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Sara Hughes
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# Climate Change in Cities

## Innovations in Multi-Level Governance

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# Chapter 1
# Introduction

**Sara Hughes, Eric K. Chu and Susan G. Mason**

**Abstract** Cities are increasingly shaping the trajectory and impacts of climate change. While local actors play a central role in designing the institutions, infrastructures, and behaviors that drive decarbonization and adaptation to changing climatic conditions, their options and incentives are inextricably enmeshed within broader political and economic processes. Resolving these tensions and contradictions is likely to require innovative approaches to governing climate change in the city: new interactions, new political actors, new ways of coordinating and mobilizing resources, and new frameworks and technical capacities for decision-making. This book presents pioneering work on the range of innovative practices, experiments, and ideas that are becoming an integral part of urban climate change governance in the twenty-first century. Theoretically, the book builds on a nearly two-decade history of scholarship identifying the emergence of new urban actors, spaces, and political dynamics in response to climate change. Empirically, the chapters investigate new governance arrangements from around the world and leverage the insights they provide for both theory and practice. The book is organized around four guiding questions: 1) how do multilevel governance arrangements relate to innovation for urban climate change governance? 2) where is the greatest need for innovation? 3) where is innovation difficult or stifled? 4) how can innovation be fostered and encouraged in a multilevel governance context?

**Keyword** Cities and climate change · Mitigation · Adaptation · Urban governance

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## 1.1 Climate Change in Cities: Innovations in Multilevel Governance

Cities play a critical role in shaping the trajectory and impacts of global climate change. In the most recent Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), cities were recognized as drivers of transformative action, especially in terms of their ability to address the sectoral, demographic, spatial, and ecological challenges of climate change and extreme disaster risks (Bartlett and Satterthwaite 2016; IPCC 2014; Revi et al. 2014; Ziervogel et al. 2016). Furthermore, as global policymakers are advocating for the concept of "climate change resilience" as an amalgamation of co-benefits between mitigation, adaptation, and sustainable development (Adger et al. 2011), cities are gaining political salience within current global agreements such as the Paris Agreement (2015) of the United Nations Framework Convention on Climate Change (UNFCCC), the Sustainable Development Goals (SDGs), and the New Urban Agenda (2016) of Habitat III (Paris Agreement 2015; Parnell 2016). All of these global frameworks take note of the centrality of urban communities and decision-makers in responding to climate change; however, how to achieve the changes that are necessary in cities in an equitable, accountable, and inclusive way is still unclear.

This book is motivated by two intersecting challenges underlying the task of responding to climate change in cities. First is the multilevel context in which urban governance takes place. The decisions and outcomes observed at the urban scale are often the product of a multitude of actors and forces within the city and at regional, national, and international scales. Governing cities is a collective endeavor, and climate solutions are especially likely to straddle political and jurisdictional boundaries. Urban climate change solutions are necessarily embedded in and produced by multilevel governance contexts. Second is the need for innovative approaches to governing the city, especially in the context of climate change uncertainty, resource, and capacity constraints, as well as increasing urbanization rates at a global scale (Bartlett and Satterthwaite 2016; Rosenzweig et al. 2010). Complex urban governance systems produce and demand innovative political, institutional, economic, spatial, and social approaches to governing the drivers and consequences of climate change in cities. Addressing climate change in a meaningful way therefore requires the development of new patterns and processes of engagement, finance, and collaboration.

The chapters in this volume provide theoretical and empirical insights into the relationship between innovative approaches to urban climate change governance and the multilevel context in which they are embedded. The authors draw on empirical case studies and insights from across the global North and South, and focus explicitly on those innovations that produce new relationships between levels of government, between government and citizens, and between governments, the private sector, and transnational and civil society actors. This comparative, empirical approach highlights the context-dependent dynamics that shape mitigation and adaptation innovation in cities, despite the burgeoning number of global and national climate change directives.

## 1.2 Scope of the Book

While climate change was initially framed as requiring a coordinated and global response, international policy action has been slow in coming. Instead, a plethora of strategies, frameworks, policies, and funding mechanisms at sub-national levels have dominated the landscape. Primary among these have been actions taken by cities—independent of national directions—to respond to climate change. Many have joined together to form city networks to facilitate joint action, knowledge sharing, and peer accountability, such as in the form of C40 Cities Climate Leadership Group and ICLEI's Cities for Climate Protection program (Betsill and Bulkeley 2004; Hakelberg 2014). Cities have also become the target for donors and nongovernmental organizations with an interest in climate change, such as the World Bank's Cities and Climate Change program and the Rockefeller Foundation's 100 Resilient Cities program. Many cities have also elected to organize regionally or domestically, such as in the case of the Southeast Florida Regional Climate Compact in the US, the Regional Adaptation Collaboratives Program in Canada, the UK Climate Change Impact Programme (UKCIP), the Asian Cities Climate Change Resilience Network (ACCCRN), and many others (Bauer and Steurer 2014; Betsill and Bulkeley 2007; Chu and Schenk 2017). Many of these actions and partnerships recognize the intrinsic value of urban knowledge and capacity, but also highlight the unique challenges of governing climate change at the urban level given the presence of complex political interests, economic priorities, and multi-scalar dynamics.

The emergence of climate change as a distinct global public policy issue corresponded with a resurgence of cities as a unit of analysis in the fields of politics, economics, and development. Across European and North American cities, economic restructuring in the post-World War II era of neoliberalization—with the growing influence of globalized trade, investment, and speculation—promoted private capital as the primary driving force behind municipal politics, planning action, and spatial development (Friedmann 1986; Harvey 1989; Lefebvre 1991). In the global South, trends in democratization meant that many cities were increasingly beneficiaries of devolved budgetary, legislative, and infrastructural powers, but were hamstrung by capacity and governance deficits that were symptomatic of the post-colonial condition (Robinson, 2011; Roy, 2011; Watson, 2009). Despite these divergent experiences, both point to contemporary cities being sites of capital accumulation, contentious politics, and the spatial manifestations of the two (Brenner and Theodore 2005). Climate change discourses therefore arose from this backdrop of concentrated power amongst small numbers of urban economic elites, structural biases towards decentralized network governance approaches, and a persistent "hollowing out" of public sector planning and decision-making authorities (Chu et al. 2016; Himley 2008; Swyngedouw 2004).

While the importance of cities as both socio-political entities and nodes of spatial-material flows is well established, the work of realizing the potential of cities to make a meaningful contribution to climate change mitigation and adaptation is

just beginning. This book aims to contribute to the effort to better understand climate change responses in cities, what is missing, what it takes to realize the potential of cities, and the factors and processes at play that are shaping the outcomes we see. A primary aim of this book is to explore the extent to which cities are able to harness and facilitate the innovative and creative potential of multilevel pathways of resource support, capacity development, and authority. By drawing on theories in the fields of public policy, urban planning and administration, governance, and environment and society, the book unpacks the complex governance structures and processes through which climate change innovations arise (or not) in cities across the global North and South.

## 1.3 Why Multilevel Governance?

A central feature of climate change action in cities is the political and jurisdictional complexity that shapes urban decision-making and its outcomes. Efforts to facilitate transformative change in cities must confront the multiple levels and scales at which urban processes are organized. Spatially, many cities are fragmented, with political boundaries dividing what are otherwise contiguous urban regions. Cities have unique ecologies—ecosystems, built environments, and human communities—that are not clearly bounded and often spatially mismatched with one another (Albrechts 2004; Bai et al. 2010). Coordinating climate change actions across diverse landscapes and populations is challenging due to the geographical specificities of climate risks and impacts, which are determined by particular socio-cultural contexts, political or legal jurisdictions, and ecological conditions (Adger et al. 2013). The interconnectedness of different infrastructure networks across space is compounded by the fragmentation of governance scales and jurisdictions, resulting in numerous agencies and authorities with distinct yet highly interconnected roles and responsibilities.

Cities are typically embedded within wider governance regimes, with responsibilities divided across different levels of government; so many climate change actions require collaboration across jurisdictional boundaries. For example, changing urban mobility behaviors by incentivizing public transportation usage or transit-oriented development is critical for reducing greenhouse gas emissions, but such actions rely on coordinated policies and planning across regions, as transportation networks and urban agglomerations transcend political boundaries (Bollinger et al. 2014). Moreover, the patterns in which communities spread across space—driven by housing availability, zoning and land use planning, and the provision of employment opportunities—impacts travel demands, motor vehicle dependency, and greenhouse gas emissions levels (Dulal et al. 2011).

In other cases, the trans-boundary nature of infrastructure networks influences the ability of cities to coordinate climate adaptation and risk management actions across space (Davoudi et al. 2009; Zimmerman and Faris 2010). As a result, since cities cannot tackle these issues as standalone stressors on specific locations (Hallegatte 2009), they must instead approach climate change as portfolios of systemic risks on

infrastructure networks that stretch across political boundaries. Beyond trans-boundary infrastructure, addressing other issues—including land use, biodiversity conservation, and solid waste management networks—is key to facilitating climate action, yet similarly hobbled by fragmented governance (Grimm et al. 2008).

The effectiveness of many climate change programs also hinges on the ability to coordinate across political jurisdictions due to the presence of trans-boundary risks —such as sea level rise and storm surges—that span ecosystems and infrastructure networks (Bollinger et al. 2014; Corfee-Morlot et al. 2010). The complexities around scale and space have profound implications for who actually has control over relevant mitigation or adaptation decisions, which in turn informs the effectiveness and legitimacy of policy-making and planning processes (Moser 2006). To design climate change interventions that are appropriately sized and scaled, cities must be able to bridge the trans-boundary and multi-scalar nature of climate change actions. The positive or negative perceptions of the other actors involved (Downs 1967; Wright 1988) and the pursuit of similar or divergent goals (Pressman 1975; Wright 1988) will in turn affect outcomes across boundaries. Furthermore, social institutions in the form of neighborhood organizations or more complex institutions such as multi-national organizations can resolve uncertainty and stabilize anticipate actions and outcomes (Knight 1992), fostering acceptable outcomes in trans-boundary and multi-scalar actions. Polycentric systems can similarly be beneficial for dealing with climate change as they have the potential to generate benefits at multiple scales (Ostrom 2010).

Scholars of multilevel governance argue that this "stretching" of planning and policy-making authority happens horizontally—i.e., across jurisdictional boundaries in space—*and* vertically between local, regional, national, and global levels of government (Bulkeley and Betsill 2005; Hooghe and Marks 2003; Sellers 2002). In an era of urban political and economic restructuring, control over many urban planning and policy-making responsibilities is increasingly devolved to non-state, network, or extra-local actors and forces (Harvey 1989; McFarlane 2009). For example, as already noted earlier, transnational networks provide necessary capacity and resource support for urban climate change actions (Fünfgeld 2015; Hakelberg 2014). The private sector also plays a variety of key roles (Mees et al. 2012; Tompkins and Eakin 2012). For instance, water and electricity systems are often privately owned or managed, yet are both integral to communities and intertwined with other infrastructure systems. Recent priorities around urban climate change resilience have favored economically important sectors, such as in the case of protecting financial institutions in central business districts from extreme risks rather than providing much needed risk reduction services to low-income vulnerable neighborhoods (Anguelovski et al. 2016; Shi et al. 2016). Recent scholarship on "splintering urbanism", notes that the privatized enclosure and increasing specialization of infrastructure sectors are exacerbating governance fragmentation and shortfalls in public service provision (Graham and Marvin 2001). These examples highlight how urban climate change action—especially when placed within political contexts with heightened ideological, economic, and

political differences—may produce opportunities for elite capture, policy confusion, corruption, or inequitable outcomes.

With these governance challenges in mind, policy and planning responses to climate change in cities across the global North and South are often fraught with tension and contradictions (Hughes 2017; Rosenzweig et al. 2010). While on one hand local actors play a central role in designing institutions, infrastructures, and behaviors that drive decarbonization and adaptation to changing climatic conditions, their options and incentives are inextricably enmeshed within broader political, economic, and ecological processes (Bulkeley 2010). For example, some have argued that directives for rapid decarbonization as stipulated by the Paris Agreement (2015) may lead to stranded infrastructure and capital assets as many urban and regional production systems are already locked into the fossil fuel economy (Ansar et al. 2013; Gupta et al. 2017; Richels et al. 2009).

To facilitate climate change governance in cities, local authorities must share the political arena with actors ranging from private actors to transnational networks. Within this cacophony of competing interests, cities must find ways to appropriately balance the scope—in terms of both space and scale—of any climate change mitigation and adaptation action. A more comprehensive understanding is therefore needed of the innovative approaches being used to navigate the complex networks and relationships that constitute contemporary multilevel urban climate change governance.

## 1.4 Why Innovations?

To resolve the tensions and contradictions that arise in urban multilevel governance, many have argued that innovative approaches will be required to govern climate change mitigation and adaptation in cities. Innovation is "the intentional and proactive process that involves the generation and practical adoption and spread of new and creative ideas which aim to produce a qualitative change in a specific context" (Sørensen and Torfing 2011). Innovations, in the context of urban climate change governance, refer to new interactions, new political actors, new ways of coordinating and mobilizing resources, and new frameworks and technical capacities for decision-making. In most cases, innovation requires collaborative interactions between different public and private actors because municipal resources—such as financial resources, political capacity, and knowledge supply—are finite and often insufficient to meet the cross-sectoral demands of mitigation and adaptation (Anguelovski and Carmin 2011; Bulkeley and Betsill 2013). Innovations can be shaped by the multilevel governance context in which they are conceived or implemented (such as new financing tools or building design) or embodied in a novel governance arrangement itself (such as new mechanisms for citizen engagement or intergovernmental collaboration).

Though there is a long history of innovation scholarship in the domains of national economic and industrial policy (Freeman 1991; Nelson 1993), there is relatively little on innovation at the urban scale, especially beyond the fields of

economic geography (see Walker and Storper 1989, for example), cultural studies (see Evans 2009, for example), and strategic urban planning (see MacCullum et al. 2009, for example). Recent work on climate change has begun to theorize the genesis and implications of urban innovations, particular through the lens of experimentation or urban "living labs" (Bulkeley, Castán Broto, and Edwards 2015; Evans and Karvonen 2014; Chu 2016). Cities often face challenges with initiating and sustaining innovation due to lack of political support, financial resources, and human capacity (Anguelovski et al. 2014; Gordon 2013). The availability of these resources, and the likelihood of urban experiments to scale up or out will be shaped by the multilevel governance context in which they are embedded. Changes in multilevel governance arrangements can drive innovation by uncoupling cities from their traditional planning models, experimenting with alternative decision-making pathways, and helping to overcome bureaucratic constraints within city governments (Gordon 2013; Okereke et al. 2009; Sørensen and Torfing 2011). Multilevel governance can also contribute to the cycle of innovation in cities by fostering cross-sectoral and inter-municipal collaboration (Bulkeley and Betsill 2013; Massey et al. 2014) and leading by example such as in the case of states and regional agencies (Bedsworth and Hanak 2010).

Innovations in multilevel governance arrangements themselves also have the potential to address structural constraints in cities by facilitating decision-making and knowledge dissemination pathways that bridge the siloed nature of urban policy and planning, assist with accessing additional resources and capacity, and gain stakeholder support from a wider variety of urban actors (Giest and Howlett 2013; Jordan and Huitema 2014; Measham et al. 2011; Moore and Hartley 2008). Such innovations are catalyzed in a number of ways. In some instances, regional or strategic initiatives will be driven by a top-down approach, while others will be from a local level or bottom-up (Baker 2001). Innovation can be driven by crises—such as a resource shortage—directed by citizen involvement, or a product of perceived mutually beneficial outcomes.

However, there is much to be learned about the nature of governance innovations and the outcomes they produce. Some argue for centralized innovation, or for federal or nation-state level policy to provide a climate plan to acquire cooperation across multiple scales (Nelson et al. 2015). Others suggest an ongoing decision support capacity at the regional level (Dilling and Berggren 2015) or climate change alliances that can reshape the landscape crating new governance regimes (Moloney and Fünfgeld 2015). Better guidance on identifying vulnerabilities to climate change and approaches to enhancing future development investments for resiliency across countries in the global South could be an important type of innovation (Carmin et al. 2013; Furlow et al. 2011). Understanding how innovations at multiple levels of governance interact with capacity (Low et al. 2003), or the mechanisms of social and societal learning could also prove fruitful to providing flexible tools to help address climate change in cities (Pahl-Wostl 2009).

With these recent theoretical and policy advancements in mind, this book aims to take an empirical deep dive into whether and how cities utilize or facilitate innovation in multilevel urban governance systems.

## 1.5 Guiding Questions

The interactions between multilevel governance and innovation have the potential to significantly shape urban climate responses, and their investigation is a crucial component of any effort to support cities in their efforts. The chapters in this book explore four central questions:

1) *How do multilevel governance arrangements relate to innovation for urban climate change governance?* The chapters in this book examine the multiple intersections and outcomes of multilevel governance arrangements and urban climate change innovation. The case studies and theoretical developments help to establish baseline knowledge of the relationships and the dimensions along which we might characterize it. The chapters explore the ways in which multilevel governance arrangements influence innovation in urban climate response, and the extent to which new governance approaches can in and of themselves be considered important innovations. Using a variety of methods and theoretical approaches, the chapter authors explore the many intersections of multilevel governance and innovation.
2) *Where is the greatest need for innovation?* Urban climate change innovations in multilevel governance are still in their infancy. As we gain more experience with new approaches, it is important that we take stock of the kinds of innovations that are most needed and the scale of change that is required in different dimensions. Given the scope of climate change drivers and solutions, there may be no one "greatest" area or need for innovation but rather a collective effort at each level for action. In the end, the most significant innovations are those that result in substantial reductions in greenhouse gas emissions or climate risks and impacts, as well as concerted efforts that galvanize the trust of actors across scale to commit to long-term outcomes while realizing short-term benefits.
3) *Where is innovation difficult or stifled?* This book starts from the assumption that innovation is a necessary ingredient for effective and equitable urban climate change responses. The chapters help to empirically trace the dynamics of change and improve our understanding of the role that multilevel governance arrangements play in inhibiting or preventing greater innovation. They help to lay a foundation for theorizing the conditions within which innovations do or do not transpire, their respective implications for governance change, as well as their outcomes in terms of equity and inclusiveness. The chapters help to reveal common barriers to achieving the kinds of innovations that are necessary for meaningful climate change responses in cities.
4) *How can innovation be fostered and encouraged in a multilevel governance context?* There is demand from practitioners and advocates for greater insight into the strategies and institutions that are able to best foster the innovative responses to climate change that are needed despite—or perhaps even as a result of—the multilevel context in which they are necessarily embedded. The chapters in this volume take up this challenge and provide key insights into where innovation has been successful and ways that further progress can be made going forward.

## 1.6 The Chapters

This book is divided into four main parts. Part I contains four chapters on intergovernmental governance innovations. Chapter 2 by Homsy argues that although there is a strong tradition of local discretion in the United States, the complexity of climate change action means smaller municipalities are more likely to engage in climate change action when their states are also acting. Chapter 3 by Kemmerzell examines European innovations in governance in the major cities of Germany. The author examines whether multilevel governance structures—specifically the Covenant of Mayors—have an impact on local climate policy. The findings reveal that both hierarchical and lateral activities are having an impact on climate policy and the Covenant of Mayors is not a driving force but rather an ancillary factor motivating action. Chapter 4 by Boswell and Mason examines the impact of the Sustainable Communities Strategy (SCS) on coordinating city and regional climate change actions in California. The authors find mid-sized to larger cities are more likely to coordinate their policies with the region than smaller cities, but that ultimately it may be too early to tell if the SCS is a driving factor in the intergovernmental innovations. Chapter 5 by Bourgeois and Hughes examines how the degree of centralization of decision-making in metropolitan Montreal creates trade-offs for climate change policy innovation and democratic decision-making. Looking specifically at the waste management sector, the authors find the more centralized the decision-making, the less autonomy and engagement is elicited from citizen participation.

Part II has four chapters devoted to innovations in citizen engagement. Chapter 6 by Sarzynski examines the nationally recognized policy and planning efforts of the City of Baltimore, Maryland, which has innovated by combining disaster preparedness with a climate change adaptation plan. The Baltimore case reveals both the resiliency of staff when working on climate adaptation planning and the challenges of obtaining community-wide ownership for the action in the plan. Chapter 7 by Sari and Prayoga describes two projects in Semarang, Indonesia, that highlight new mechanisms for improving communication pathways within cities for local public health and environmental needs. These mechanisms include the use of digital technology coupled with citizen engagement. In both projects, citizen engagement is needed to guarantee success and local knowledge, networks, and community motivation are important. Citizen awareness of governance structures is a key ingredient for success. Chapter 8 by Engberg focuses on the Danish experience, and the national government's efforts to manage large scale project needs. The author looks specifically at the case of water management and the local level impacts of collaboration with citizens in Copenhagen. Chapter 9 by Iftikhar, Ali, and Sarzynski also focuses on water using the case of Bhalwal, Pakistan. Here, the community-government partnership-based initiative succeeded in a situation where the performance of the traditional government-managed scheme was weak. The authors analyze the reason for the initiative's success and the challenges of

duplicating the clean water project for other types of services or locations in Pakistan or similar urbanizing nations.

Part III focuses on innovations and city networks. Chapter 10 by Bellinson examines how transnational municipal networks influence local government climate policy processes and promote urban adaptation actions using the cases of Rotterdam, the Netherlands, and Berkeley, California, USA. The author finds communication, coalition building, and confronting conflicts to be key ingredients for adopting adaptive innovations. In Chap. 11, Rajasekar, Charkraborty, and Bhat focus on the case of India, which is actively trying to incorporate urban climate change into emerging "smart city" initiatives across the national and local government levels, but is faced with many obstacles. In Chap. 12, Brown unpacks the Asian Cities Climate Change Resilience Network (ACCCRN) successes in helping cities across South and Southeast Asia to be more resilient to climate shocks and stressors. The chapter provides insight into the way facilitating organizations can help cities navigate a path to processes that work. In Chap. 13, Cook and Chu examine the case of Surat, India, and the way fiscal constraints can be a barrier to climate change action, as well as how the city is developing new pathways for steering funding for climate change adaptation.

Part IV outlines the drivers and obstacles of multilevel innovations. Chapter 14 by Peterson reviews the relationship between municipal finance and the broader multilevel frameworks that govern climate change decision-making in cities. Focusing primarily on the United States, Peterson identifies some of the opportunities cities have to pursue innovations in municipal finance to support their climate policy objectives. Chapter 15 by Bausch, Eakin, and Lerner details how Mexico City has innovated to incorporate peri-urban agriculture into their climate change policies. The authors provide recommendations on how to successfully articulate peri-urban agriculture into the larger climate change dynamic. They also provide strategies for mediating trade-offs in order to obtain the desired program results. Chapter 16 by Ninomiya and Burch examines the case of Waterloo, Canada, illustrating how vital experimentation is for innovation in ideas prior to scaling up. The authors highlight the vital role that a forum can play in providing new actors and participatory process with a starting place and an opportunity to continue innovations in local energy systems. Chapter 17 by Dale and colleagues reflect on experiences working with "climate innovators" across British Columbia, Canada, and show how engaging local communities is essential for facilitating climate innovations in the absence of national-level directives.

The final chapter in the book synthesizes the insights provided by the rich diversity of cases and perspectives brought together in this volume. We refer back to our four guiding questions, and identify three important research needs in this area going forward: the institutional foundations for urban innovations, unbounding the urban in climate governance, and resisting the post-politics of climate innovations.

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# Part I
# Intergovernmental Governance Innovations

# Chapter 2
# Size, Sustainability, and Urban Climate Planning in a Multilevel Governance Framework

**George C. Homsy**

**Abstract** In the United States, the absence of federal leadership on climate change and a strong tradition of localism has created a system in which many greenhouse gas reduction efforts fall to the discretion of municipalities. This often leads to uncoordinated action across jurisdictional boundaries. Despite the widespread notion that cities can lead on climate policy from the bottom-up, I find, using a logistic regression analysis of data from 1837 municipalities, that local governments are more likely to enact climate change policies in an environment where higher levels of government have acted rather than in a decentralized one. Smaller municipalities, in particular, have increased odds of action when their states act. Using existing regional, state-based initiatives, I present options for a coordination and capacity building framework.

**Keywords** Local government · Climate change · Urban policymaking · Regionalism

## 2.1 Introduction

For much of its history, the United States has had trouble dealing with challenges of the commons or common-pool resources, especially pollution and natural resource protection. The rapid industrialization of the United States following the Second World War came with horrendous water and air pollution; rivers caught fire and deadly smog suffocated regions with pollution flowing easily across jurisdictional borders. In 1948, thick air pollution originating in Donora, Pennsylvania's zinc industry killed 13 people and sickened thousands in that city and downwind in the neighboring city of Webster (Snyder 1994). Municipalities pumped wastewater into the rivers from which downstream neighbors pulled their drinking water (Holloway et al. 2014). Local leaders were unwilling to shoulder cleanup costs or impose them

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