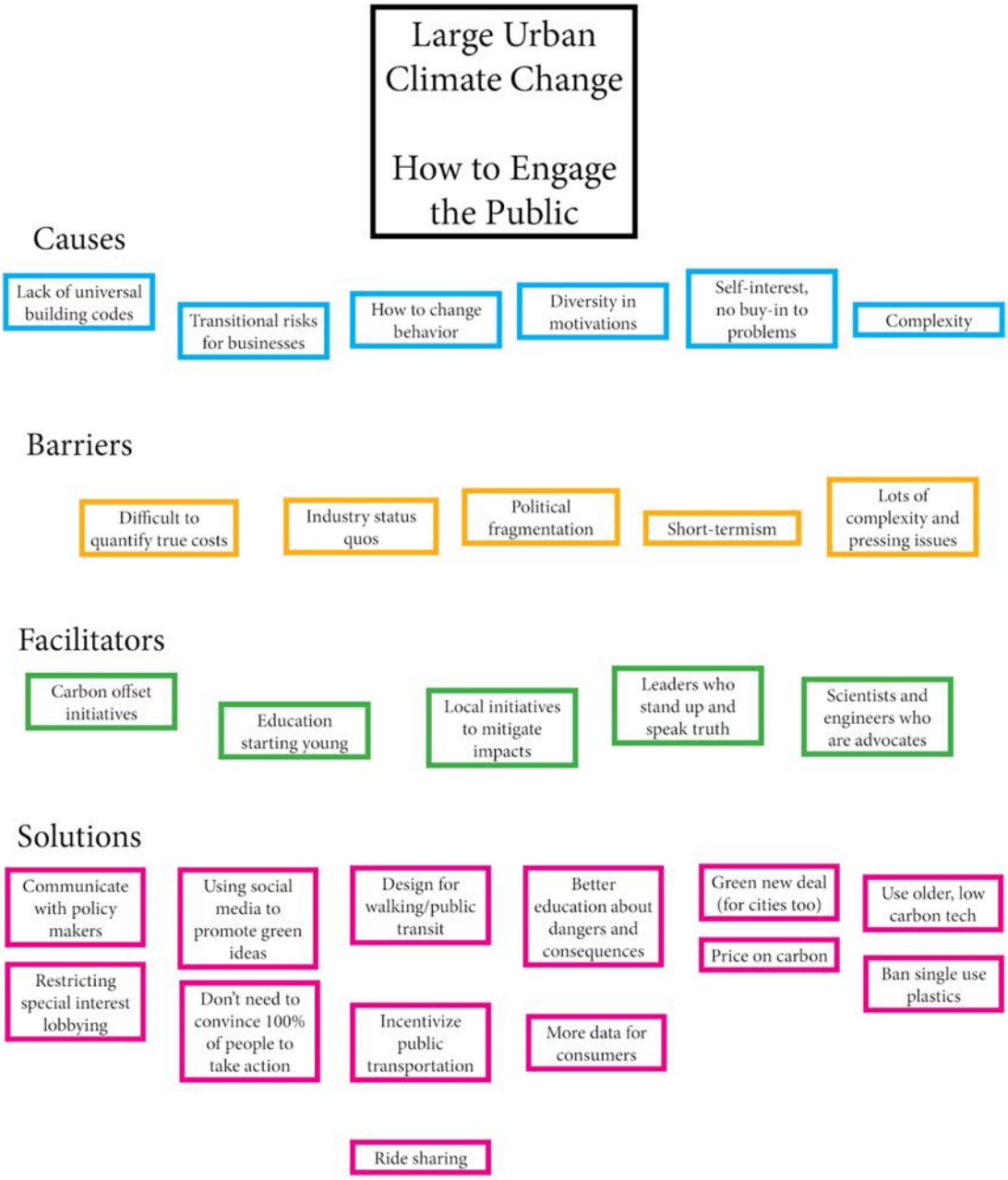

Figure 2: Condensed Diagrams - Large Urban Cities (Climate Change)

4.2.1.2 Medium Urban

Four groups focused on challenges relating to medium-sized cities. Target problems were flooding, greenhouse gases, climate migrants, and energy use. The two groups that focused on climate problems (greenhouse gases and climate migrants) created diagrams that had fewer issues in common, so they are left separate. Figures 3 to 6 capture the groups' outputs.

Commonalities: Commonalities related to a basic network of causes and consequences: market forces, fixed infrastructure, and land use, fossil fuel use, high energy use, and inefficiency contribute to climate change, which causes extreme weather and climate impacts including those to health, inequality, and storm damages. Planning for resilience, better government policies and public education were identified as levers for change. Utilities, lack of pricing for carbon, the difficulty of doing retrofits, inertia, and difficulty changing behaviors were noted as barriers, while better information about energy use and best management practices, better building codes, carbon tax dividends, community leaders, and community partnerships were acknowledged as facilitators. Incentives designed to change behavior emerged as the one broad category of solutions in common between the groups.

Discrepancies: Since there are a wide variety of medium-sized cities, the groups appeared to not less in common between the groups when compared to the large urban groups. Although the flooding group produced a diagram with much less detail and fewer variables, there was a noticeable emphasis on levers, facilitators, and barriers related to regional cooperation and planning for entire watersheds. The climate migrant group also had a simpler diagram, with the difference being that extreme weather leads to less water availability, migration to areas with more water, and increases in demands on infrastructure and for services and energy. Unique barriers to change were noted as lack of opportunities in rural areas and resources being devoted to larger cities. Faith communities emerged as a unique facilitator for this group and city size. The energy use group presented unique barriers to franchise agreements and the use of jargon, while using policy to capture efficiency gains was noted as a facilitator. The group identified a number of additional solutions that were regulatory (energy use intensity targets) and incentives-based (sustainability awards and taxes). The greenhouse gas group provided additional insights for cause (lack of transportation alternatives to driving), levers (technologies for power storage and distributed generation), barrier (extractive industries), facilitator (declining cost of photovoltaics), and solutions (incentives for engagement by academics, removal of barriers to transportation electrification).

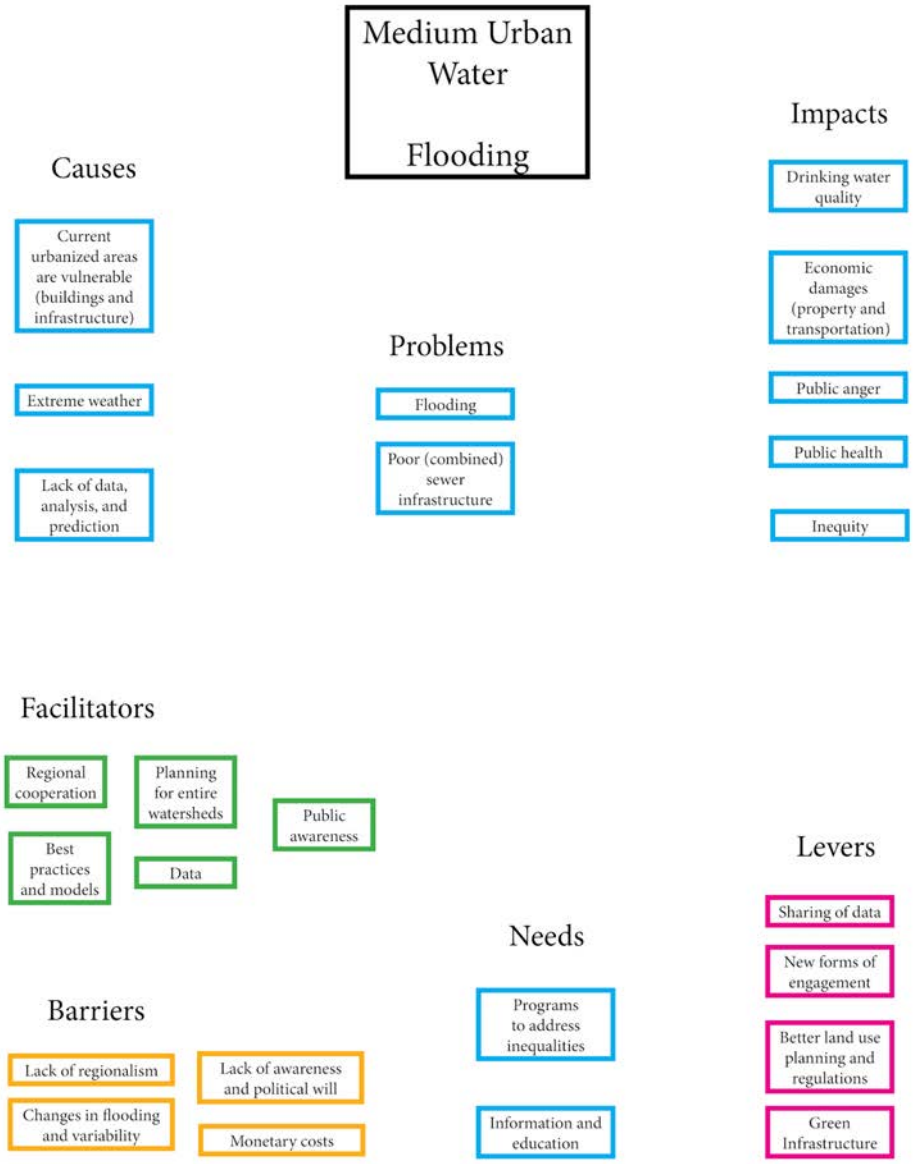

Figure 3: Condensed Diagrams - Medium Urban Cities (Flooding).

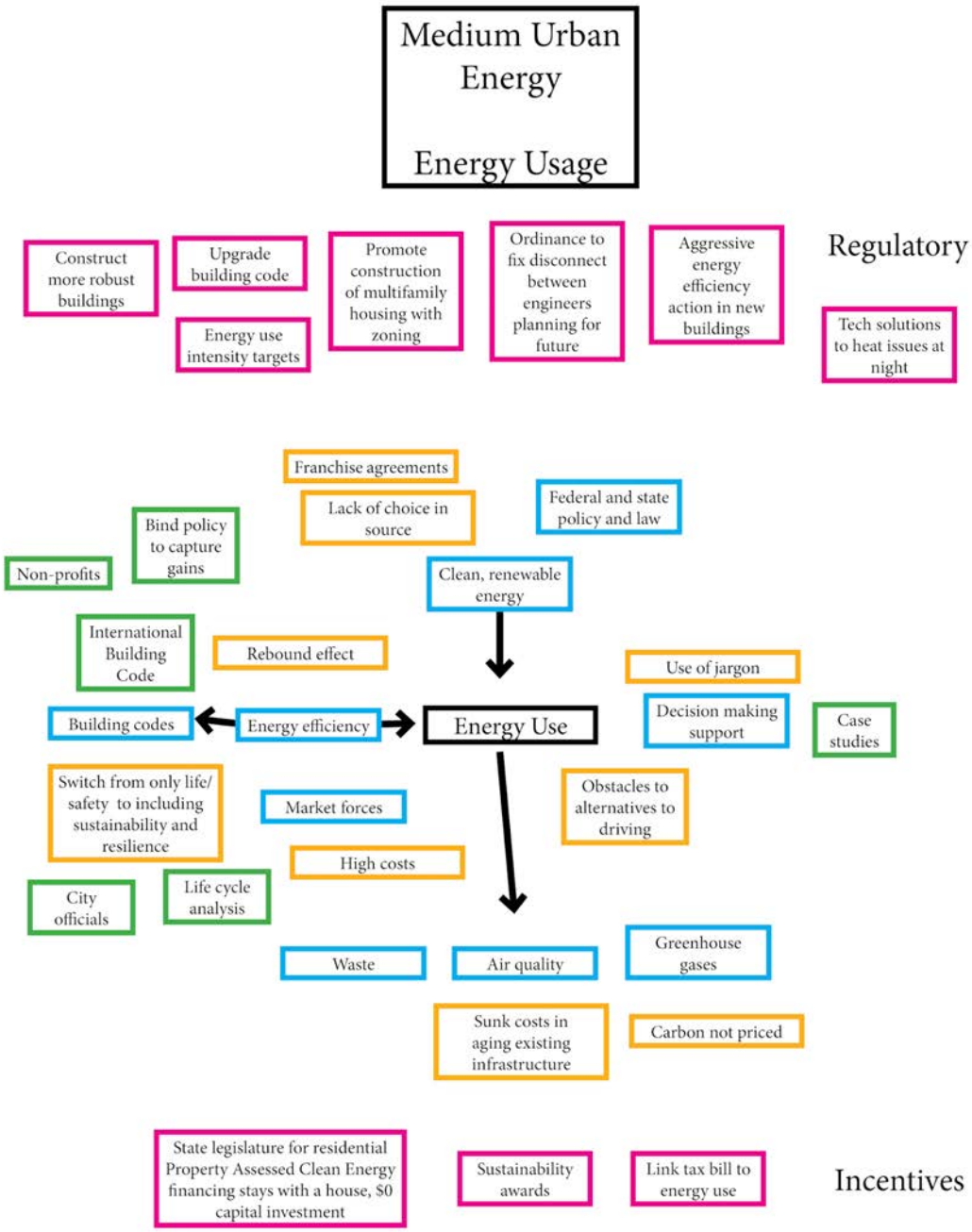

Figure 4: Condensed Diagrams - Medium Urban Cities (Energy Use).

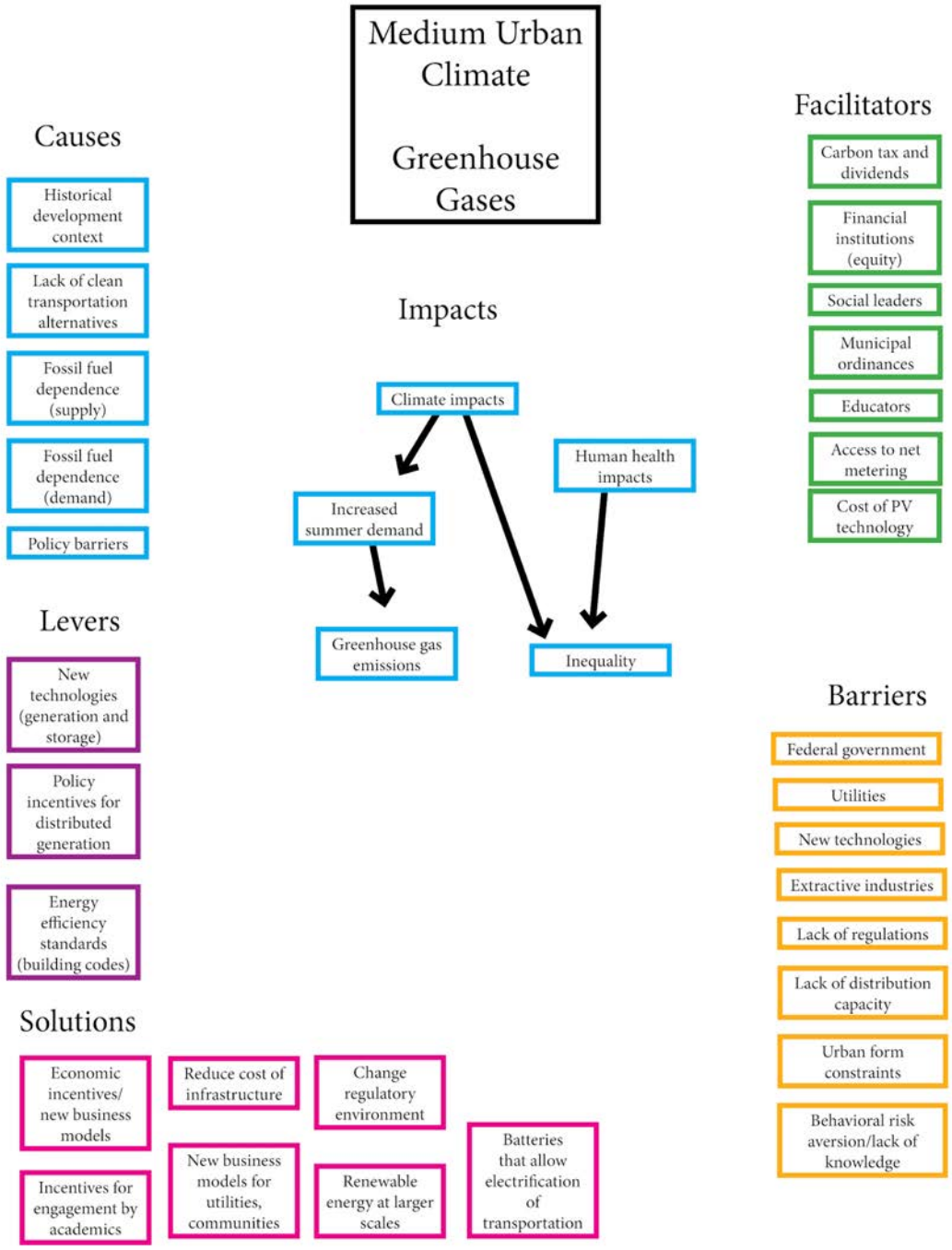

Figure 5: Condensed Diagrams - Medium Urban Cities (Greenhouse Gases)

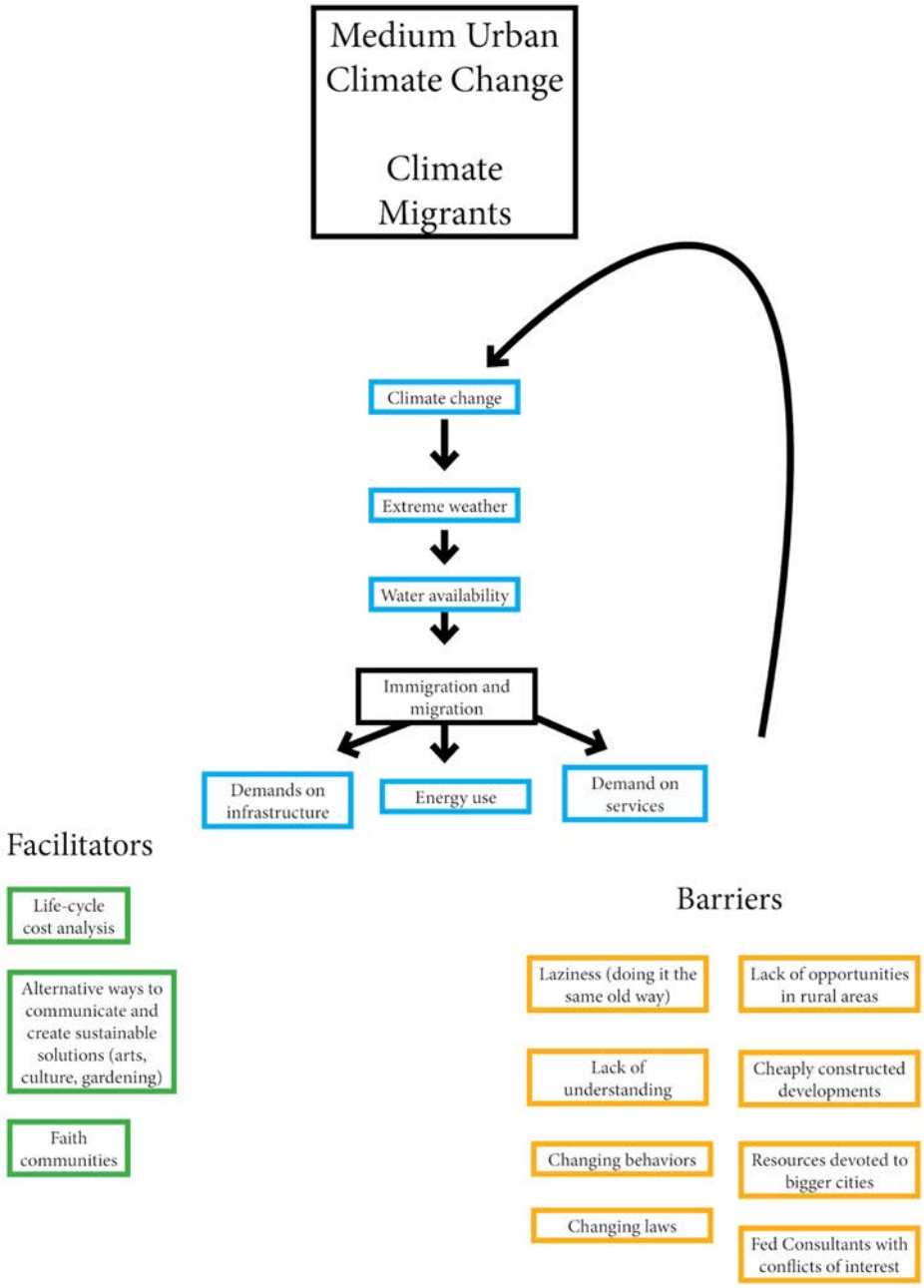

Figure 6: Condensed Diagrams - Medium Urban Cities (Climate Migration)

4.2.1.3 Small Urban

Three groups focused on small urban areas. The themes for these groups were water insecurity, out-migration, and unsustainable energy. Figures 7 to 9 capture the activity outputs for those groups.

Commonalities: There is a common network of underlying issues that contribute to climate change: extreme weather, unreliable and inefficient energy, poor infrastructure, fragmented resources, low municipal capacity, problems competing for scarce resources, and poor communication. This apparent lower quality of life impacts small urban communities through population losses, brain drain, inequality, a reduced tax base, and a degraded environment. Levers were noted as research, incentives, and education. Barriers identified included lack of willingness to change, local leaders, and financing issues. Facilitators included local activists and politicians, regulations, investors, researchers, and educators. There were two broad classes of common solutions: incentives to change behaviors, and implementation of innovative technologies.

Discrepancies: Like with medium-sized communities, there were a host of different types of small cities with different problems, thus the many discrepancies between the diagrams. The water group identified a large number of variables, which was compacted greatly, and some interesting and novel solutions, including the use of composting toilets, a new flexible distribution network for potable water, and applying green infrastructure on very large, citywide scales. The energy group had little that was not in common with the other groups, except for one consequence (resentments, distrust of others due to lack of self-reliance) and one barrier (franchise agreements).

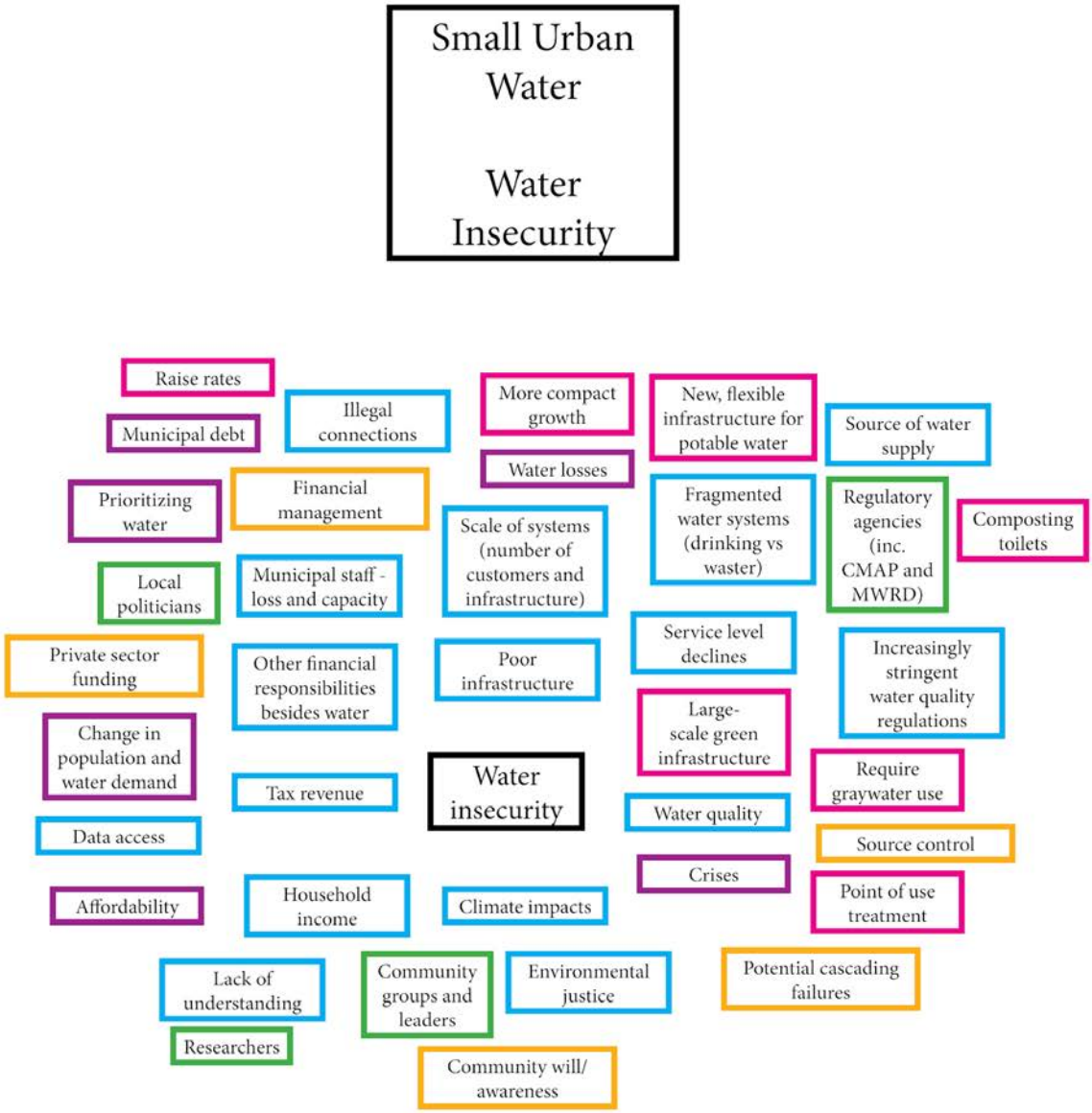

Figure 7: Condensed Diagram - Small Urban Cities (Water Insecurity).

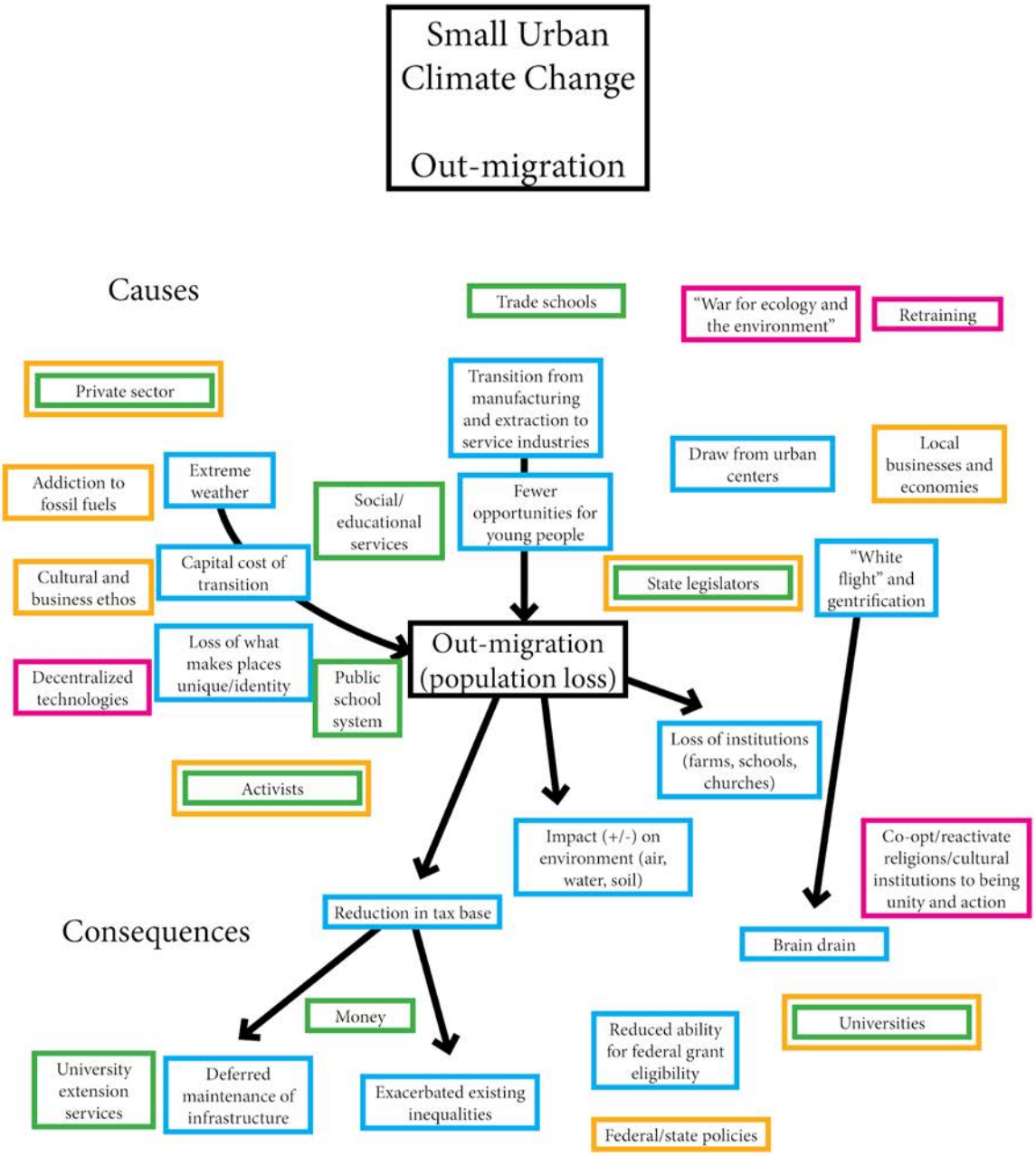

Figure 8: Condensed Diagram - Small Urban Cities (Climate Migration).

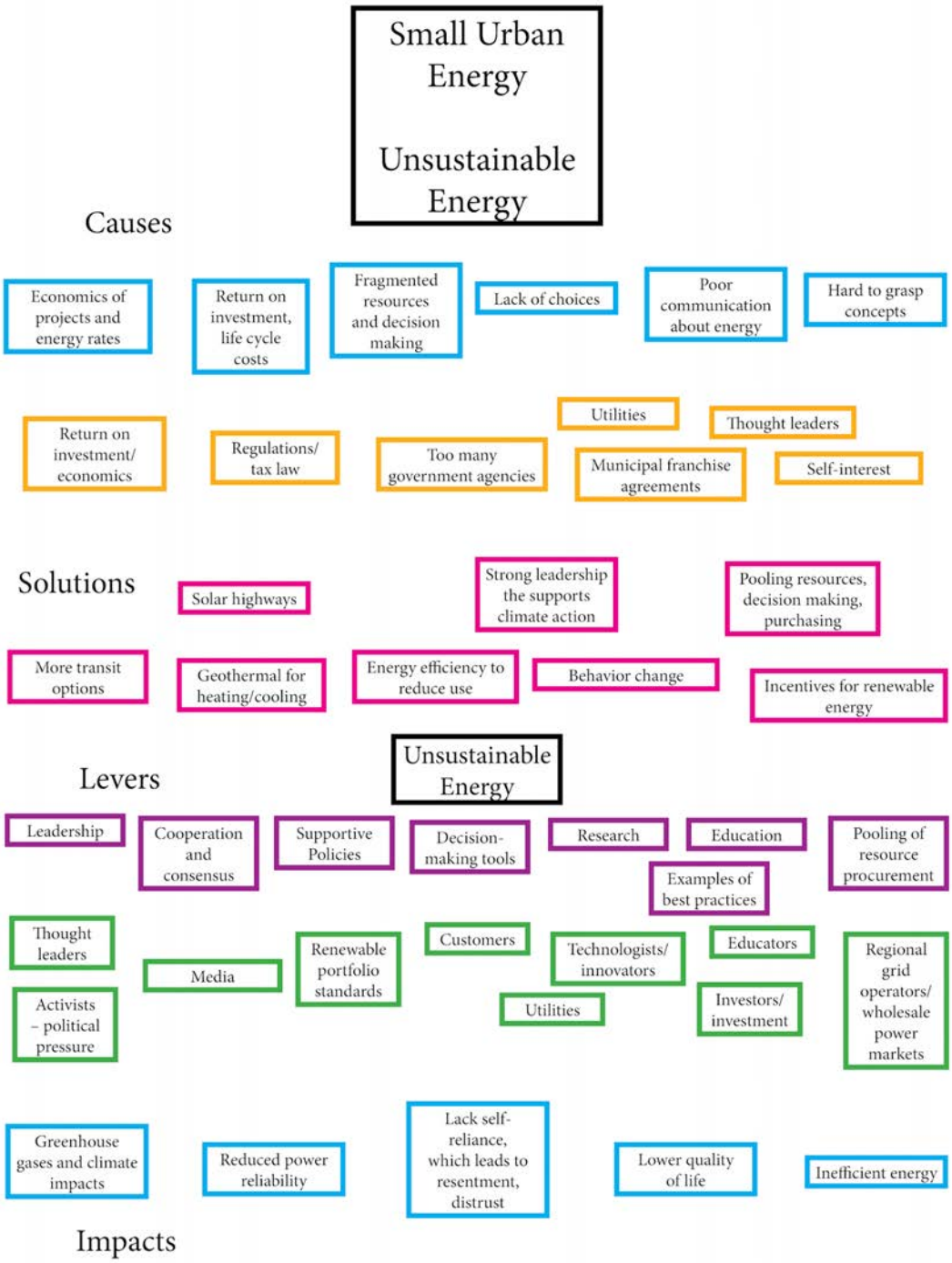

Figure 9: Condensed Diagram - Small Urban Cities (Unsustainable Energy).

4.2.1.4 Rural Communities

Three groups completed diagrams about rural communities – one focused on water quality and quantity, one on energy reliability, and one on energy and water (subtopics of renewable energy, water infrastructure, adjusting to temperature changes, and water availability and quality). In the diagrams in the panel figure, the variables of the group that focused on energy and water are split between the rural/energy and rural/water diagrams. Figures 10 and 11 capture the activity outputs for those groups.

Commonalities: A common framework of causes, consequences, and levers emerged. Climate change impacts related to extreme weather and the effects on agriculture (e.g., irrigation and wells) featured strongly. There was also a sense of helplessness, lack of information, and few resources to combat the changes; many rural communities boards are made up of individuals with other full-time jobs. A weak economy leading to population decline and poor infrastructure was noted. Education and individualism were identified as key levers. Utilities, insularity to change, farming practices, short-term oriented village planning, lack of resources, and fragmented governance were barriers. Universities, regional collaboration, state and federal bureaucracies, were noted as key facilitators. Common solutions focused on solar technology, better training, and outreach, identifying local champions with high trust to be advocates, and ensuring that planning efforts focus on rural communities, not just large cities.

Although Chicago and medium-sized cities face pressing issues of their own, market forces still lead to dynamic private sector investments. Smaller cities and rural areas, on the other hand, face decline, with increasingly limited options, and relying on help from state and federal government programs. Rural residents being more resistant to change, partly due to a strong sense of individualism was also noted. However, this is a paradox since the state and federal government rather than markets tend to provide the most readily available solutions. One important asset identified by the groups that can counter this in rural areas was a strong sense of community.

Discrepancies: The groups developed non-overlapping issues related to their specific problems. The energy groups focused more on monopolies and high energy costs. The water groups discussed agricultural runoff, stress to animals, septic systems, and drainage and proposed solutions including removal of dry waste from the water, acreage fees, and creating a helpline (1-800-well-help).

Figure 10: Condensed Diagram - Rural Communities (Water).

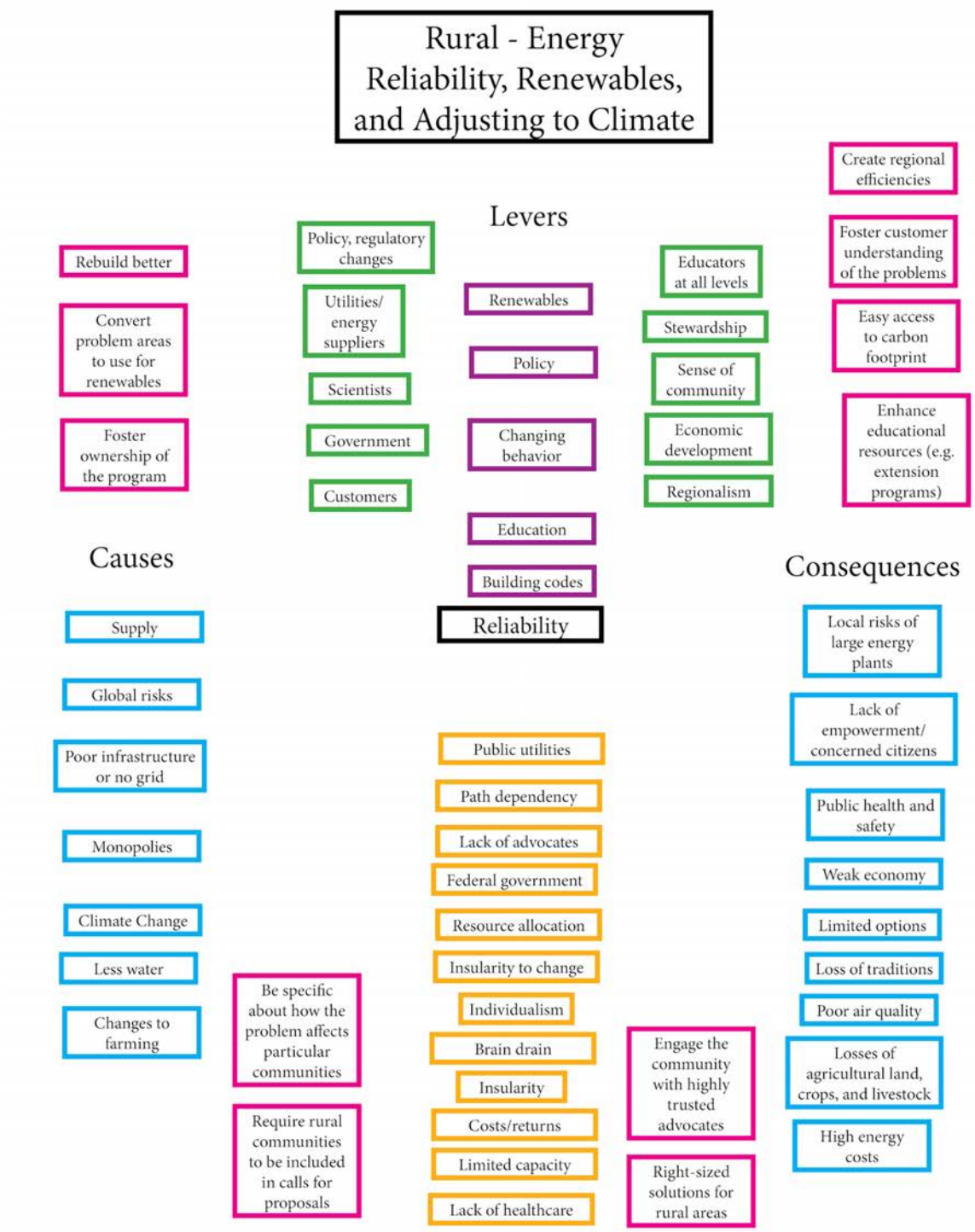

Figure 11: Condensed Diagram - Rural Communities (Energy).

4.2.2. Commonalities and Differences Based on Critical Problems

4.2.2.1 Climate

Four groups discussed climate change problems: engagement around climate issues (large urban), greenhouse gasses (medium), climate migrants (medium) and out-migration (small). The two groups that focused on medium-sized urban areas (greenhouse gases and climate migrants) created diagrams that had fewer issues in common, and are left separate.

Commonalities: The common causes and consequences focused on climate impacts, extreme weather, financial risk, poor infrastructure, fewer local opportunities, migration, inequality, public health, and changing demands for services. The common levers were distributed energy systems, new technology, better building codes, new business models, and new forms of incentives. Barriers identified included: the private sector (including utilities and extractive industries), fossil fuel dependence, short-term financial stresses, local politics, the complexity of information, and difficulty changing behavior. Local initiatives, community leaders, comprehensive education, and new financing mechanisms were noted as facilitators. The only common solution that emerged was a general sense of the need for a large government intervention like the "green new deal" to reduce greenhouse gasses and reorganize the economy.

Discrepancies: The large urban group devoted several variables related to supporting transit use and individual incentives to change behavior. Medium cities identified several variables related to constraints placed by historical development patterns, urban form, and new construction. The small urban group listed one distinct consequence as the loss of a place's identity and proposed a solution strategy to co-opt religious and cultural institutions to foster unity about climate action.

4.2.2.2. Water

Five groups discussed water: two large urban groups discussed water quality and were combined on the panel figure; one group focused on flooding (medium urban); one focused on water insecurity (small urban); and two rural groups worked on water-related issues (both on water quantity, one additionally on water infrastructure), which were combined into one diagram on the panel.

Commonalities: Climate change and extreme weather have cascading effects that cause impacts on agriculture, public health, inequality, and finances. All cities have water infrastructure in poor conditions or outdated and they have bad choices about how to fix them. Individuals are overwhelmed with the complexity and struggle to deal with rising bills and damages. Fragmentation in the water supply system and in planning as a result of not being based on entire watersheds are significant barriers. Levers included better data, regulations, and engagement. Common solutions identified were heavily focused on ways to create new incentives, foster regional approaches, provide better data and understanding to residents, and do better engagement. There was less emphasis on technology since answers are already known, but it's difficult to finance upgrades to infrastructure or build green infrastructure.

Discrepancies: The large urban group diagram had one additional key barrier -- the perception that Chicago does not have a water problem at all, -- and one unique type of solution -- buyouts for property in at-risk areas. The small urban group suggested some unconventional solutions, including a new flexible network for potable water, composting toilets, and large-scale green

infrastructure ("turn Chicago into a swamp"). Rural areas have had especially distinct water causes and consequences compared to urbanized areas, due to agriculture: irrigation, agricultural runoff, septic systems, abandoned and contaminated wells, and drainage. They also faced weaker economies and depopulation. Insularity and absentee landlords are barriers, while stewardship of the land was noted as a facilitator. The rural group proposed unique solutions in response to these issues, including removal of dry waste from the water, acreage fees, and creating a helpline (1-800-well-help), filtering water, limiting daytime watering, and reestablishing USDA conservation districts.

4.2.2.3. Energy

Four groups focused on energy issues: energy use (medium urban), unsustainable energy (small urban), energy reliability (rural), and renewable energy and adjusting to rising temperatures (rural). The rural diagrams were combined into one diagram for the panel figure.

Commonalities: Communities of all sizes faced the same issues of reliability, lack of choice in providers, affordability, financing of projects, and difficulties in understanding energy use. Barriers included municipal franchise agreements, utilities, resistance to change, and lack of effective advocates for change. Scientists, better information and analysis, non-profits, and state and local officials were identified as facilitators. Federal and state policy were noted as the levers, and solutions focused on better information for consumers and policymakers, better ways to analyze costs of projects, new building codes, changed rate structures, and encouraging renewables to reduce greenhouse gas emissions.

Discrepancies: The medium urban group suggested regulatory changes (to capture gains made by efficiency improvements to avoid rebound effects) and incentives (sustainability awards). The small urban groups placed more of an emphasis on new technologies, such as geothermal exchange and solar highways. The rural groups focused on the dangers inherent from hosting large energy plants and the economic effects of the decline in coal mining.

4.3. Overview of Day 2 Workgroup Activities

On Day 2, participants had the opportunity to select, based on personal interest, from among the problem-solution pairs that were identified through Day 1 activities. Five groups of participants were formed for the purpose of further developing ideas around the following problem-solution pairs which drew the most interest among the participants (in no specific order of interest):

- Water & green infrastructure
- Flooding and decision support systems
- Climate-induced migration (medium cities)
- Greenhouse gas production and utility-scale solar production
- Greenhouse gas production/pollution and new business models for utilities
- Greenhouse gas production/pollution and economic incentives for practice change
- Greenhouse gas productions/more renewables
- Unsustainable energy use and investment in energy efficiency
- Unsustainable energy use and more renewables

The general interest areas around which the subgroups were then organized included:

1) Green infrastructure

2) Decision support (consumer)
3) Renewables/solar
4) Building coalitions between cities/regional planning
5) Building new business models/financing options/economic models

Each group, once formed, then went on to complete Activities 4 through 7. The participants identified and prioritized actions, projects to undertake, and deliverables (Activity 4). They then flushed out some of the details needed to start such projects (Activity 5). In so doing they identified resources available/needed (e.g., key technology, point people, institutional and funding sources, other collaborators, etc.), as well as issues, concerns, and barriers that need to be overcome as part of the implementation process. They worked on shaping the network needed to help ensure the continuation of the identified projects (Activity 6). As such, communication methods, initial goals and deadlines, and point people were identified. Finally, prior to the close of the workshop, a representative from each group presented a summary of each group's planning efforts to the other groups (Activity 7).

The physical output from Day 2 group activities included a range of documents. While the main ideas or 'takeaways' from each group were recorded in different ways (some on provided worksheets, some on paper or in drawings), each group completed a form that contained the following subsections: (a) name of the group facilitator and the scribe, (b) description of the problem, (c) action needed, (d) resources available, (e) resources needed, (f) key technology, (g) point people, (h) other collaborators needed, and (i) issues or concerns to be addressed. In addition, each group prepared a contact list for the group.

4.4 Overview of Day 2 Activity Output Diagrams

4.4.1 Solutions

By bringing together interdisciplinary groups of people from different professional areas of expertise, solutions were generated that spanned the spectrum of ideas to advance water and energy-related sustainability across communities. These included:

- A proposed pilot project (demonstration site) for solar photovoltaic renewable energy generation and storage at the community scale
- Creating a toolkit of options for the adoption of aggressive energy codes for new and existing buildings
- Learn from other cities that are doing water and energy benchmarking (e.g., Chicago, Evanston)
- Building a generalizable framework that cities can use for green infrastructure across the country (a database)
- Creating an asset map of decision support systems to enable better decision-making theory for green infrastructure optimization
- Building communication platforms to market and promote solutions to small businesses, residential markets, and institutions
- Housing as infrastructure - incentivizing PACE in Cook County through information
- Citizen commission capacity building to support and connect citizen commissions

The challenge of working in the area of sustainability is not a lack of existing resources. It is that they are not compiled in an easy to find, easy to understand or easy to use way whether for ordinary citizens or for professional and municipal leaders for planning, policy and

implementation in the real world. This workshop was useful in bringing together a diverse group of people to help identify existing resources, such as models for GI optimization, many types of data sets from government and businesses, codes, policies and programs from other cities, existing municipality networks, Greenest Region Compact, previous studies, US Green Building Council, universities, and some financing sources. Finding ways to leverage these resources in ways that best address challenges faced by cities of all sizes would provide insight that is not currently available.

In order to move projects forward, funding seems to be the key resources needed. Other supportive resources that need bolstering include buy-in and forward-looking regulations from policy makers, training for end-users, GIS technical staff, time, aggregation of best practices/cutting-edge practices, tools and templates for different size communities, marketing of solutions, municipalities to pilot utility-scale solar/storage, social and political science expertise, convening and digital/website support, social media, and financing benchmarking hardware and software. Funding sources span the spectrum from private investment, federal and state grants, foundations, and fees for services.

4.4.2 Communication Networks

The groups were asked to identify preferred methods of maintaining a network and communication to make progress on the projects. While only one of them provided this information back on the worksheets, the following is a list of methods generated:

a) Virtual monthly meetings
b) Using Google Docs to collaborate

5. Participant opinions about sustainability and impact of the workshop

Another of the objectives of this conference grant was to identify the impacts of a workshop that brings researchers together with municipal and industry stakeholders. Do participant's opinions about sustainability challenges, solutions and barriers change? Are new ideas and connections created? We surveyed conference participants to explore answers to these questions.

5.1 Pre-conference Survey and Results

Before the CURES Connections workshop, information was gathered from 59 participants to jump-start the event and provided data for this research. The organizers wrote a survey in Qualtrics (approved by the UIUC IRB office) that asked the following questions:

1. In your professional opinion, what key problems and challenges do urban systems face related to water, energy, and a changing climate? Please answer in no more than 200 words.
2. In your professional opinion, what technologies, infrastructures, policies, and actions could be useful solutions to those problems? Please answer in no more than 200 words.
3. In your professional opinion, what barriers, if any, are currently limiting the ability for urban systems to address the issues that you described in (1)? Please answer in no more than 200 words.

We also asked whether respondents would share anonymized answers to questions (1) and (2) with other participants, and we asked several demographic questions (category of profession, discipline, level of education, and gender)

The survey was mailed on July 24, 2019, two weeks before the CURES Connections workshop itself to 121 actual or potential participants. Of those, 77 people started the survey and 61 people completed it (response rate of 50%).

Word clouds were created from the responses to questions (1) and (2) and given to conference participants during the first small group activity, to prompt thinking about sustainability challenges.

The answers to questions (1), (2), and (3) revealed much about the concerns and ideas of the participants. The pre-workshop survey indicated that water issues were at the top of people's concerns, followed by climate and energy. Specific problems noted included flooding, heat, and quality of water, air, and other elements of urban life. Participants were worried about economic conditions and recognized the changing and systemic nature of the problems. The participants noted a range of solutions to these urban sustainability problems. Infrastructure was highest on the list (especially "green"), but respondents also noted changes to transportation, new policies (including pricing and changes in incentives), targeted planning, and education initiatives. When asked about barriers to making a change, participants raised concerns about politics, funding, leadership, and social factors.

5.2 Post-conference Survey and Results

We also gathered information from participants less than two weeks after the workshop took place. On August 20, 2019, we sent a survey to a total of 129 people (the original sample and a few late registrants to the workshop). Of those sent the survey, 43 provided complete responses for a response rate of 33%. This survey asked the same first three questions as the pre-workshop survey and the same demographic questions. It also asked several new questions:

4. As a result of the CURES Connections Workshop, did you make a working relationship with someone new from a different profession or discipline? yes/no
5. Describe 1-2 specific professional actions you yourself could take to address the problems you described in questions (1) and (2). Please answer in no more than 200 words.
6. Are these actions things that you discussed at the CURES Connections Workshop? yes/no
7. On a scale of 1-5 where 1 is not important at all and 5 is extremely important, how important do you think it is for you to actually take those actions?

Of the participants who responded to question (4), 88% reported that they had made a working relationship with someone new outside of their own sphere of work. Of participants who outlined actions they could take to solve sustainability challenges in question (5), 81% stated in question (6) that those were ideas they discussed at the workshop itself. Two-thirds of respondents to question (7) rated the actions they could pursue as extremely important (5 out of 5) and the rest rated their stated actions as a 4 out of 5 - still very important.

A content analysis of responses to the first three questions reveal some subtle but interesting differences. Table 2 shows the word counts before and after the workshop, Figure 12 shows the word clouds before and after the workshop once top words were removed. Post-workshop responses indicate that health has emerged as a highly-noted challenge, and time as a barrier to solutions (reflecting the discussion at the workshop about the rapidity with which climate change would trigger serious and, in some cases, irreversible problems) became more relevant for participants. While policy and infrastructure are still prominent in the list of

solutions, an emphasis on business, finance, and design in solutions emerged post-workshop survey. The overall shifts in importance or emergence of topics and words from pre-workshop to post-workshop responses reflect changes in participants' opinions about urban sustainability challenges, solutions, and barriers.

Table 2. Top Word Counts in Responses to Survey Questions Before and After Workshop

Top Word Counts in Responses to Survey Questions Before Workshop		
Challenges	**Solutions**	**Barriers**
water	water	lack
urban	energy	infrastructure
climate	infrastructure	political
energy	climate	social
change	transportation	solutions
infrastructure	green	change
systems	policies	funding
flooding	improved	agencies
problems	planning	barriers
areas	public	climate
challenges	systems	energy
resources	change	transportation
cities	development	challenges
economic	clean	green
transportation	transit	include
heat	carbon	leadership
quality	education	make
challenge	incentives	people
changing	practices	public
impacts	pricing	sector

Top Word Counts in Responses to Survey Questions After Workshop		
Challenges	**Solutions**	**Barriers**
water	carbon	lack
climate	energy	climate
systems	climate	funding
energy	solutions	political
urban	change	barriers
change	business	change
infrastructure	renewable	issues
flooding	research	policy
issues	based	public
public	infrastructure	don't
challenges	policy	resources
due	needed	social
effects	policies	systems
health	projects	time
heat	storage	communities
increased	battery	effectively
quality	city	environmental
renewable	decision	financial
social	design	incentives
sustainability	financing	level

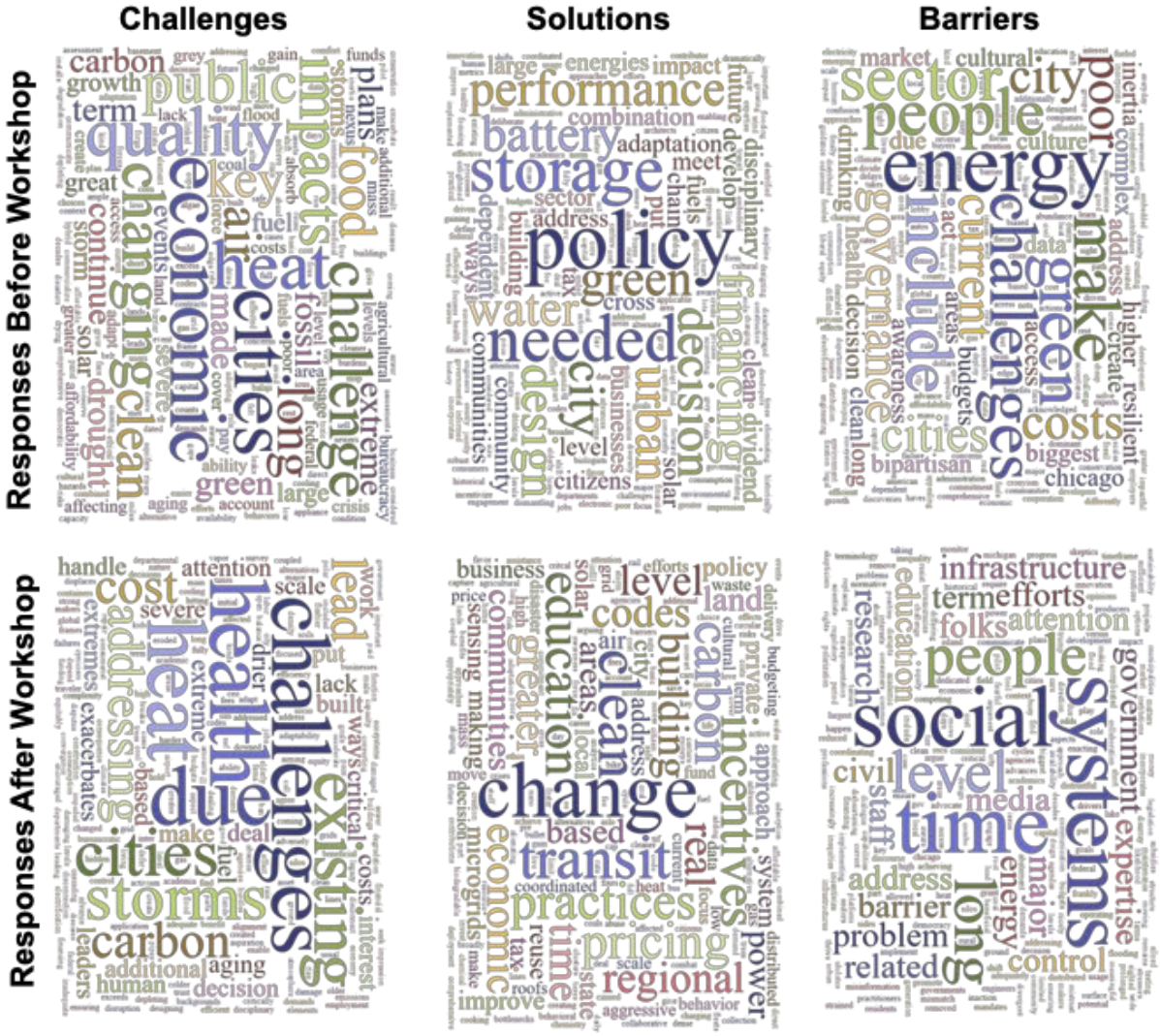

Figure 12: Word Clouds of Responses to Survey Questions Before and After the Workshop.

5. Overall Workshop Outcomes

The confluence of speaker keynotes, panel discussions, and group activities, with the active participation of attendees (Appendix B), from municipal, industry, NGO stakeholder groups, and a wide range of academic disciplines, provided a rich basis for interdisciplinary learning, networking, and project identification and planning. By the end of the workshop, each workshop objective was significantly achieved.

5.1 Identification of factors differentiating sustainability solutions for communities of different sizes (Objective 1)

One of the assumptions underlying the workshop planning was that the effective design and implementation of water, energy, and climate-related solutions for the Midwest requires an understanding of how the causes and effects of water, energy and climate issues vary in cities of different sizes. The information recorded in the group created artifacts, consolidated, and shared during and after the workshop validated this assumption. Section 4 of this report summarized the

commonalities and differences in critical problems, causes, and consequences, lever points, facilitators, and barriers to change for water, energy, and climate-related issues among cities of different sizes.

For example, as it relates to the "causes and effects" of water, energy, and climate adaptation, a few factors were commonly stated by group, regardless of the city size of focus for the group's discussions (e.g., outdated and poor condition infrastructure as a cause of water issues). On the other hand, some were expected to be more salient, or unique to, certain city sizes (e.g., lack of public transportation options in rural communities; economic effects on rural coal communities).

As it relates to the "barriers and enablers" of energy, water, and climate change solution implementation, cities of different sizes deal with several common factors (e.g., the need for large scale interventions and perceived barriers created by the private sector (utilities/extractive industries). However, several barriers and enablers seemed more salient to, or unique to, certain city sizes (e.g., perception that Chicago does not have a water issue as a barrier; rural community residents sense of 'stewardship of land').

5.2 Effects of integrating researchers with municipal and industry stakeholders on research (Objective 2)

The second workshop objective was to understand the effects of bringing together a broad set of stakeholders from industry, academia, NGOs, and government. To this end, an extensive effort was placed on identifying participants who would not only represent this range of stakeholders but who would also be committed and active participants throughout the duration of the workshop.

The resulting demographics for the workshop reflected the desired stakeholder diversity. More than 50% of the 124 workshop participants represented municipalities, businesses, agencies, and NGOs; the remainder were from academia (See Figure 13).

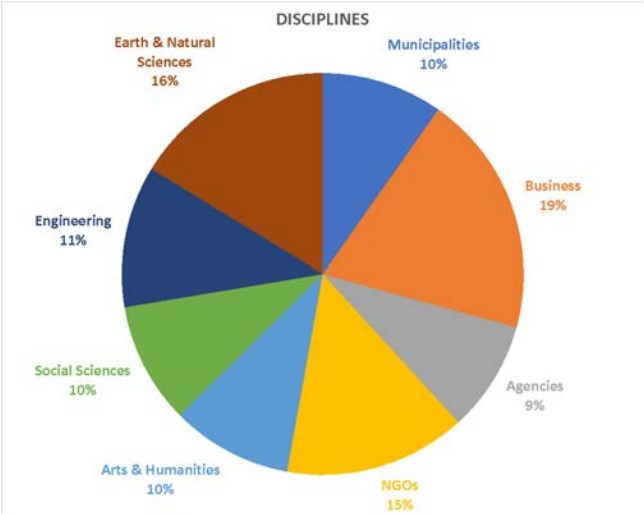

Figure 13: Background of Workshop Participants

Moreover, the workshop participants were very engaged in the activities. The broad stakeholder representation combined with the active engagement (see Figure 14) led to a range of benefits that might not have otherwise occurred in a purely academic or panel format setting:

- Increased visibility of the urgency to take action across stakeholder groups.
- Increased understanding of municipal initiatives currently underway.
- Increased insight into the roles of the different organizations represented.
- Insight into actions that have 'worked' or 'not worked' in different communities and lessons learned.
- Increased access to data and potential research sites.
- Increased potential for researchers to help with municipal projects.
- Emphasis on the value of participant time (e.g., urgency in ensuring workshop was value-creating given the opportunity costs for participants).
- Increased understanding of how research and input from a range of disciplines can help inform solution design and implementation while helping ensure unintended consequences of actions are minimized (e.g., marginalization of affected citizen groups).
- A greater understanding of our community stakeholder's resources and constraints, and new ideas for university services and programs.
- Identification of opportunities for student engagement (e.g., internships) in working on community issues and community research projects.
- Expanded recognition of the role of the university as a potential repository/go-to place for data and expertise.

Figure 14: Workshop Participants Engaged in Planned Activities

Also, based on the pre and post-conference surveys, it appears the broad stakeholder presence and the workshop activities may have led some participants to broaden their perspectives of the issues (including causes and impacts) and solutions (including barriers and enablers). As explained in Section 5 above, health impacts on communities, the time pressure to make changes, and the importance of business, finance, and design thinking rose to the top of many participants' minds after the conference.

5.3 Roles for neglected disciplines in Sustainability Research (Objective 3)
Traditionally, sustainability research has been interdisciplinary, but the focus and outputs of the research have taken very different forms, depending on which discipline leads the initiative. More often than not, when sustainability research originates in natural science and engineering fields, the focus tends to rely heavily on outputs of quantifiable environmental change and observable phenomena.

In this conference, we intentionally invited scholars and community groups from multiple fields, with the view that urban sustainability problems emerge from human interactions with natural systems, but also as a result of socially-learned ways of doing business, politics, communication, and education. Our intent was to create more-than-passing conversations among scientists, humanists, artists, policymakers, and broad sectors within urban communities. The idea was to find areas of understanding, but also ideas that may clash with each other to ultimately lead to new ideas not previously imagined in traditional sustainability research.

The workshop offered:
- ***Direct insight from panelists on potential roles for arts and humanities.*** For example, artists and qualitative social scientists stressed that the ways scientists think and communicate are not always easily understandable to non-scientists. Since sustainability is a human problem, humanists and artists are trained in understanding and representing human experiences. They, therefore, can help better communicate the relationship between science and everyday experiences; they can also make more visible to scientists the ways our cultural or physical limitations are creating sustainability challenges, or how past or present events either foster or limit the scientific imagination in seeking future solutions.
- ***A broad view of the scope of urban sustainability in different types of cities.*** Presentations and participation by humanists, community organizers, and qualitative scientists demonstrated that while concerns over urban sustainability may be shared in a broad sense, they are perceived distinctly, and this point cannot be taken lightly. When environmental sustainability research inadvertently jeopardizes historical preservation or generates social or racial conflict, it has a limited chance for future success. For many sectors represented at the workshop, the concerns surrounding urban sustainability were primarily environmental or economic. However, participants and presenters representing community groups from different neighborhoods and municipalities in the Chicago area, and small to midsize cities in Illinois, keyed into points that urban sustainability can't be possible in their communities without direct connections to paths of finding meaningful work, a sense of heritage and history, and a respect for cultural diversity.
- ***Direct opportunities for engagement in discussions among people with distinct backgrounds, experience, and expertise.*** The range of discussions that occurred among participants was broad, and it was promising to see how smaller working groups were formed with participants from disparate sectors. Overall, the group work pointed to the need for additional engagement from public policy, social services, ethics, business, education, communication, and finance disciplines.

5.4 Implementable strategies supporting a large-scale multi-stakeholder research network to tackle sustainability issues (Objective 4)
The activities on Day 2 of the workshop focused on designing 'doable' solutions related to the issue-solution pairs. As explained earlier, the solutions offered relate to solar photovoltaic

renewable energy generation and storage, green building and green infrastructure framework for different sized cities, water and energy usage benchmarking, and connecting stakeholders to needed data and to each other.

Many projects were more specifically focused on building databases, decision support systems (DSS), and stakeholder communication platforms. These could provide community residents, homeowners, business owners, community planners, and other institutional representatives centralized access to information they need to make decisions about how to improve energy and water infrastructure, and energy and water use in their homes, businesses, and communities, and on how to then organize and fund such projects. In some cases (e.g., DSS for green infrastructure planning) a large part of underlying technology and data is already available. Universities were discussed as potential homes for some of the knowledge-based systems and as sources of human resources (e.g., students as interns on projects and for engaging with the public).

The emphasis on information sharing platforms was not surprising given a recurring theme throughout the workshop: Between all the research institutions and private and public sector organizations there is a tremendous amount of knowledge that can already be leveraged to deal with water, energy, and climate related issues. We need to know who knows what, who needs what, and to get information and available solutions collected and shared now – we are running out of time.

6. General Lessons Learned from Conducting the Workshop

While the workshop's objectives were met, several "lessons learned" came out of its planning and conduct. They relate to organizing team background diversity, participant identification and recruitment, workshop logistics, and activity design, and may be useful for organizers of future workshops of this nature and more generally for convergence research.

Organizing committee diversity. Having a team of organizers with diverse academic backgrounds, and the inclusion of several non-academic stakeholders as partners in the planning, was key to this workshop's success. The resulting diversity in perspectives helped ensure: (a) broad stakeholder representation at the workshop through broader networking and understanding of stakeholder motivation to participate (and what would dissuade attendance), and (b) the design of activities that drew out a broad set of views on the issues and supported system thinking and actionable outcomes. At the same time this broad inclusion led to a complex and time-consuming planning process; thus, time allocated for planning such an effort should be generous. Patience is also required.

In addition, including individuals who are trained in or who have experience with effective multi-stakeholder process management on the organizing committee is important for the effective design and conduct of the workshop, for ensuring buy-in to workshop outcomes, and for maintaining stakeholder engagement after the workshop. There are several known multi-stakeholder process management principles, practices, and tools that can be usefully applied to address factors such as ensuring stakeholder voices (leveling power), dealing with conflict, effective communication, facilitating systems things, encouraging collaboration in leadership, etc. (Brouwer et al. 2016; Hemmati 2012).

Identifying and recruiting participants. Business, municipality, and NGO leaders, as well as academics, were asked to dedicate 1.5 workdays (not including travel), to absorb related costs

including opportunity costs, and to answer surveys. We felt requesting stakeholders to commit two full days was asking for too much, but that one day was not long enough to generate stakeholder-initiated action plans.

The request for 1.5 days of active participation was 'a big ask'. So, we focused on having a clear, action and solution-oriented agenda that would signal the workshop would expressly draw on each attendee's knowledge and suggestions in driving solutions. We explicitly sought to identify stakeholder representatives who would commit to attending and being actively engaged through the entire workshop. Follow-up with invitees occurred as needed, and many who could not attend graciously suggested alternative individuals who would effectively represent the stakeholder group. In addition, for those who indicated attendance created a financial hardship, some financial support was offered (i.e., hotel cost covered). Nonetheless, informal discussion with some participants indicated that concern about the issues and a desire to make a difference was a main motive for attendance. Thus, motivating stakeholders to attend workshops when they have less buy-in to the urgency or validity of the issues is expected to remain a recruiting challenge.

Addressing logistics impacts. Having the workshop take place in downtown Chicago had many benefits, but also created some challenges. The location (UI System Discovery Partners Institute) was generally convenient for stakeholders who lived in the broader Chicago area and who were able to access the location via public transport. On the other hand, the distance to Chicago and related traffic and parking access created a potential deterrence for invitees from middle and southern Illinois and neighboring states. The Chicago location also impacted some of the participant selection and recruiting decision making. For the future, to help offset potential location bias, it might be wise to propose and hold a series of workshops, or follow-on workshops, in cities of different sizes and in different regions (e.g., at UIS, UIUC and other universities). This might ensure an even stronger representation of stakeholder interests from across the Midwest than was already achieved at the workshop.

Recognizing gaps in stakeholder representation in activities. This workshop included broad stakeholder representation, yet certain working groups did not have access to particular stakeholder perspectives in their discussions (e.g., missing a municipal, insurance company, or economist representative perspective) or had fewer representatives with direct understanding of a particular city size (e.g., rural community representation). Ensuring groups record who participates in an activity can help identify gaps in stakeholder input. Some groups recognized this and explicitly identified missing stakeholders in the 'other collaborators needed' section of the group report form for the Day 2 group activities. Knowing 'who' was present in designing a solution is helpful for solution review and validation.

Setting expectations for activity outcomes. Understanding the breadth, and level of detail that can be achieved in multi-stakeholder workshops became important. For some stakeholder representatives, this was the first time they participated in such a forum; it was important to design activities so their voices would be heard to help ensure continued engagement in post-workshop projects.

In addition, the level of depth/detail recorded in the outputs of workgroup activities varied by group. For example, some groups captured significant detail on their drawings where others generalized concepts. Having trained facilitators who are dedicated to capturing ideas is

recommended for future workgroup activities of the kind undertaken; this would allow all participants to fully dedicate their attention to idea generation.

Overall, the mix of panel and workshop activities was effective in creating dialogue and bringing different views to bear on the issues – a desirable and actionable first step from a convergence research perspective that should add to the effectiveness of detailed solution designs as they are further developed. For example, the business and finance sub-group that formed on Day 2 included an expert on equity in community effects of policy and practices who effectively reminded the other group members (e.g., from business, energy, water policy, financing, municipality operations, education, and law) of the importance of ensuring projects undertaken are designed and implemented in a way that ensures equity in benefit access and considers the potential negative consequences that might be experienced in different communities (especially underserved communities).

7. Maintaining the Momentum

The CURES Connection Workshop was a collaborative effort that brought together over 130 stakeholders from across the United States representing researchers and experts from many disciplines and leaders from municipalities, agencies, private industries, non-profit organizations, and utilities. The workshop set groundwork for a multi-disciplinary, multi-stakeholder approach to design sustainability solutions for cities of different sizes.

To illustrate, the workshop outputs suggest that ensuring rural community access to quality drinking water involves context specific issues (e.g., septic system flooding, agricultural runoff, irrigation practices, failed and/or abandoned infrastructure, upstream water usage) and forms of community engagement (e.g., engaging faith communities and local champions, appealing to sense of community and stewardship (land and animals), regionalized services, and assisting town councilors holding other full time jobs/volunteers). At the same time, solutions need to be designed and implemented in a way that respects and capitalizes on rural community history and individuality, is equitable, does not embarrass or stigmatize individuals or communities (e.g., poor residents, coal mining communities), and includes funding solutions. As such, there are important roles for historians and for heritage studies, communications and social networking specialists, social studies experts, other humanities and social science experts, as well as business, economics and finance experts, in facilitating an environment in which needed change can be agreed upon, communicated, funded, and implemented.

Potential next steps include:

- Continuing to develop partnerships with other institutions to offer additional regional workshops in cities of different sizes and in different parts of the Midwest (e.g., at community centers or universities in other locations). This would ensure stronger representation of Midwest stakeholder interests from across the Midwest than was already achieved at the workshop, offset potential location and participant bias in the workshop outputs, and possibly lead to convergence on system level programs of action for cities of different sizes ('right-sized' with the 'right content').
- Working with workshop sub-groups to take additional steps to implement potential 'quick wins' and to develop proposals for more resource intensive projects. For example, one project being led by workshop participants involves inclusion of 'neighbor to neighbor' comparisons of energy and water use data placed on all commercial and

residential utility bills across Illinois; providing such data appears to be a relatively effective way to reduce overall energy and water consumption(Benartzi et al. 2017).

Several program management advantages are apparent in this approach to designing sustainability solutions for cities of different sizes. System level resources and constraints can be better identified to facilitate project prioritization. Sub-projects can be more easily coordinated and expertise leveraged. Engagement with stakeholders can be coordinated to minimize requests on their time and repeated conversation. Stakeholder process management training can be coordinated to optimize stakeholder engagement. Lessons learned can be shared. Sustainability transition models for cities of different sizes could be developed and improved upon with each subsequent use.

However, conducting this, or other multidisciplinary, multi-stakeholder driven efforts will require appropriate incentives, benefits, and rewards for the researchers and stakeholders engaged in the process, beyond those currently in place. In this regard, the CURES Connections Workshop organizing committee supports and echoes the suggestions made by our Northwestern University colleagues in the 2019 SUSPIRE workshop report: It is important to "valorize or generate better rewards for the effective application of research findings in communities" (SUSPIRE, 2019, p. 42) in such a way that encourages policy maker, researcher, and community stakeholder engagement and commitment to project success.

Beyond the recommendations provided in the SUSPIRE workshop report (e.g., financial support for pilot projects and information meetings and knowledge transfer/training; budget flexibility; joint agency support (pooling resources)), it is also important to address the following:

- ***The "publish-or-perish" criteria for researcher success.*** Publications are the main criteria for researcher evaluation. This creates a direct conflict given the significant effort and time required to engage in projects that benefit communities. Sustainability programs should be designed primarily to address community needs. The NSF may want to consider encouraging universities and accrediting bodies to place equivalent value on convergence research and consider its different forms of deliverables, especially when the activities involve urgently implementing solutions to achieve the 17 U.N. Sustainability Goals
- ***The need for MSP Management Resources.*** Convergence research projects involve multi-stakeholder process (MSP) management from their start. Managing such programs requires extensive project management skills and resources. In addition, stakeholders (e.g., researchers, private sector representatives) and workshop facilitators (e.g., students engaged in documenting work outputs) may not be sufficiently experienced with the underlying principles and processes that make MSP management effective. Also, solutions may involve creating student internship programs to assist with initiatives. The NSF should include funding for personnel involved in program management and project control, as well as MSP leadership and management training, as part of convergence research program awards.
- ***Need for business school engagement.*** The need for business engagement in driving and funding solutions became increasingly evident in the workshop. Since, business school curricula play an important role in shaping business leader thoughts and action, the NSF could strongly encourage business school leaders review their curricula to promote socially responsible business and supply chain behaviors (e.g., covering social purpose

project funding and investment options (e.g., socially responsible investment funds (Hicks. C, 2019)); teaching about benefit corporations (B Lab, 2019)).

- ***Access to long term funding.*** Certain solutions require longer-term funding (e.g., design and maintenance of knowledge repositories and knowledge centers, decision support systems, help lines, high-cost infrastructure upgrades). NSF assistance in funding or identifying potential sources of funding for long term projects, including facilities, equipment, and support staff is desirable.

Finally, continuing the effort to design solutions for cities of different sizes will require a range of partnerships. The CURES Connection Workshop would not have been successful without the effective collaboration between the University of Illinois system universities, Northwestern University, University of Chicago, Argonne National Labs, the Metropolitan Mayors Caucus, Greenleaf Advisors, and Green Diamond. In addition, the grant received from the NSF enabled the conduct of the workshop.

REFERENCES

Anderson, G. B., and M. L. Bell, 2011: Heat waves in the United States: mortality risk during heat waves and effect modification by heat wave characteristics in 43 U.S. communities. *Environ. Health Perspect.*, **119**, 210–218.

Benartzi, S., and Coauthors, 2017: Should Governments Invest More in Nudging? *Psychol. Sci.*, **28**, 1041–1055.

Brouwer, J. H., A. J. Woodhill, M. Hemmati, and K. S. Verhoosel, 2016: The MSP guide: How to design and facilitate multi-stakeholder partnerships.

Burke, M. B., E. Miguel, S. Satyanath, J. A. Dykema, and D. B. Lobell, 2009: Warming increases the risk of civil war in Africa. *Proc. Natl. Acad. Sci. U. S. A.*, **106**, 20670–20674.

Cadavid, C. L., and A. W. Ando, 2013: Valuing preferences over stormwater management outcomes including improved hydrologic function. *Water Resources Research*, **49**, 4114–4125, https://doi.org/10.1002/wrcr.20317.

Cao, C., X. Lee, S. Liu, N. Schultz, W. Xiao, M. Zhang, and L. Zhao, 2016: Urban heat islands in China enhanced by haze pollution. *Nat. Commun.*, **7**, 12509.

Chen, X.-L., H.-M. Zhao, P.-X. Li, and Z.-Y. Yin, 2006: Remote sensing image-based analysis of the relationship between urban heat island and land use/cover changes. *Remote Sens. Environ.*, **104**, 133–146.

Creutzig, F., G. Baiocchi, R. Bierkandt, P.-P. Pichler, and K. C. Seto, 2015: Global typology of urban energy use and potentials for an urbanization mitigation wedge. *Proc. Natl. Acad. Sci. U. S. A.*, **112**, 6283–6288.

Field, C. B., and Coauthors, 2014: IPCC, 2014: Climate change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of working group II to the fifth assessment report of the intergovernmental panel on climate change.

Georgescu, M., P. E. Morefield, B. G. Bierwagen, and C. P. Weaver, 2014: Urban adaptation can roll back warming of emerging megapolitan regions. *Proc. Natl. Acad. Sci. U. S. A.*, **111**, 2909–2914.

Grimm, N. B., S. H. Faeth, N. E. Golubiewski, C. L. Redman, J. Wu, X. Bai, and J. M. Briggs, 2008: Global change and the ecology of cities. *Science*, **319**, 756–760.

Guhathakurta, S., and P. Gober, 2007: The Impact of the Phoenix Urban Heat Island on Residential Water Use. *J. Am. Plann. Assoc.*, **73**, 317–329.

Heilig, G. K., 2012: World urbanization prospects: the 2011 revision. *Social Affairs (DESA), Population Division, Population …*,.

Hemmati, M., 2012: *Multi-stakeholder processes for governance and sustainability: beyond deadlock and conflict*. Routledge,.

Hsiang, S. M., K. C. Meng, and M. A. Cane, 2011: Civil conflicts are associated with the global climate. *Nature*, **476**, 438–441.

Huang, C., A. G. Barnett, X. Wang, P. Vaneckova, G. FitzGerald, and S. Tong, 2011: Projecting Future Heat-Related Mortality under Climate Change Scenarios: A Systematic Review. *Environmental Health Perspectives*, **119**, 1681–1690, https://doi.org/10.1289/ehp.1103456.

Isaac, M., and D. P. van Vuuren, 2009: Modeling global residential sector energy demand for heating and air conditioning in the context of climate change. *Energy Policy*, **37**, 507–521.

Kennedy, C., and Coauthors, 2009: Greenhouse gas emissions from global cities. *Environ. Sci. Technol.*, **43**, 7297–7302.

Klinenberg, E., 2015: *Heat Wave: A Social Autopsy of Disaster in Chicago*. University of

Chicago Press, 328 pp.
Krayenhoff, E. S., M. Moustaoui, A. M. Broadbent, V. Gupta, and M. Georgescu, 2018: Diurnal interaction between urban expansion, climate change and adaptation in US cities. *Nat. Clim. Chang.*, **8**, 1097–1103.
Li, D., E. Bou-Zeid, M. Barlage, F. Chen, and J. A. Smith, 2013: Development and evaluation of a mosaic approach in the WRF-Noah framework. *J. Geophys. Res. D: Atmos.*, **118**, 11–918.
——, ——, and M. Oppenheimer, 2014: The effectiveness of cool and green roofs as urban heat island mitigation strategies. *Environ. Res. Lett.*, **9**, 055002.
McGeehin, M. A., and M. Mirabelli, 2001: The Potential Impacts of Climate Variability and Change on Temperature-Related Morbidity and Mortality in the United States. *Environmental Health Perspectives*, **109**, 185, https://doi.org/10.2307/3435008.
Oleson, K. W., A. Monaghan, O. Wilhelmi, M. Barlage, N. Brunsell, J. Feddema, L. Hu, and D. F. Steinhoff, 2015: Interactions between urbanization, heat stress, and climate change. *Clim. Change*, **129**, 525–541.
Patz, J. A., D. Campbell-Lendrum, T. Holloway, and J. A. Foley, 2005: Impact of regional climate change on human health. *Nature*, **438**, 310–317.
Rahdari, A., S. Sepasi, and M. Moradi, 2016: Achieving sustainability through Schumpeterian social entrepreneurship: The role of social enterprises. *J. Clean. Prod.*, **137**, 347–360.
Romero-Lankao, P., H. Qin, and K. Dickinson, 2012: Urban vulnerability to temperature-related hazards: A meta-analysis and meta-knowledge approach. *Glob. Environ. Change*, **22**, 670–683.
Rosenzweig, C., and Coauthors, 2009: Mitigating New York City's Heat Island: Integrating Stakeholder Perspectives and Scientific Evaluation. *Bull. Am. Meteorol. Soc.*, **90**, 1297–1312.
Sailor, D. J., and A. A. Pavlova, 2003: Air conditioning market saturation and long-term response of residential cooling energy demand to climate change. *Energy*, **28**, 941–951.
Schneider, A., M. A. Friedl, and D. Potere, 2009: A new map of global urban extent from MODIS satellite data. *Environ. Res. Lett.*, **4**, 044003.
Semenza, J. C., C. H. Rubin, K. H. Falter, J. D. Selanikio, W. D. Flanders, H. L. Howe, and J. L. Wilhelm, 1996: Heat-related deaths during the July 1995 heat wave in Chicago. *N. Engl. J. Med.*, **335**, 84–90.
Sharma, A., and Coauthors, 2018a: The Need for an Integrated Land-Lake-Atmosphere Modeling System, Exemplified by North America's Great Lakes Region. *Earth's Future*, **6**, 1366–1379.
——, S. Woodruff, M. Budhathoki, A. F. Hamlet, F. Chen, and H. J. S. Fernando, 2018b: Role of green roofs in reducing heat stress in vulnerable urban communities—a multidisciplinary approach. *Environ. Res. Lett.*, **13**, 094011.
Stone, B., and Jr, 2012: *The City and the Coming Climate: Climate Change in the Places We Live*. Cambridge University Press, 205 pp.
Stone, B., Jr, J. Vargo, P. Liu, Y. Hu, and A. Russell, 2013: Climate change adaptation through urban heat management in Atlanta, Georgia. *Environ. Sci. Technol.*, **47**, 7780–7786.
USGCRP, 2017: Climate Science Special Report: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. *U.S. Global Change Research Program, Washington, DC, USA*, 475 pp.
——, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel,

K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. *U.S. Global Change Research Program, Washington, DC, USA*, 1515 pp.

Winters, B. A., J. R. Angel, C. Ballerine, J. L. Byard, and A. Flegel, 2015: Report for the urban flooding awareness act.

Wuebbles, D., and Coauthors, 2019: *An Assessment of the Impacts of Climate Change on the Great Lakes*. The Environmental Law & Policy Center, http://elpc.org/wp-content/uploads/2019/03/Great-Lakes-Climate-Change-Report.pdf.

Zhao, L., 2018: Urban growth and climate adaptation. *Nature Climate Change*, **8**, 1034–1034, https://doi.org/10.1038/s41558-018-0348-x.

——, X. Lee, R. B. Smith, and K. Oleson, 2014: Strong contributions of local background climate to urban heat islands. *Nature*, **511**, 216–219.

——, ——, and N. M. Schultz, 2017: A wedge strategy for mitigation of urban warming in future climate scenarios. *Atmos. Chem. Phys.*, **17**, 9067–9080.

Appendix 1: Agenda

2019 CURES Connections Workshop: New Voices and Paths to Urban Sustainability
August 7-8, 2019
Discovery Partners Institute, Chicago IL

Wednesday, August 7

8:00-8:30 Light breakfast and registration

8:30-8:45 Welcoming comments

8:45 – 9:15 Keynote address: Urban sustainability challenges and solutions
Suzanne Malec-McKenna, Interim CEO Great Lakes and St. Lawrence Cities Initiative

9:15 – 10:15 Panel of Municipal Leaders: Water, energy, and climate problems at different urban scales
Panelists: Kevin Burns, Mayor Geneva; Kim Stone, Councilwoman, City of Highland Park; Scott Tess, Environmental Sustainability Manager at City of Urbana; confirming two more panelists.
Moderator: Don Wuebbles, University of Illinois

15-minute break

10:30 – 12:00 Small group activity: Prioritizing and diagnosing sustainability challenges

12:00 – 1:00 Lunch
1:00 – 2:00 Panel of NGOs and business leaders: Role private and non-profit sectors can play in urban sustainability
Panelists: Hilary Pearson, XXX, Exelon; Google; Raj Rajan, Inunext; Naomi Davis, Blacks in Green; Steve Frenkel, CURRENT; Nancy Cole, Union of Concerned Scientists
Moderator: Elizabeth A. Kócs, University of Illinois, Chicago

2:00 – 2:15 Break

2:15 – 2:45 Small group activity: Understanding actors in the sustainability system

2:45-3:30 Panel of social science, arts, and humanities scholars: Looking at sustainability challenges in cities of different sizes through the lens of arts and humanities and human dimension
Panelists: Ladd Keith, University of Arizona; Patricia Romero Lankao, NREL, confirming two more panelists
Moderator: Anne-Marie Hansen, University of Illinois, Springfield

3:30 – 3:45 Break

3:45-4:30 Panel of technical, earth and natural science scholars: Engineering perspective to urban woes and potential solutions across scales
Panelists: Aaron Packman, Northwestern University; Luis Bettencourt, University of Chicago; Alan Hamlet, University of Notre Dame; Xuhui Lee, Yale University
Moderator: Ashish Sharma, UIUC

4:30 – 5:30 Small group activity: Concrete pathways to sustainability

5:30 – 7:00 Reception for an informal discussion

Thursday, August 8

8:00-8:30 Light breakfast

8:30-9:00 Opening plenary talk: Best practices in engaged multidisciplinary research
Rachel Switzky, Director, Siebel Center for Design, University of Illinois

9:15-10:15 Large group activity: Choosing steps towards sustainability action

10:15 – 10:30 Break

10:30 – 11:15 Small group activity: Getting to work on taking those steps

11:15-12:00 Small group activity: Constructing the network for sustained progress

12:00-1:30 Working lunch: Wrap up and next steps

Appendix 2: Participant list

First Name	Last name	Organization
Jillian	Abbinanti	Urban Gateways
Bill	Abolt	AECOM
Mindy	Agnew	Village of Oak Park, Illinois
John	Andersen	Greenleaf Advisors
Amy	Ando	University of Illinois Urbana-Champaign
Max	Berkelhammer	University of Illinois at Chicago
Marc	Berman	UChicago/Mansueto
Luis	Bettencourt	University of Chicago
Gia	Biagi	Studio Gang Architects
James	Breitkreitz	Zurich Insurance
Kevin	Burns	City of Geneva
Rosa	Cabrera	University of Illinois at Chicago Latino Cultural Center
Ximing	Cai	University of Illinois at Urbana-Champaign
Alexis	Cain	US-EPA
Jacob	Campbell	The Field Museum
Guy	Carpenter	Carollo Engineers
Patrice	Charlebois	Illinois-Indiana Sea Grant
Elizabeth	Cisar	Joyce Foundation
Joycee	Coffee	Climate Resilience Consulting
Nancy	Cole	Union of Concerned Scientists
Christine	Davis	Illinois Environmental Protection Agency
Naomi	Davis	Blacks in Green
Katie	DeMuro	Greenleaf Advisors
Yongheng	Deng	Wisconsin School of Business, University of Wisconsin-Madison
Richard	Dickinson	National Science Foundation
Anne	Dodge	Mansueto Institute for Urban Innovation
Keenan	Dungey	University of Illinois Springfield
Aaron	Durnbaugh	Loyola University
Todd	Fein	Green Diamond
Steve	Frenkel	Current
Connie	Frey Spurlock	Southern Illinois University Edwardsville

Mary	Gade	Gade Environmental Group LLC
Marcelo	Garcia	University of Illinois at Urbana-Champaign
Dave	Gorman	Village of Lombard
Alan	Hamlet	University of Notre Dame
Celeste	Hammond	John Marshall Law School
Anne-Marie	Hanson	University of Illinois Springfield
Justin	Hart	Metropolitan Water Reclamation District of Greater Chicago
Jessica	Hector-Hsu	Regional Transportation Authority (RTA)
Kailah	Hopkins	Urban Gateways
Melissa	Hulting	US EPA Region 5
Devin	Hunter	University of Illinois Springfield
Brian	Imus	Illinois Green Alliance
Debra	Jacobson	Prairie Research Institute - Illinois State Water Survey/Illinois Sustainable Technology Center
Amy	Jewel	Institute for Market Transformation
Aditi	Jha	Siebel Center for Design - University of Illinois at Urbana-Champaign
Katie	Kaluzny	Illinois Green Alliance
Marcella Bondie	Keenan	Center for Neighborhood Technology
Ladd	Keith	The University of Arizona
Justin	Keller	Metropolitan Planning Council
Kamau	Kemayo	University of Illinois Springfield
Cynthia	Klein-Banai	University of Illinois at Chicago
Elizabeth	Kocs	University of Illinois at Chicago Energy Initiative
Rao	Kotamarthi	Argonne National Laboratory
David	Kristovich	ISWS, Prairie Research Institute, University of Illinois in Urbana-Champaign
Mark	Krivchenia	University of Illinois at Chicago
Praveen	Kumar	University of Illinois at Urbana-Champaign
Ming	Kuo	University of Illinois at Urbana-Champaign
Angela	Larsen	Alliance for the Great Lakes
Warren	Lavey	University of Illinois at Urbana-Champaign and University of Illinois at Chicago
Xuhui	Lee	Yale University
David	Leopold	UI Labs

Abigail Derby	Lewis	Chicago Field Museum
Jane	Lin	University of Illinois at Chicago
Yu-Feng	Lin	Illinois Water Resources Center
Tim	Lindsey	Smart Energy Design Assistance Center
Mario	Longoni	Field Museum: Keller Science Action Center
D. Gavin	Luter	University of Wisconsin-Madison
Edith	Makra	Metropolitan Mayors Caucus
Jay	Marhoefer	Intelligent Generation
Dean A	Massey	IESP, University of Illinois at Chicago
Paula	McCombie	Village of South Barrington
Sally	McConkey	Illinois State Water Survey, Prairie Research Institute
Susanne Malec	McKenna	Great Lakes St. Lawrence Cities Initiative
Sara	Meerow	Arizona State University
Lisa	Merrifield	University of Illinois Extension
Bill	Miller	Northwestern University
Emily	Minor	University of Illinois at Chicago
Peter	Mulvaney	Jacobs Engineering
Jason	Navota	Chicago Metropolitan Agency for Planning
Stephen	Newell	Self
Caitie	Nigrelli	Illinois-Indiana Sea Grant
Kevin	O'Brien	Illinois Sustainable Technology Center & Illinois State Water Survey
Peter	Orris	University of Illinois at Chicago School of Public Health
Aaron	Packman	Northwestern University
Shantanu	Pai	Prairie research institute
Mike	Pfeffer	Related Midwest
Mark	Potosnak	DePaul University
Katherine Moore	Powell	the Field Museum
Marcus	Quigley	Opti
Raj	Rajan	Inunext LLC
Carolee	Rigsbee	University of Illinois at Springfield
Patricia	Romero-Lankao	National Renewable Energy Laboratory and University of Chicago

Bernice	Rosenzweig	The City University of New York
Olga	Rostapshova	University of Chicago
Dale	Sands	The Village of Deer Park/ United Nations Disaster Risk Reduction
Swarnali	Sanyal	University of Illinois at Urbana-Champaign
Caitlin	Sarro	Institute of Cultural Affairs (ICA-USA)
Elena	Savona	Elevate Energy
Bill	Schleizer	Delta Institute
Margaret	Schneemann	University of Illinois Extension Sea Grant
Jordan	Schnell	Northwestern University
Sabina	Shaikh	University of Chicago
Ashish	Sharma	University of Illinois at Urbana-Champaign
Sanjiv	Sinha	ECT, Inc.
Frank	Soldano	Related Midwest
Ashlynn	Stillwell	University of Illinois at Urbana-Champaign
Deborah	Stone	Cook County
Kim	Stone	City of Highland Park
Bill	Sturm	Serena Sturm Architects
Rachel	Switzky	Siebel Center for Design at the University of Illinois Urbana-Champaign
Diane	Tecic	Illinois Department of Natural Resources
Scott	Tess	City of Urbana, IL
Tom	Theis	University of Illinois at Chicago
Kimberly	Van Meter	University of Illinois at Chicago
Vidya	Venkataramana n	Northwestern University
Shaowen	Wang	University of Illinois at Urbana-Champaign
Sarah	Wilkins	AGU's Thriving Earth Exchange
Cindy	Winland	Just Transition Fund
Ouri	Wolfson	University of Illinois at Chicago
Ruby	Woodside	Second Nature
Don	Wuebbles	University of Illinois at Urbana-Champaign
Moira	Zellner	University of Illinois at Chicago
Lei	Zhao	University of Illinois at Urbana-Champaign