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Bellinson, Ryan; Chu, Eric

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Learning Pathways and the Governance of Innovations in Urban Climate Change Resilience and Adaptation

Abstract. The proliferation of transnational municipal networks (TMNs) has precipitated different innovative models of urban climate change governance. To date, there have been few reflexive inquiries into how urban governance institutions and processes themselves are learning to innovate as a result of participating in TMNs. In response, this paper draws on theories of institutional learning and urban governance to offer a conceptual distinction between *innovations in governance* and the *governance of innovations* in the context of climate resilience and adaptation. We apply the latter, more procedural orientation to evaluate the case studies of Rotterdam and Berkeley, where we highlight the actors, networks, and resources required to motivate and sustain actions against concurrent sectoral interests. Experiences from the two cities show that learning pathways are constructed and reified through processes of communication and negotiation, which result in the grounding of TMN resources. A focus on unpacking the variations in learning and implementation within cities can offer insights into the opportunities for enabling more meaningful forms of procedural innovation. We should therefore more critically engage the innate political economic nature of urban governance, which has direct implications for how climate resilience and adaptation innovations are ultimately sustained in local contexts.

1. Introduction

Cities around the globe are organizing through transnational municipal networks (TMNs) to build capacity, share knowledge, and tackle their climate challenges collectively (Bulkeley, 2013). TMNs have become notable political actors in advancing innovative planning strategies such as encouraging cross-sectoral learning, translating science, harnessing new funding mechanisms, and emphasizing projects that promote co-benefits. However, as Author 1 (2018, *in this issue*) notes in the editorial to this special issue, there continues to be a lack of research on understanding how the learning resources offered by TMNs actually contribute to procedural change within member cities. Furthermore, TMNs have been critiqued for being networks of larger elite cities, for emphasizing the positive actions taken by these elite members (see Author 9, 2018 *in this issue*), and for promoting top-down, technocratic planning models (Author 8, 2018 *in this issue*; Dzebo & Stripple 2015; Boyd & Osbahr 2010; Bulkeley 2013).

Current scholarship on TMNs examines their roles within the broad field of global environmental governance, although primarily in the context of climate change mitigation and, to a lesser degree, climate adaptation (see Andonova et al. 2013; Lee 2013). In this paper, we apply these insights to emerging climate resilience actions and highlight the perspectives and outcomes of two cities participating in 100 Resilient Cities (100RC), a TMN supported by The Rockefeller Foundation. We offer a conceptual distinction between two forms of governance innovation (cf. Sørensen & Torfing 2011). The first is *innovations in governance*, which refers to the development of new ideas, innovative interventions, and novel decision-making arrangements, and is the form of outcome-oriented innovation most prioritized by TMNs. Second, we explore the *governance of innovations*, which speaks to the everyday procedural politics associated with learning and adopting new ideas while facilitating qualitative changes in places. This conceptual distinction is important because although governance innovations are disseminated across the globe relatively uniformly (McCann 2011; Peck & Theodore 2015), these new ideas are in fact interpreted and embedded differently across variegated political, social, and economic contexts. To critically unpack the dynamics associated with the *governance of innovations*, we ask: How are cities building new learning arrangements to internalize emerging innovations in climate resilience as advocated by TMNs?

This paper draws on theories of urban governance, urban innovation, and institutional learning (both endogenous and exogenous) in the context of climate change. We then apply these

to two case studies and illustrate the interplay between *innovations in governance* and the *governance of innovation*. We conclude that although TMNs are notable in facilitating the former, the latter requires more sustained forms of internal buy-in, leadership, and awareness to enable meaningful procedural learning and innovation. We should therefore additionally examine the innate political economic nature of urban governance, which has direct implications for how climate resilience and adaptation innovations are debated, designed, and ultimately (meta-) learned and implemented in urban contexts.

2. Learning and Innovation in Climate Adaptation and Resilience

This section surveys how climate resilience innovations can emerge through TMN activities and are subsequently governed in cities. We note that the ability of cities to acquire and develop resilience capacity rests on the integration of climate risk awareness, internal political and economic interests, and external capacity and resource support (cf. Ahern 2010). In other words, cities must address different learning modes and interactions between their endogenous and exogenous sources (see Author 1, 2018 *in this issue*). With this as an entry point, we explore what Sørensen and Torfing (2011) refer to as an “innovation cycle”, whose product includes concurrent pathways of *innovations in governance* and the *governance of innovation*. The latter form of procedural innovation seeks to better manage urban political and economic interests. We conclude the section by highlighting how these theories can contribute to unpacking the *politics* of governing climate resilience innovations.

2.1. TMNs and Urban Climate Resilience

Cities often experience institutional and political fragmentation that can lead to political conflict, especially in the context of multi-sectoral issues like climate change (Blanco 2013; Chu and Schenk 2016; Innes 1998). Top-down strategies are often constrained and can be ineffectual in the face of dynamic cross-sectoral challenges (Blanco 2013). In response, local governments have moved away from their reliance on hierarchal structures and towards new forms of horizontal governance founded upon cooperation, coordination, and mutual support, where multiple actors jointly make decisions and take action (Pierre 2011; Holden 2011; Melo & Baiocchi 2006). These new arrangements help align actors and institutions, as well as engage and foster new cooperative learning, planning, and decision-making pathways (Bogason & Musso

2006; Coen & Thatcher 2008). Cooperative forms of governance can also support enhanced learning, more efficient resource usage, and increased capacity to address complex problems (Provan & Kenis 2008; Bäckstrand 2008; Giest & Howlett 2013; Bogason & Musso 2006).

TMNs have emerged as an important governance actor, promoting horizontal dialogue and cooperation between local government, civil society, and private actors (Healey 1998; Gordon 2010). In relation to the scholarship on policy mobilities (cf. McCann 2011), TMNs offer more formal, institutionalized networks for sharing best practices, distributing scientific knowledge, and facilitating inclusive policy processes (Author 6, 2018 *in this issue*; Betsill & Bulkeley 2011; Leck & Simon 2012). Current research on urban regimes also notes that robust local governance requires interaction between public and private actors to mobilize capacity and resources (Leck & Simon 2012; Blanco 2013), but this often proves difficult because of unclear mandates, competing interests, or opposing political ideologies (Meerow & Stults 2016). For example, conflicting planning agendas can lead to strains or a misdirection of finite resources (Healey 2004; Leck & Simon 2012; Chu et al. 2017; Innes 1998).

Despite these advances, TMNs have also been critiqued for not helping cities build corresponding governance structures to internalize such institutional developments (Anguelovski & Carmin 2011; Bulkeley 2013; Jordan & Huitema 2014). TMNs have additionally been criticized for being networks of elite cities that lack representation from smaller or ‘second-tier’ cities, and that they tend to overly promote the positive aspects in order to garner recognition and access to international financial resources (Kern & Albert 2009; Betsill & Bulkeley 2011; Bäckstrand 2008). Lastly, it is unclear to what extent TMNs spur climate action in city members versus non-city members (Robinson & Gore 2015) and whether the presence of TMNs actually translates into a higher propensity for climate actions (Gore & Robinson 2010).

2.2. Governing Innovations in Cities

Innovation is an “intentional and proactive process that involves the generation, practical adoption, and spread of new and creative ideas which aim to produce a qualitative change in a specific context” (Sørensen & Torfing 2011: 849). Though there is a long history of innovation scholarship in the domains of national economic policy (see Freeman 1991; Nelson 1993), there is relatively little on innovation at the urban scale, especially beyond the field of economic geography or spatial planning (see Walker & Storper 1989; MacCullum et al. 2009). Recent

work on climate change has begun to theorize urban innovations, particular through the lens of experimentation or “living labs” (Betsill & Bulkeley 2011; Bulkeley & Broto 2015; Krause 2012). Drawing on the concepts developed by Berry & Berry (1999) and Francis et al. (2005), there are two main forms of policy innovation – the diffusion of *innovations in governance* and the internal pathways of learning and mainstreaming, i.e. the *governance of innovation*.

The first type – *innovations in governance* – include the conventionally recognized TMN outputs such as member-to-member best practice sharing, the distribution of scientific materials, and providing members frameworks for new planning methodologies (Berry 1994; Massey et al. 2014). The second form – the *governance of innovation* – is the process through which member cities institutionalize TMN outputs into their internal decision-making pathways (Fried et al. 2014). In other words, the process of governance innovation entails the parallel process of, first, disseminating exogenous top-down learning outcomes from the TMN to the member cities and, second, the endogenous bottom-up process of learning and implementing TMN activities within cities (Bassett & Shandas 2010).

Both forms of innovation can take place in a cycle with four distinct stages, with TMNs directly engaged in the last three. In the first stage (idea generation), policy ideas are generated through the internal agenda-setting process (Sørensen & Torfing 2011). Decision-makers have likely identified problems and opportunities, questioned their embedded assumptions, and clarified relevant goals (Eggers & Singh 2009). In the second stage (idea selection), TMNs provide a platform for policymakers with different knowledge and experiences to jointly assess benefits and risks of potential climate policies (Sørensen & Torfing 2011; Spaans & Waterhout 2017; Anguelovski, Chu & Carmin 2014). In the third stage (idea implementation), TMNs help to mobilize external human and financial resources, assist in orchestrating new governance structures, and coordinate efforts between member cities (Sørensen & Torfing 2011; Andonova 2013). Through enabling new horizontal arrangements, TMNs may strengthen the joint ownership of new ideas, which can subsequently reduce resistance to new policies during the implementation process (Eggers & Singh 2009). In the final stage (practice dissemination), TMNs cultivate strong peer-to-peer relationships as a platform to share innovations through learning and exchanges (Bulkeley 2013; Anguelovski & Carmin 2011). As TMNs have relatively “weak ties”, they have a larger reach and can potentially be more effective in quickly disseminating novel ideas (Carmin et al. 2012). The outcomes of the innovation cycle, therefore,

can include the formation of partnerships, knowledge networks, policies and plans, or financial and budgeting capacities.

While this cycle is idealized, in practice cities often face challenges with initiating and sustaining innovations because of a lack of political support, finance, and capacity (Anguelovski & Carmin 2011; Gordon 2013). In response, TMNs can help by facilitating communication, learning, and knowledge dissemination pathways that bridge the largely siloed nature of urban planning as well as the internal-external division of labor (Jordan & Huiteima 2014; Giest & Howlett 2013). TMNs can be drivers of innovation by uncoupling cities from their traditional planning models and experimenting with alternative learning pathways (Okereke et al. 2013; Hoffmann 2011; Sørensen & Torfing 2011; Gordon 2013; Argyris & Schon 1996).

Although the emergence of TMNs as a distinct political agent in promoting climate resilience is clear, there remain questions around the restructuring of urban governance in response to these new forms of politics and its implications for how innovation is internalized in cities. We do not know the specific dynamics associated with the *governance of innovation*, i.e., how procedural innovations advocated by TMNs can facilitate local structural changes and/or meta-learning in the network to improve climate change resilience and adaptation outcomes. Furthermore, existing approaches to experimentation and innovation are often constrained when addressing multi-scalar, trans-boundary challenges like climate change (Bulkeley & Broto 2015; Hoffmann 2011). In response, we seek to address these knowledge gaps by exploring how emerging climate resilience innovations can be understood as a continuous and political process of learning, negotiation, and contestation to foreground new options for sustained policy change and equitable development.

3. Methodology

Two case studies – Rotterdam (Netherlands) and Berkeley (California, USA) – were selected because they were among the first group of 32 cities to be admitted to 100 Resilient Cities (100RC) in December 2013, and represent two early adopters of comprehensive climate resilience policies. Furthermore, both have mayoral-city council executive bodies responsible for approving budgets, setting policy agendas, and representing the public interest. While the two face unique developmental challenges and are embedded in different socio-political contexts, they share a similar ideological climate and have enacted similar policy levers to further their

resilience objectives. Historically, both cities have pursued low-interest financing for planning projects, modified zoning and building codes to accommodate latest climate science, leveraged citizen awareness to put political pressure on elected officials, and provided tax incentives to promote desired behaviors (City of Berkeley 2009; City of Rotterdam 2009; City of Rotterdam 2013). Both cities also have Chief Resilience Officers (CRO) (see section 3.1) that head small teams closely aligned with their respective city’s planning departments. Finally, Berkeley and Rotterdam are economically important nodes situated within large metropolitan regions.

In terms of our comparative approach, however, although both cities are considered “extreme cases” (Yin 2013) due to their progressive, early adoption of climate resilience policies, Berkeley and Rotterdam have vastly divergent approaches to *governing innovations*, i.e., their processes for planning, learning, and implementing innovations. In this context, we selected two cases studies because of the opportunities for cross-comparison through parallel data sampling and analysis (Small 2009), as well as the greater potential for exploring the political and institutional nuances of how innovations can be governed across different contexts. Finally, a comparison of Berkeley and Rotterdam’s experience will provide greater richness – or “thickness” of the respective case narratives (Gerring 2006; Yin 2013) – in the findings.

The methodology involves semi-structured interviews and archival analysis (see Table 1). Interviews were conducted with key members of the cities’ planning, climate change, and environmental departments, identified based on their participation in drafting the policies listed in Table 1. The interviews addressed the themes of the policy cycle, procedural changes, policy settings, institutional learning, and TMN governance outcomes. The interviews were recorded, transcribed, and thematically coded based on the four stages of the climate policy innovation cycle described in section 2.2. The archival analysis included seven emblematic climate policy documents (three from Berkeley and four from Rotterdam) as well as public meeting records from Berkeley. The policy documents were selected based on their role in facilitating notable procedural changes, where we investigated each policy’s motivations, funding sources, and key recommendations. Finally, video recordings of three public meeting in Berkeley – which were recorded by the city government and publicly released via its website – were reviewed for relevant political debates and policy outcomes. Public records from Rotterdam, however, were not included because there were no formal mechanisms to capture public opinion during their process of drafting climate change plans.

[TABLE 1 HERE]

3.1. 100 RC

The Rockefeller Foundation’s 100 Resilient Cities (100RC) program named its first group of 32 selected members – which included Berkeley and Rotterdam – in December 2013. After two subsequent rounds of expanding membership, the network has 98 members as of early 2018. Members are offered four resources upon admittance into the network. The first is two years of financial support for a Chief Resilience Officer, which is a newly created senior policy position closely connected to the City Manager’s or Mayor’s Office. The CRO’s primary role is to coordinate all city resilience efforts by working across departments, bridging planning domains, and improving internal coordination. The second resource is a methodological foundation (i.e., the City Resilience Framework (CRF)) upon which cities can develop their resilience strategy (Spaans & Waterhout 2017). Third, through “Platform Partners”, 100RC gives members access to a curated network of NGOs and private actors who can supply tools and services for developing resilience strategies. Lastly, 100RC facilitates knowledge exchanges and peer learning opportunities via their own network of cities.

4. Comparative Approaches to Governing Innovation for Urban Climate Resilience

Though Berkeley and Rotterdam are both recipients of external support from 100RC, the two cities have vastly divergent approaches to governing climate resilience innovations. Rotterdam has experienced mostly top-down planning while Berkeley has utilized community-driven directives. This section illustrates these variations by emphasizing how different interests are communicated, how internal and external priorities are learned (cf. Author 1, 2018 *in this issue*), and how policy coalitions are built by particular leaders and entrepreneurs.

4.1. Berkeley

Berkeley has a long history of addressing sea level rise, drought, wildfire fire, and storm surges (City of Berkeley 2016). In 2006, Berkeley voters approved Ballot Measure G, which mandated the city reduce GHG emissions to 80% below 2000 levels by 2050 (City of Berkeley 2009). This referendum led former Mayor Tom Bates to develop a plan to reach the target and other climate priorities (City of Berkeley 2009). In 2009, Measure G was codified into the Climate Action Plan

(CAP). Though the CAP was mainly a climate mitigation plan, there was a segment of the plan dedicated to addressing adaptation (City of Berkeley 2009). The CAP development was facilitated by the Office of Energy and Sustainable Development (OESD) and closely coordinated with several municipal departments, local organizations, civil society, and ICLEI-Local Governments for Sustainability (City of Berkeley 2009).

The CAP was a community-driven policy, with a strong focus on inclusivity through citizen participation committees and numerous public meetings (City of Berkeley 2009). To promote inclusion, in 2007, Berkeley's City Council allocated two years of funding to assess potential climate risk management strategies and gather community input on how these strategies would be prioritized (City of Berkeley 2009). A program administrator in Berkeley's OESD noted that, "[we] worked with the community to figure out together how we could best meet their priorities in a plan that would be feasible and successful" (Interview 2016). The CAP was a unique initiative because of the number of government and community stakeholder that were involved throughout the process. This led to a structured learning and negotiation process, and ultimately a policy that was viewed as meeting the originally specified emissions reduction and adaptation goals in an inclusive and achievable manner.

Four years after Berkeley's CAP, the CAP 2015 Update report was commissioned by the City Council and City Manager's Office, with the OESD in charge of scoping (City of Berkeley 2015). The CAP instituted mechanisms to monitor GHG reduction targets, adaptation investment progress, and public engagement, as well as to periodically conduct progress reports to address unforeseen implementation barriers (City of Berkeley 2009). The main decision-making pathways for the CAP 2015 Update took place through public meetings, a citizen volunteer committee, and the cross-departmental City of Berkeley Sustainability Working Group (BSWG). The main finding was that greater collaboration between the OESD, municipal departments, and the City Council was required to increase program implementation capacity (City of Berkeley 2015). Based on this finding, the city set forth a strategic policy adjustment process for climate adaptation, which called for increased collaboration between the BSWG and the City Council. By beginning to fortify these cross-sectoral ties, the city believed that climate policy priorities could be implemented more effectively.

With Berkeley's selection as a member of 100RC, the city had a clear opportunity to overhaul its climate governance process through improving cross-sectoral decision-making as

identified in the CAP 2015 Update (City of Berkeley 2016). These advancements led to the Berkeley Resilience Strategy (2016), which explicitly benefited from 100RC support. For example, Berkeley's newly hired Chief Resilience Officer (CRO) received substantial policy input from 100RC based on their City Resilience Framework (CRF) (Interview 2016). Under the leadership of the CRO, the OESD was then tasked with managing the Resilience Strategy's scoping, design, and implementation process (City of Berkeley 2016).

The Resilience Strategy received input from over 1,000 local residents through community workshops, City Council meetings, and events hosted by community-based organization including the Sierra Club, League of Women Voters, Livable Berkeley, and Bicycle Friendly Berkeley Coalition (City of Berkeley 2016). Additionally, a citizen volunteer committee, the private sector, and civil society organizations were included in scoping the strategy through stakeholder committees. This form of community-based learning and policymaking is not new to Berkeley, but the amount of public input, range of involved stakeholders, and depth at which city decision-makers partnered with outside actors was a new procedural development. 100RC assisted in this procedural innovation by helping Berkeley create new governance arrangements that could better capture public inputs and support.

After over a year of scoping the Resilience Strategy, the OESD presented a draft version to the public at the June 2015 City Council meeting and asked for public comment. At this stage, the public raised several points that were subsequently incorporated into the final Resilience Strategy, including the need to address compounding disasters, provide disaster preparation education to the community, as well as revise building codes and ordinances to reflect new resilience requirements (Berkeley City Council Meeting 2015).

Berkeley's resilience policies were not only shaped by the inclusive nature through which the plan was developed, but also through collaboration with other 100RC members that share similar climate risks. As a member of the OESD noted, "in creating a resilient city, the first line of defense and the best resource is other cities" (Interview 2016). This sentiment is reiterated in the Resilience Strategy, where a particular policy – namely converting the street network from conventional storm-water infrastructure to green infrastructure – was directly learned from a best-practice site visit to Rotterdam (City of Berkeley 2016). Although the longer-term implications are somewhat unclear, partnerships and coalitions with other 100RC member cities (i.e., exogenous learning opportunities) were critical in disseminating best practices, generating

new ideas, and facilitating local learning capacities. 100RC was instrumental in informing the process of governing climate resilience innovations: the network provided Berkeley with the funds and framework for their CRO (who led the entire process), supplied the city with knowledge and capacity support in the form of the CRF and from local city representatives, and opportunities to network and learn from other 100RC members.

4.2. Rotterdam

As a low-elevation city, Rotterdam faces sea level rise, salt-water intrusion, and storm surges (City of Rotterdam 2016). In Rotterdam, water is seen as both a resource and a major climate risk. To respond to extreme flooding and water related risks, Rotterdam has consistently reformed its governance structures and institutions by developing new departments, offices, and expert working groups, and has transitioned from viewing water as an isolated policy arena to a holistic, multi-sectoral policy sphere. For example, in 2009, the City of Rotterdam designed Rotterdam Climate Proof (RCP) to build upon the Rotterdam Climate Initiative (RCI), which was Rotterdam's signature mitigation policy (City of Rotterdam 2009).

The goal of the RCP was to create a "climate proof" city by 2025, and sought to build momentum from RCI, increase the city's activities on climate mitigation and adaptation, and develop an institutionalized climate governance structure between the city government and local stakeholders (City of Rotterdam 2009). The RCP also had three ancillary action goals, which are to create knowledge and innovation on water and spatial development, implement green infrastructure projects, and market RCP's work to other cities (City of Rotterdam 2009). During this period, Rotterdam developed a reputation as an innovative city and assumed a role as a knowledge distributor in C40 and other TMNs, particularly in the areas of water management and climate adaptation.

In 2013, Rotterdam published the Rotterdam Adaptation Strategy, which aimed to increase capacity and centralize decision-making authority to address Rotterdam's increasing climate vulnerabilities. Unlike the RCP, the Adaptation Strategy turned to select community informants and experts to assist with city staff and decision-makers during the scoping process, as the city viewed them as playing a role in supplying contextually relevant information on environmental risks and development needs (City of Rotterdam 2013). For example, these informants were most involved in helping to develop specific adaptive infrastructure projects

(such as the Benthemplein Water Plaza) that were to have co-beneficial qualities, especially in relation to existing public transportation, functional public space, civic art, and other priorities (City of Rotterdam 2013). The Rotterdam Adaptation Strategy sought to blend sectoral policy arenas, integrate planning domains, and mix local government actors with stakeholders in a new fashion. Because the RCP managed the scoping of the Adaptation Strategy, the city government placed attention to building coalitions with the Port of Rotterdam Authority as well as the private sector to facilitate greater learning and cooperation throughout the policy process (City of Rotterdam 2013). However, beyond playing informational roles in the initial stages, the public's involvement in actual planning and policy-making decreased as the process moved towards implementation stages.

The Rotterdam Resilience Strategy was published in 2016. Like Berkeley, Rotterdam's Resilience Strategy was produced as one of the conditions of membership in 100RC (City of Rotterdam 2016). Thus, before setting the agenda and scoping its Resilience Strategy, Rotterdam's CRO and his small team spent several weeks working with 100RC to develop a shared understanding of "resilience", a new word and policy area in the Dutch context (Interview 2016). During this formative period, 100RC worked closely with Rotterdam to help them grasp its City Resilience Framework (CRF) and the technical aspects of resilience (Interview 2016). The city also worked to include citizens in the agenda setting process through a 100RC-mandated community agenda-setting workshop.

From the early scoping process, the Resilience Strategy was clearly conceptualized distinctly from previous climate policies as evidenced by the Resilience Strategy's cross-sectoral Steering Committee, a Strategy Team representative of public and private stakeholders, and the wide range of community informants involved during the initial scoping stages (City of Rotterdam 2016). Resilience, therefore, was presented by 100RC as an issue not just pertaining to the City of Rotterdam or under the jurisdiction of a single municipal department, but instead as a policy area deeply integrated throughout the city's broader economic and political interests.

One justification for why Rotterdam approached resilience differently was their new role within 100RC. Unlike Rotterdam's previous TMN engagements, Rotterdam was able to utilize their relationship with other 100RC members to extract best practices and to help cultivate new learning approaches and policy frameworks. As Rotterdam's CRO noted,

“Because of 100RC, I have new counterparts to collaborate with because it is difficult to invent the wheel all by yourself. It’s so much easier, so much more productive to share ideas and create on topics together” (Interview 2016).

Rotterdam’s new network role is valuable, and as the CRO continued,

“The challenge now is to discover each other’s best practices. There are so many innovative cities in the network and there’s a big opportunity for us if we really get the practices on the table and shared” (Interview 2016).

Finally, one of the most consequential procedural innovations of the Resilience Strategy is the integrated manner in which the plan was developed and implemented. Nearly every city department was involved in the scoping process while many regional governments were regularly consulted. For example, Rotterdam relied on strong coalitions with the Port of Rotterdam Authority and the local private sector to collaboratively develop processes of harnessing innovations from other cities, as well as to market their lessons to other cities. Unlike in Berkeley, Rotterdam has not focused on including community actors beyond the initial scoping and information-gathering processes, instead choosing to rely on experts, scientists, and businesses. Like Berkeley, however, 100RC not only facilitated Rotterdam’s Resilience Strategy, it also steered its learning and governance process: the network provided funding and a framework for their CRO, supplied decision-makers with the CRF and technical support, and gave Rotterdam opportunities to network with other 100RC members.

5. Patterns of Learning and Innovation in Urban Climate Change Planning

In both Berkeley and Rotterdam, climate resilience and adaptation innovations have at times benefited from the inclusion of new political actors, participatory policy pathways, new knowledge, and cross-sectoral networks. TMNs – in this case 100RC – have provided opportunities for active learning and reflection (cf. Argyris and Schon 1996). For Berkeley, the CRO-led OESD catalyzed greater cross-department coordination and public engagement to broaden political awareness, while in Rotterdam the CRO-led Department of City Development created more pathways of knowledge sourcing through involving local stakeholders and public agencies. In both cities, climate risks, the urban political context, and TMN resource support all shaped the governance context through which the policy process and learning cycle takes place, but the actual depth of learning across the municipal government – as well as larger opportunities

for meta-learning (cf. Author 1, 2018 *in this issue*) – are a bit more uncertain. In this section, we examine how these different factors have led to variations in how innovations are governed in Berkeley and Rotterdam. Despite the introduction of similar forms of TMN-led innovative governance, we argue that historical trajectories of political power and sectoral interests must be unpacked to understand the long-term politics of learning and governing innovations in cities.

5.1. *Drivers of Innovation*

Processes of policy innovation are often dependent on local governance contexts (Gordon 2013). In cities, the practical starting point is deeply influenced by local climate risks and impacts, the urban political economy, and transnational actor interventions (Gordon 2013; Healey 2004; Kern & Bulkeley 2009). Both Berkeley and Rotterdam face well-documented climate risks and impacts that are coupled with high public perception of those risks in political discourse. Berkeley and Rotterdam, being located within major regional economies and closely linked to local knowledge institutions, have a history of harnessing innovation in the local economic, industrial, and service sectors, which provided a foundation for translating innovation into environmental sustainability and infrastructure arenas. Additionally, both cities have a history of engaging with TMNs and have often played a leading role within them, such as in the case of Rotterdam's knowledge distributing role in the Connecting Delta Cities network within C40 (City of Rotterdam 2013). All of these contextual factors make Rotterdam and Berkeley more amenable to exogenous sources for resilience and adaptation innovations. However, when combined with a history of collaborative learning and participatory governance, especially in the Berkeley case, these result in greater internal support for more flexible institutional mechanisms and bottom-up initiatives in the face of external stress (Bäckstrand 2008; Bogason & Musso 2006; Leck & Simon 2012).

5.2. *Learning and Governance Outcomes*

Drawing on the experiences from Berkeley and Rotterdam, we distill four emblematic learning and governance outcomes (see Table 2). The first is the formation of new partnerships and coalitions, which refers to the emergence of coalitions and the institutionalization of collaborative exchanges between municipal sectors. Notable examples include the cross-departmental City of Berkeley BSWG, Berkeley citizen stakeholder committees, and

Rotterdam’s citywide cross-actor Resilience Strategy Team, who are all contributing towards increasing their city’s capacity to innovate and use “combined thinking” to solve adaptation challenges. By developing a coalition of local actors representing different sectors – as well as with local community activists in the case of Berkeley and expert informants in the case of Rotterdam – networks can help cities widen the political opportunity space, address potentially conflicting interests, and facilitate a collaborative and reflective policy process (Anguelovski & Carmin 2011; Provan & Kenis 2008; Author 3, 2018 *in this issue*; Author 4, 2018 *in this issue*).

[TABLE 2 HERE]

The second outcome is new pathways of knowledge and learning circulation. This refers to the distribution and translation of the best science through TMNs – such as risk projections, maps, tool kits, and participatory technologies – and the knowledge sharing that takes place between cities during peer exchanges. Both Berkeley and Rotterdam revealed the distribution of knowledge and science as one of the primary benefits of joining TMNs. For example, by utilizing 100RC-disseminated scientific information and network events, Rotterdam was able to sculpt its contextual definition of resilience (Interview 2016). New knowledge and science can also lead to procedural changes by raising political awareness and influencing idea generation and selection processes (Anguelovski & Carmin 2011; Kern & Bulkeley 2009; Gordon 2013).

The third outcome is new methods of framing, designing, and implementing policies. This refers to TMN resources and learning tools to support innovative methods of crafting policies, such as tools for uncovering synergistic sectoral entry-points, techniques for prioritizing resilience options, and creating opportunities for policy entrepreneurs and coalitions. In both cities, decision-makers described tools provided by 100RC – such as Platform Partners – that have helped break down silos between different sectors (Interview 2016). Additionally, participation was key to framing and designing policies that were promoted by the TMN, especially in Berkeley but less so in Rotterdam. Another related development was the creation of a CRO, which has fostered greater inter-institutional dialogue and enabled new ways of formulating, learning, and implementing innovative strategies.

Finally, the fourth outcome is access to knowledge, finance and other resources. This refers to the exogenous network relations, tools, and information resources provided by TMNs to

support policy initiatives. For 100RC, both cities again discussed the role of Platform Partners in affording them access to an array of valuable opportunities, such as Rotterdam's public private partnership with Microsoft for their cyber resiliency plan (Deltaplan Cyber) or Berkeley's consultations with MWH Global for mapping opportunities for green infrastructure in the city (City of Rotterdam 2016; City of Berkeley 2016). Additionally, 100RC helped both cities with insights about innovative funding options, such as Rotterdam's 100 Homes for Asylum Seekers program that drew funds from a private philanthropic organization or Berkeley's Community Resilience Center Program that was funded through a voter-approved special tax fund (City of Rotterdam 2016; City of Berkeley 2016). Though broad and varied, these resources are an important catalyst for different pathways for governing innovations.

However, while local governments can benefit from 100RC membership, there are also potential uncertainties, particularly with regard to the CRO position. The Rockefeller Foundation provides two years of funding for member cities to finance the CRO position in member cities. This leads to questions of longevity and sustainability of the planning agendas they are tasked to pursue. Furthermore, this may constrain the ability to facilitate meta-learning within the city (see Author 1, 2018 *in this issue*) if TMN resources are not sustained in the long run. Similarly, the CRO can raise legitimacy concerns if this highly ranked position is hired externally, especially since the position requires a policy entrepreneur with strong leadership skills and the ability to bridge divides within government. As the CRO is a position that is intrinsically political, it is imperative that the CRO be viewed as a legitimate actor in order for them to be politically effective.

5.3. *The Governance of Learning and Innovation: Some Critical Implications*

Innovations in urban climate resilience can develop when cities are able to learn, translate, and ground external TMN resources into scoping, designing, and implementing policies (Sørensen & Torfing 2011; Giest & Howlett 2013; Okereke et al. 2013). In the case of 100RC, it has moved explicitly into the urban political arena through creating the CRO position as well as facilitating exogenous networking opportunities. In this sense, our findings show that processes of *governing innovations* depend on cities' abilities to negotiate established sectoral interests, existing environmental policy efforts, and external knowledge and resource support. The *politics* of governing learning pathways, therefore, speak to the need to unpack emerging issues of political

power and potentially conflicting interests that are neglected in the Sørensen and Torfing (2011) model. We argue that in addition to the physical, tangible products of innovation in urban climate change policy and planning, what is equally as important is the series of procedural innovations that seek to negotiate and manage urban political and economic interests (cf. Author 6, 2018 *in this issue*; Author 8, 2018 *in this issue*).

One inherently political issue is leadership, which is embodied in both Berkeley and Rotterdam through the position of the CRO. As the CRO's main duty is to create new and more efficient collaborations with stakeholders, its role tangibly illustrates the contentious nature of facilitating urban climate adaptation and resilience. The CRO position requires nuanced and local knowledge to accommodate different policy opportunities and constraints. However, by instituting a rigid framework for hiring and implementing the CRO, 100RC may struggle to account for the idiosyncrasies in local contexts such as the power dynamics between municipal executive and legislative branches or the changing preferences of the electorate. For CROs to be successful, their position needs to be created through a flexible and adaptable framework, as seen through Berkeley and Rotterdam's experience with building new external partnerships that support concurrent urban development priorities.

A second implication is the fact that innovative policies, when introduced to a given urban context, often encounter local jurisdictional and bureaucratic limitations. Climate resilience and adaptation decision-making is constrained by higher levels of government, spatial and competency mismatches, and the complexity of urban systems (Carmin, Dodman & Chu 2013). In some circumstances, TMNs may be able to facilitate cross-departmental coalitions and community involvement, as in the case of Berkeley. In other circumstances, TMNs can foster multi-sectoral collaboration and form coalitions of experts to drive new policy processes, as in the case of Rotterdam. However, such advances are less likely to occur beyond the jurisdiction of the member city – such as in neighboring municipalities or higher tiers of government – or in cities that are more resource and capacity constrained, particularly those in less economically privileged circumstances.

Lastly, in the case of 100RC, its standardized approach to resilience may actually stifle deeper learning and meta-learning pathways by crowding out opportunities to use more endogenous sources and develop genuine reflexivity. In other words, having a specified structure for harnessing policy innovations may suppress the broader processes of generating innovations

and insights internally, as well as possible feedback and lesson-drawing from the learning processes initiated. As TMNs include local government members with differing population sizes, climate risks, and political economic contexts, it is important for TMNs to be reflexive in their governing styles to recognize diversity and provide maximum benefit to their members. TMNs must provide local governments some level of oversight and direction, but they must not stifle them with formatted solutions and management tasks that lead to a lack of flexibility and suppresses endogenous innovation.

6. Conclusion

In response to our initial question and posed by Author 1 (2018 *in this issue*), we have shown that cities are indeed constructing more integrated decision-making pathways across municipal sectors to facilitate action, learning, and innovation through a more negotiated political process (cf. Harris, Chu & Ziervogel 2017). At times, the process of *governing innovations* draws on historical experiences of local stakeholders and community groups, such as in the case Berkeley. In other times, this process relies on expert planners and policymakers who source climate knowledge from local informants, as in the case of Rotterdam. From both examples, we see that cities are constantly learning and innovating in order to address emerging climate resilience challenges (Andonova et al. 2013).

Through TMNs like 100RC, cities are building more networked arrangements through which climate resilience policy innovations become implemented and learned (Bulkeley 2013; Chu 2016), but this occurs in particular ways. The experiences from Berkeley and Rotterdam show that local governments have to wade through muddied political landscapes with diverse stakeholders and distribute their limited resources, all while constantly striving to bridge multiple spheres of authority (Bulkeley & Betsill 2013). Our results therefore underline a further need to critically evaluate the *politics* associated with governing learning and innovation pathways, addressing also issues of political power and conflicting political economic interests embedded within the design and execution of climate resilience and adaptation actions in cities (cf. Author 3, 2018 *in this issue*).

We therefore need to be wary of the particular methods and techniques used by TMNs to promote innovations in member cities (cf. Author 6, 2018 *in this issue*). By offering a conceptual distinction between *innovations in governance* and the *governance of innovations*, we illustrated

how TMNs can be critiqued for their top-down governing style and lack of meta-learning, based on the pursuit of innovation outcomes through frameworks with limited flexibility and responsiveness to local political contestations (Giest & Howlett 2013; Okereke et al. 2013). In the case of 100RC, the creation of the CRO position forms a highly delicate political intervention, raising questions of legitimacy, accountability, and institutional embedding. Furthermore, the tools and frameworks provided imply strong direction, potentially constraining the room for more place-based innovation. We should harness more open approaches and experimentation to enable deeper learning outcomes (Bulkeley 2013; Chu 2016), allowing for iteration, reflexivity, and the building of sustained policy coalitions.

References

- Ahern, J. (2013). Urban landscape sustainability and resilience: The promise and challenges of integrating ecology with urban planning and design. *Landscape Ecology*, 28(6), 1203-1212.
- Andonova, L. B. (2013). Boomerangs to partnerships? Explaining state participation in transnational partnerships for sustainability. *Journal of Chemical Information and Modeling*, 53(9), 1689–1699.
- Andonova, L. B., Betsill, M. M., & Bulkeley, H. (2013). Transnational climate governance. *Journal of Chemical Information and Modeling*, 53(9), 1689–1699.
- Anguelovski, I., & Carmin, J. (2011). Something borrowed, everything new: Innovation and institutionalization in urban climate governance. *Current Opinion in Environmental Sustainability*, 3(3), 169–175.
- Anguelovski, I., Chu, E., & Carmin, J. (2014). Variations in approaches to urban climate adaptation: Experiences and experimentation from the global south. *Global Environmental Change*, 27, 156–67.
- Argyris, C., & Schon, D. A. (1996). *Organizational learning II: Theory, method and practice*. Reading: Addison-Wesley.
- Author 1 (2018). Guest-Editorial: Learning and meta-learning in urban climate governance: Concepts, key issues and challenges ahead. *Journal of Environmental Policy and Planning*. Under review.
- Author 3 (2018). Contrasting governance learning processes of climate leading and lagging cities: Portland, Oregon, and Phoenix, Arizona, USA. *Journal of Environmental Policy and Planning*. Under review.
- Author 4 (2018). Learning transformative urban energy governance: The role of leadership, community action and translocal networks in three Korean cities. *Journal of Environmental Policy and Planning*. Under review.
- Author 6 (2018). Learning the way with examples and ideas? Governing climate change in German municipalities through best practices. *Journal of Environmental Policy and Planning*. Under review.
- Author 8 (2018). Incremental, reformistic or transformational: What kind of change do C40 Cities advocate to deal with climate change? *Journal of Environmental Policy and Planning*. Under review.
- Author 9 (2018). Network comparison of socialization, learning and collaboration in the C40 Cities Climate Group. *Journal of Environmental Policy and Planning*. Under review.
- Bäckstrand, K. (2008). Accountability of networked climate governance: The rise of transnational climate partnerships. *Global Environmental Politics*, 8(3), 74–102.
- Bassett, E., & Shandas, V. (2010). Innovation and climate action planning: Perspectives from municipal plans. *Journal of the American Planning Association*, 76(4), 435-450.
- Blanco, I. (2013). Analysing urban governance networks: Bringing regime theory back in. *Environment and Planning C: Government and Policy*, 31(2), 276–291.
- Berry, F. S. (1994). Sizing up state policy innovation research. *Policy Studies Journal*, 22(3), 442-456.
- Berry, F. S., & Berry, W. D. (1999). Innovation and diffusion models in policy research. *Theories of the policy process*, 169.

- Betsill, M., & Bulkeley, H. (2011). Experimenting with cities and technology deployment. *Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto*, 103.
- Bogason, P., & Musso, J. A. (2006). The democratic prospects of network governance. *American Review of Public Administration*, 36(1), 3–18.
- Boyd, E., & Osbahr, H. (2010). Responses to climate change: exploring organizational learning across internationally networked organizations for development. *Environmental Education Research*, 16, 629–643.
- Bulkeley, H. (2013). Reconfiguring environmental governance: Towards a politics of scales and networks. *Journal of Chemical Information and Modeling*, 53(9), 1689–1699.
- Bulkeley, H., & Betsill, M. M. (2013). Revisiting the urban politics of climate change. *Environmental Politics*, 22(1), 136-154.
- Bulkeley, H., & Betsill, M. (2005). Rethinking sustainable cities: Multilevel governance and the “urban” politics of climate change. *Environmental Politics*, 14(1), 42–63.
- Bulkeley, H., & Broto, C. V. (2015). Government by experiment? Global cities and the governing of climate change. *Transactions of the Institute of British Geographers*, 38(3), 361-375.
- Carmin, J., Dodman, D., & Chu, E. (2013). Urban climate adaptation and leadership: From conceptual understanding to practical action. (No. 2013/26). OECD Publishing.
- Carmin, J., Anguelovski, I., & Roberts, D. (2012). Urban climate adaptation in the global south: Planning in an emerging policy domain. *Journal of Planning Education and Research*, 32(1), 18-32.
- Coen, D., & Thatcher, M. (2008). Network governance and multi-level delegation: European networks of regulatory agencies. *Journal of Public Policy*, 28(1), 49–71.
- Chu, E. (2016). The governance of climate change adaptation through urban policy experiments. *Environmental Policy and Governance*, 26(6), 439-451.
- Chu, E., Anguelovski, I., & Roberts, D. (2017) Climate adaptation as strategic urbanism: Assessing opportunities and uncertainties for equity and inclusive development in cities. *Cities*, 60, 378–87.
- Chu, E., & Schenk, T. (2016). Communicating about climate change with urban populations and decision-makers. *Oxford Research Encyclopedia of Climate Science*, M. C. Nisbet [ed.]. Oxford and New York: Oxford University Press.
- City of Berkeley. (2016). Office of Energy and Sustainable Development. Berkeley Resilience Strategy.
- City of Berkeley. (2015). Office of Energy and Sustainable Development. Climate Action Plan Progress Update.
- City of Berkeley. (2009). Department of Planning and Development. Climate Action Plan.
- City of Rotterdam. (2016). Rotterdam Climate Initiative. Rotterdam Resilience Strategy: Ready for the 21st Century.
- City of Rotterdam. (2013). Rotterdam Climate Proof. Rotterdam Climate Change Adaptation Strategy.
- City of Rotterdam. (2009). Rotterdam Climate Proof. Rotterdam Climate Proof: The Rotterdam Challenge on Water and Climate Adaptation.
- Dzebo, A., & Stripple, J. (2015). Transnational adaptation governance: An emerging fourth era of adaptation. *Global Environmental Change*, 35, 423–435.

- Eggers, W. D., & Singh, S. K. (2009). *The Public Innovator's Playbook: Nurturing bold ideas in government*. Ash Institute, Harvard Kennedy School.
- Francis, T. B., Whittaker, K. A., Shandas, V., Mills, A. V., & Graybill, J. K. (2005). Incorporating science into the environmental policy process: a case study from Washington State. *Ecology and Society*.
- Freeman, C. (1991). Networks of innovators: A synthesis of research issues. *Research Policy*, 20(5), 499–514.
- Gerring, J. (2006). *Case study research: Principles and practices*. Cambridge University Press.
- Giest, S., & Howlett, M. (2013). Comparative climate change governance: Lessons from European transnational municipal network management efforts. *Environmental Policy and Governance*, 23(6), 341–353.
- Gordon, D. J. (2013). Between local innovation and global impact: Cities, networks, and the governance of climate change. *Canadian Foreign Policy Journal*, 19(3), 288–307.
- Gore, C., & Robinson, P. (2010). Municipal climate change response and urban sustainability: A Canadian national survey.
- Harris, L. M., Chu, E. K., & Ziervogel, G. (2017). Negotiated resilience. *Resilience*, 1–19.
- Healey, P. (2004). Creativity and urban governance. *Policy Studies*, 25(2), 87–102.
- Healey, P. (1998). Building institutional capacity through collaborative approaches to urban planning. *Environment and Planning A*, 30(9), 1531–1546.
- Hoffmann, M. J. (2011). *Climate governance at the crossroads: experimenting with a global response after Kyoto*. Oxford University Press.
- Holden, M. (2011). Public participation and local sustainability: Questioning a common agenda in urban governance. *International Journal of Urban and Regional Research*, 35(March), 312–329.
- Innes, J. E. (1998). Information in communicative planning. *Journal of the American Planning Association*, 64(1), 52–63.
- Jordan, A., & Huitema, D. (2014). Innovations in climate policy: The politics of invention, diffusion, and evaluation. *Environmental Politics*, 23(5), 715–734.
- Kern, K., & Alber, G. (2009). Governing climate change in cities: Modes of urban climate governance in multi-level systems. *Competitive Cities and Climate Change*, 171–196.
- Kern, K., & Bulkeley, H. (2009). Cities, Europeanization and multi-level governance: Governing climate change through transnational municipal networks. *Journal of Common Market Studies*, 47(2), 309–332.
- Krause, R. M. (2012). An assessment of the impact that participation in local climate networks has on cities' implementation of climate, energy, and transportation policies. *Review of Policy Research*, 29(5), 585–604.
- Leck, H., & Simon, D. (2012). Fostering multiscalar collaboration and co-operation for effective governance of climate change adaptation. *Urban Studies*, 50, 1221–1238.
- Lee, T. (2013). Global cities and transnational climate change networks. *Global Environmental Politics*, 13(1), 108–27.
- MacCullum, D., Moulaert, F., Hillier, J., & Haddock, S. V. (Eds.). (2009). *Social Innovation and Territorial Development*. London: Routledge.
- Massey, E., Biesbroek, R., Huitema, D., & Jordan, A. (2014). Climate policy innovation: The adoption and diffusion of adaptation policies across Europe. *Global Environmental Change*, 29, 434–443.

- McCann, E. (2011). Urban policy mobilities and global circuits of knowledge: Toward a research agenda. *Annals of the Association of American Geographers*, 101(1), 107-130.
- Meerow, S., & Stults, M. (2016). Comparing conceptualizations of urban climate resilience in theory and practice. *Sustainability*, 8(7), 701.
- Melo, M. A., & Baiocchi, G. (2006). Deliberative democracy and local governance: Towards a new agenda. *International Journal of Urban and Regional Research*, 30(3), 587–600.
- Nelson, R. R., ed. (1993). *National innovation systems: A comparative analysis*. Oxford and New York: Oxford University Press.
- Okereke, C., Bulkeley, H., & Schroeder, H. (2009). Conceptualizing climate governance beyond the international regime. *Global Environmental Politics*, 9(1), 58–78.
- Peck, J., & Theodore, N. (2015). *Fast policy: Experimental statecraft at the thresholds of neoliberalism*. Minneapolis, MN: University of Minnesota Press.
- Pierre, J. (2011). *The politics of urban governance*. Palgrave Macmillan.
- Provan, K. G., & Kenis, P. (2008). Modes of network governance: Structure, management, and effectiveness. *Journal of Public Administration Research and Theory*, 18(2), 229–252.
- Robinson, P., & Gore, C. (2015). Municipal climate reporting: Gaps in monitoring and implications for governance and action. *Environment and Planning C: Government and Policy*, 33(5), 1058-1075.
- Small, M. L. (2009). How many cases do I need? On science and the logic of case selection in field-based research. *Ethnography*, 10(1), 5-38.
- Spaans, M., & Waterhout, B. (2017). Building up resilience in cities worldwide – Rotterdam as participant in the 100 Resilient Cities Programme. *Cities*, 61, 109-116.
- Sørensen, E., & Torfing, J. (2011). Enhancing collaborative innovation in the public sector. *Administration & Society*, 43(8), 842–868.
- Walker, R., & M. Storper. (1989). *The capitalist imperative: Territory, technology and industrial growth*. Wiley-Blackwell.
- Yin, R. K. (2013). Case study research: Design and methods. *Sage Publications*.

Table 1. Key resilience policy and planning actors and outcomes in Berkeley and Rotterdam

City	Policy/Plan	Key Actors	Select Planning Outcomes
Berkeley	<i>Climate Action Plan (2009)</i>	Office of Energy and Sustainable Development, Department of Public Work, City Manager’s Office, Berkeley City Council, HUD, civil society	<ul style="list-style-type: none"> • Create partnerships for infrastructure adaptation projects • Develop Climate Adaptation Strategy • Create vulnerability and impact assessments at a neighborhood level
	<i>Climate Action Plan 2015 Update (2015)</i>	Office of Energy and Sustainable Development, City Manager’s Office, The Ecology Center, civil society	<ul style="list-style-type: none"> • Create new funding pathways • Increase cross-sectoral integration within government
	<i>Berkeley Resilience Strategy (2016)</i>	100RC, Office of Energy and Sustainable Development, City of Oakland; City of San Francisco, Association of Bay Area Governments, Berkeley City Council, civil society	<ul style="list-style-type: none"> • Require land use planning decisions to be based off of the most current science • Diversify water supply to reduce climate risks • Pursue ‘green infrastructure’
Rotterdam	<i>Rotterdam Climate Proof (2009)</i>	Regional Water Boards, Rotterdam Climate Initiative, Port of Rotterdam Authority, Erasmus University, TU Delft	<ul style="list-style-type: none"> • Build knowledge and innovation on water related planning sectors • Market innovation to other cities
	<i>Rotterdam Climate City Mitigation Action Program (2010)</i>	City of Rotterdam, Rotterdam Climate Initiative, Port of Rotterdam Authority, Ministry of Economic Affairs, Ministry of the Environment, Erasmus University, civil society	<ul style="list-style-type: none"> • Develop and implement sustainable building codes • Promote sustainable business management
	<i>Rotterdam Adaptation Strategy (2013)</i>	City of Rotterdam, Port of Rotterdam Authority, Climate Proof Rotterdam, Rotterdam City Council, Private sector partners	<ul style="list-style-type: none"> • Fortify dike flood barriers • Extreme rainfall capture infrastructure • Drought protection
	<i>Rotterdam Resilience Strategy (2016)</i>	100RC, Port of Rotterdam Authority, utility companies, housing co-operations, Ministry of the Environment, Rotterdam CRO Strategy Team, Resilience Strategy Steering Committee	<ul style="list-style-type: none"> • 68 action items under an umbrella of seven resilience themes

Table 2. Summary of innovation drivers and learning outcomes in Berkeley and Rotterdam

City	Innovation Drivers	Learning Outcomes
Berkeley	<ul style="list-style-type: none"> • Strong public perception of climate risks • Deep economic ties to other cities in the region • History in TMNs 	<ul style="list-style-type: none"> • Cross governmental coalitions (BSWG) • Citizen stakeholder committee • New policy pathways that disintegrate planning silos • Relationship with 100RC Platform Partners
Rotterdam	<ul style="list-style-type: none"> • High perception of climate risks • Strong economic ties to other cities in the region • History in TMNs 	<ul style="list-style-type: none"> • City wide Resilience Strategy Team • 100RC helped define resilience on a policy level • New policy pathways that disintegrate planning silos • Relationship with 100 RC Platform Partners