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SETTING THE FOUNDATION: HOW LOCAL CLIMATE CHANGE ADAPTATION INITIATIVES CAN PAVE THE WAY FOR A REGULATORY REGIME THAT WORKS

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ABSTRACT:

Climate change is here and with it a growing awareness of the need to adapt to impacts that are already occurring. At the same time, efforts to establish an international regulatory program to reduce or mitigate greenhouse gas (GHG) emissions have all but collapsed. This article argues that climate change adaptation at the local level, particularly in urban areas, represents a logical step forward. In addition to managing risk, adaptation can stimulate a needed shift in emphasis towards a more pluralist or polycentric approach to climate regulation, laying the groundwork for future national and global regulatory regimes. Examining some of the strategies that local governments in the United States are undertaking to adapt to climate change, the article identifies overlaps, as well as potential conflicts, between adaptation planning at the local level and broader environmental management objectives, including GHG mitigation. The United States could greatly benefit from national level action to expand and strengthen local climate adaptation initiatives, and the article concludes with a proposal for a national climate change adaptation fund.

I. Introduction

As the world grapples with the implications of rising temperatures for the next 100 years, the once taboo subject of climate change adaptation has taken center stage in environmental policy debate. As of May 2011, developed countries had pledged several billion dollars to help developing countries adapt to climate change impacts, following through on pledges made in Copenhagen and formalized in Cancun. National adaptation plans are assuming a central policymaking role in countries like the United Kingdom and the Netherlands. And in the United States, local governments in places like New York, Boston, and Seattle are refining metropolitan adaptation plans that date back several years or decades. Policymakers hope that these plans will help to avoid wasted investment and, in many cases, pay ecological as well as economic dividends.

1 See, e.g., J.B. Ruhl. Climate Change Adaptation and the Structural Transformation of Environmental Law, 40 ENVTL. L. 363, 433 (2010) (“environmental law now recognizes mitigation and adaptation as being joined at the hip.”); Peter Hayes, Resilience as Emergent Behavior, 15 HASTINGS W. NW. J. ENVTL. L. & POL.’Y 175 (2009) (“[T]he main game is now adaptation which renders mitigation no less urgent, but shifts the political equation in dramatic ways that cannot be ignored any longer.”); Thomas Lovejoy, Mitigation and Adaptation for Ecosystem Protection, 39 ENVTL. L. REP. 10,072, 10,073 (2009) (“The adaptation part of the climate change agenda is only just beginning to get attention, and needs much more right away.”); Ileana M. Porras, The City and International Law: In Pursuit of Sustainable Development, 36 FORDHAM URB. L. J. 537, 593 (2009) (“Most climate change experts and policy-makers recognize that adaptation and mitigation are not mutually exclusive strategies but must, on the contrary be employed in tandem.”); see also Daniel H. Cole, Climate Change, Adaptation, and Development 26 UCLA J. ENVTL. & POL’Y 1, 2 n.6 (2008); Robin Kundis Craig. Stationary is Dead—Long Live Transformation: Five Principles for Climate Change Adaptation Law, 34 HARV. ENVTL. L. REV. 9 (2010).


4 See infra Part IV.
The costs of climate change, even under optimistic scenarios, will clearly be large.\(^5\) One recent UNFCCC study pegs adaptation expenses at $49-$171 billion per year by 2030 across the globe,\(^6\) while a recent World Bank report estimates that by 2050 a two degree Celsius temperature rise would require between $70-100 billion per year of adaptation investment.\(^7\) This includes substantial capital investment. For example, California state officials have estimated that “coastal armoring” to protect against flooding on the Pacific Coast and San Francisco Bay would require an initial investment of $14 billion and recurring maintenance expenses of over a billion dollars annually.\(^8\)

The greater burden of adaptation, however, lies in directing government and private investment towards climate resilient development. This can take many forms, and better valuation of ecosystem services is a critical component.\(^9\) In New York, for example, where temperature increases are expected to make heat waves an increasing threat to public health, the city has embarked on a major tree planting campaign—“Greening the Bronx”—to combat urban heat island effect and more severe ozone pollution on hot summer days.\(^10\) In addition, because conservative estimates of sea level rise indicate that a 1-in-100 year flood may become a 1-in-15 year event over the next few decades,\(^11\) the city has begun updating flood insurance rate maps in order to better guide zoning and construction policy.

Climate change presents a serious obstacle to development and poverty reduction, and adaptation costs will hit hardest among those least able to afford them.\(^12\) In the words of Bangladeshi Prime Minister Begum Khaleda Zia, “[for some] the impacts might be lifestyle threatening, for others it is life threatening.”\(^13\) In the United States, the experience of Hurricane Katrina...


\(^9\) See *Millennium Ecosystem Assessment* (2004) available at: www.milleniumassessment.org (detailing twenty-five services provided by environmental resources, such as food, climate regulation, and safeguarding water supply).


\(^11\) See *id.* at 154. By the 2020’s, the probability of a “1-in-100 year flood” occurring in a given year will rise as high as 1-in-65, and by 2080, it may become a 1-in-15 year event. PLANYC. The report’s sea level, precipitation and flood projections “represent the middle 67% of values from model-based probabilities [in] 16 Global Climate Models (GCMs) (7 GCMs for Sea Level Rise) and three emissions scenarios.” The estimates exclude, however, a “rapid ice-melt scenario” and the actual cost of protecting large portions of New York City from a rising sea remains to be determined. *Id.*


\(^13\) Bangladesh Ministry of Environment and Forest. *National Adaptation Programme of Action: Final Report* (2005), at 2, available at unfccc.int/resource/docs/napa/ban01.pdf. Examination of Bangladesh’s National Adaption Programme of Action (NAPA) lends credence to this distinction. Rather than insurance rate maps, the Bangladesh plans focus on already precarious food security and water scarcity problems wrought by salinity intrusion in the...
demonstrated this axiom all too well. Effective climate change adaptation, including better emergency preparedness, thus takes on an equitable dimension that should endear it to those who are concerned with the United States’ growing inequality and the sinking fortunes of its poorest citizens.

In addition to greater equality, adaptation should increase public awareness of climate change. It should do so in a tangible way, because adaptation has an inherently local focus. And eventually, emerging adaptation institutions and policies may serve to re-orient climate regulation away from the top-down, unitary model of global regulation embodied in the Kyoto Protocol. This is critical, because at the local level, reducing GHG emissions itself reaps no discernable local benefit. To be sure, mitigation strategies may coincide with policy solutions to other problems of local character, such as air or water pollution, but in many cases—e.g. a municipality’s purchase of power from renewable sources rather than downwind coal-fired plants—they will not. By contrast, adaptation policies inherently reap local benefits, and in many ways, align with climate change mitigation and help to build up the supporting governance structures for an effective mitigation regime. And by integrating reforms across a broad range of policy areas, from water management to land use planning to public health, adaptation aid can play a critical role in regions where government is already struggling to cope with basic needs.

The next part of this article begins with a brief description of climate change adaptation policy. Part III introduces the notion of polycentric climate change regulation. Part IV considers the specific climate challenges facing urban development, and puts forth the case for directing resources for adaptation to cities. The experience of adaptation planning in various cities in the United States provides helpful guidance on effective policy responses to climate change, and Part V takes a look at these and proposes policy reforms for expanding this work and eventually setting the foundation for a national climate mitigation program. The article concludes with a proposal for a national climate change adaptation fund to work toward these objectives.

II. Adapting to a Warmer World

References to climate change adaptation bring to mind large-scale infrastructure projects such as the Thames barrier in London, or the relocation of entire villages threatened by melting permafrost and rising sea levels, as detailed in the Inuit Circumpolar Conference’s landmark Rivers and aquifers servicing major coastal settlements. Id. at 27. Indeed, adaptation is simply not an option for many communities in Bangladesh and across the world, thus creating a substantial climate change refugee crisis. See, e.g., Sebastián Albua and Isabel Cavelier Adarve, Protecting People Displaced by Disasters in the Context of Climate Change: Challenges from a Mixed Conflict/Disaster Context, 24 Tul. Envtl. L.J. 239 (2011).

14 See Lisa Grow Sun. Disaster Mythology and the Law, 96 Cornell L. Rev. 1131, 1179-82 (describing the bungled response to Hurricane Katrina and the tragedy that ensued, including the observation that when local authorities “purported to declare martial law in their jurisdictions,” they encouraged “the egregious police misconduct that occurred following Katrina.”).

15 See, e.g. Edna Sussman et al. Climate Change Adaptation: Fostering Progress Through Law and Regulation. 18 N.Y.U. Envtl. L. J. 55, 56 (2010) (“rather than discouraging a commitment to mitigation, calling attention to adaptation can actually inspire a greater commitment to mitigation as the specter of future consequences is highlighted.”).

16 See Katherine M. Baldwin. Note: NEPA and CEQA: Effective Legal Frameworks for Compelling Consideration of Adaptation to Climate Change. 82 Cal. L. Rev. 769, 777-78 (2009) (citing Thames Barrier design and contingency plan as “incremental method” that societies may use to manage climate uncertainty.).
petition before the Inter-American Human Rights Commission. For the most part, however, climate change will simply make existing social and environmental problems worse. And the solutions to these problems consist in large part on building local government capacity. Specifically, local government capacity to address problems associated with water management, public health, and disaster response are paramount, including capabilities to identify climate change related vulnerabilities, craft plans to address them, and implement those plans with adequate monitoring and enforcement. These capabilities are also necessary for broader economic and social goals.

Adaptation presents the challenge of “mainstreaming” climate change planning into more general development goals. In other words, plans and policies for confronting climate risks cannot be developed in isolation. Rather, effective adaptation policy needs to draw on authorities across a broad spectrum of policy areas—public works, energy, water, transportation, public health—collaborating to integrate adaptation plans into their respective regulatory jurisdictions. A climate change adaptation program should thus represent a bundle of parallel initiatives—water management, emergency preparedness, land use planning—to respond to climate vulnerabilities facing a particular locality, and better align local economies with the ecologies that support them. Mainstreaming has proven difficult, however, precisely because it involves a broad range of actors, including community groups, and increasingly, private sector developers. Information regarding the actual impact of climate change at the local level, where impacts matter most, can be highly uncertain. This uncertainty makes it difficult to assess the relevance of climate change projections for individual decisions.

Climate change poses an unprecedented challenge for human civilization. The projected speed and intensity of projected changes to the earth’s temperature and atmospheric makeup resulting from anthropogenic GHG emissions will surpass those of any other period that mankind has ever witnessed. According to the IPCC, climate change is causing and will continue to cause more frequent heat waves, more extreme storms and cyclones, an increase in the areas affected by

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17 See Marguerite E. Middaugh. Comment: Linking Global Warming to Inuit Rights. 8 SAN DIEGO INT’L L.J. 179, 197 (2006) (explaining how under international law the United States was found to have violated Inuit human rights by failing to take action on climate change).

18 “Mainstreaming” might also be referred to as “procedural” adaptation strategies. See Alejandro E. Camacho, Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure, 59 EMORY L.J. 1, 23 (2009) (“Though most commenters have focused on substantive strategies that seek to minimize or reverse the adverse effects of climate change on natural systems, the most crucial adaptations may take the more indirect form of procedural governmental strategies. Rather than focusing on directly managing the effects of climate change—or the natural systems or human conduct that may exacerbate such effects—this category is intended to encompass strategies that manage the regulatory programs and processes that develop more direct strategies.”).


21 Adger et al. supra note 20.

drought, and a rise in sea levels, including a higher frequency of extreme storm surges.\textsuperscript{23} These phenomena will have overlapping effects, producing feedback cycles and confounding models based on assumptions rooted in historical, typically linear trends. This carries important implications for managing food security, public health, urban infrastructure, and other critical areas. For example, rising sea levels and increased frequency of extreme storm surges will compromise water supplies as a result of salinity intrusion, increase the incidence of coastal flooding, and lead to permanent property loss in many areas. Increased temperatures and more frequent heat waves will diminish crop yields, increase urban “heat island” effects, worsen ground-level ozone “smog” and other air pollution problems, and increase the incidence of vector-borne diseases.\textsuperscript{24} The intensity of climate change impacts will vary from area to area, but adaptation policy may prove the most important determinant of which areas incur the greatest losses.\textsuperscript{25}

Unlike efforts to mitigate GHG emissions, adaptation policy does not fall neatly within the domain of pollution control or even environmental law.\textsuperscript{26} Because climate change impacts will affect so many different aspects of human welfare, adaptation will have to take place across a wide range of jurisdictions and policy areas. The success of projects will largely depend on local conditions. More generally, the uncertainty of climate change impacts translates into policy uncertainty at the point of implementation. Thus, unlike mitigation projects that might proceed relatively independent of local institutions, adaptation requires first and foremost more responsive local institutions. On the upside, because adaptation gains accrue primarily to local residents, unlike the dispersed global benefit of GHG reductions, local support for adaptation efforts may be more forthcoming than for mitigation projects.

This article argues that adaptation should serve as the foundation for broader climate change regulation. Local adaptation plans in the United States typically entail land use and energy conservation measures that serve mitigation as well as adaptation purposes.\textsuperscript{27} But while local action plans for reducing GHG emissions have become ubiquitous, only a few cities have undertaken serious adaptation planning.\textsuperscript{28} As discussed further in Part IV, climate change adaptation policies can fulfill a critical educational role, focusing residents’ attention to the problem of climate change and the consequences of inaction. But even ignoring the influence of

\begin{itemize}
  \item\textsuperscript{23} Id. at 7.
  \item\textsuperscript{24} Moser and Satterthwaite, supra note __, at 3-4; see also Paul H. Brietzke and Carl Adrianopoli. Climate Change in Cities of the Developing World, 25 ENVTL. L. & LITIG. 85, 87 (2010).
  \item\textsuperscript{25} Moser and Satterthwaite, supra note __ at 13. (noting that “the scale and nature of [climate related] risk varies greatly between urban centers and also within them, between different population groups or locations.”); see also Daniel A. Farber, Adapting to Climate Change: Who Should Pay, 23 J. Land Use & Envtl. L. 1, 18 (2007) (“The cost of adaptation may or may not be large in comparison with the total world economy, but that comparison will not be relevant to localities that need billions of dollars worth of expenditures for climate change adaptation.”).
  \item\textsuperscript{26} Ruhl, supra note 1, at 364 (“Mitigation policy has been framed as an initiative primarily within the domain of environmental law--a form of pollution control on steroids--and thus it will be environmental law that makes the first move and other policy realms that apply support or pushback. By contrast, environmental law does not “own” adaptation policy; rather, numerous policy fronts will compete simultaneously for primacy and priority as people demand protection from harms and enjoyment of benefits that play out as climate change moves relentlessly forward.”).
  \item\textsuperscript{27} See, e.g. PlaNYC, supra note __.
  \item\textsuperscript{28} Moser and Satterthwaite, supra note __ at 16 (“Even in the cities of high-income countries where there is the greatest awareness of climate change -- and that have made substantial efforts to reduce emissions -- there has been no move on adaptation.”).
\end{itemize}
adaptation work on voter preferences and broader norms, more resilient communities will also
tend to be less carbon intensive. For example, water scarcity, intensified by climate change,
suggests the need for more compact urban land-use patterns, which generate less storm water
runoff pollution, and waste less on transporting water to far flung suburbs.\textsuperscript{29} More generally,
water scarcity supports better valuation of the ecosystem services provided by forests and
wetlands. These measures tend to promote higher density, fewer automobiles, less energy
consumption and a reduction of GHG emissions.\textsuperscript{30}

This is not to say that adaptation initiatives should simply serve as a more politically palatable
packaging for local mitigation efforts. Effective adaptation policies, such as providing poor
residents with fans and air conditioning during a heat wave, may conflict with mitigation
objectives.\textsuperscript{31} Conflating adaptation and mitigation objectives can create confusion and divert
attention from a local government’s most pressing adaptation needs, such as disaster
preparedness.\textsuperscript{32} But all adaptation policy should foster better understanding of climate change,
better integration and coordination of local government services, and better long-term planning
capacity. And these elements are conducive to pursuing GHG mitigation at the local level, and
thus highlight a fundamental synchronicity between local climate change adaptation and
mitigation.

\section*{III. Towards a Polycentric Model of Climate Regulation}

An expanding body of commentary has taken to questioning the relevance of the Kyoto Protocol
to the United Nations Framework Convention on Climate Change and the international
negotiation framework that produced it.\textsuperscript{33} Kyoto’s defenders point out that it is “the only game in
town,”\textsuperscript{34} but for proponents of a pluralist or polycentric model of climate regulation, that
perception represents part of the problem. The conventional, state-centric model of international
relations, and of climate change regulation in particular, is ill-suited to incorporate and build
upon the relative success of national, state and local initiatives, and foster horizontal networks,
such as the Cities for Climate Protection (CCP) campaign sponsored by the International Council

\begin{thebibliography}{9}

\bibitem{29} Sussman et al. \textit{supra} note __.
\bibitem{30} \textit{Id}.
\bibitem{31} See \textit{infra} note __.
\bibitem{32} Moser and Satterthwaite, \textit{supra} note __, at 16, n.9 (noting “considerable confusion between adaptation and
mitigation” among local governments in low- and middle-income countries.).
\bibitem{33} See, e.g. William Boyd. \textit{Climate Change, Fragmentation, and the Challenges of Global Environmental Law:}
Accord, and now the Cancún Agreement, provide unambiguous confirmation that the existing United Nations
process is limited, at best, and unlikely to be a major driver of climate governance in the coming years.”); Daniel
Cole. \textit{From Global to Polycentric Climate Governance,} EUI Working Paper RSCAS 2011/30 available at:
www.eui.eu/Projects/GGP/\textbar/WorkingPapers/RSCAS201130-DanHCole.pdf; at 16 (characterizing the Kyoto
Protocol as “at best, a tentative half-step in the direction of a functional and effective global climate regime,” and
suggesting that “participants in the global roving cocktail party known as the ‘Conference of the Parties’ seem to be
under the misapprehension that they alone make climate policy.”); Amy Seidl. \textit{FINDING HIGHER GROUND:}
\textit{ADAPTATION IN THE AGE OF WARMING} (2011), at 10 (characterizing Copenhagen as a “collective rock bottom” and
noting that meeting the reduction goals of the 192 countries that participated would yield atmospheric GHG
concentrations of “770 ppm, far and away beyond the limit of atmospheric carbon necessary to stabilize Earth’s
climate.”).
\bibitem{34} Robert Stavins. “A Meaningful U.S. Cap and Trade System to Address Climate Change” 32 HARV. ENV. L. R. 293,
\end{thebibliography}
for Local Environmental Initiatives (ICLEI).35 These lower level actions are important as both support and guidance for an eventual global regime that effectively mitigates GHG emissions.36 In the words of Elinor Ostrom, policymakers should “self-consciously adopt a polycentric approach to the problem of climate change in order to gain the benefits at multiple scales as well as to encourage experimentation and learning from diverse policies adopted at multiple scales.”37 The next section takes a closer look at this idea and how climate change adaptation in U.S. cities could help to advance it.

The conventional conception of climate change and its regulatory prognosis go hand in hand. As a global problem, fitting into the tragedy of the commons archetype, climate change requires a global solution of “mutual coercion, mutually agreed upon.”38 The need for a global solution implies the need for an international treaty among nation-states, and the Kyoto Protocol represents the most advanced expression of this in climate regulation, establishing a unitary regulatory structure among “Annex-I” nations who have committed to limit emissions within their jurisdictions and comply with a set of trading and other rules agreed to under the Protocol.39 This regulatory structure establishes a hierarchy, under which national, state, and local governments undertake the means to ensure compliance with the emissions reductions that the various political and industrial interests negotiate at the top. Increasingly, this structure and the associated conception of climate change regulation have come under fire.40

Most would agree that climate change represents a huge collective action problem. But recent literature questions the associated global prognosis.41 For one, while the standard exposition of collective action problems does well to describe inaction on climate change, it struggles to account for the numerous success stories, in which cooperation has prevailed to remedy an environmental or other collective action problem.42 Treating climate change solely as a global collective action problem also ignores the multiple scales of externalities involved in climate regulation, such as air pollution in traffic clogged cities.43

35 See supra note 25 and accompanying text.
38 Garrett Hardin, The Tragedy of the Commons, 162 SCI. 1243 (1968).
39 Stewart supra note __, at 682 (explaining notion of unitary climate regulation architecture).
40 See supra note __ (Boyd/Cole)
41 Ostrom supra note __, 3-4 (arguing against waiting for a single global solution to the climate change problem).
42 Olstrom equates the “tragedy of the commons” problem with the game theory construct of the Prisoner’s Dilemma, which provides the formal logic behind the “expectation of noncooperation leading to socially suboptimal outcomes in the regulation of shared natural resources.” Id. at 7.
43 Id. at 13-15. (“Efforts to reduce pollution levels in large metropolitan areas focus both on total energy use and on emissions of particulates and thus generate benefits at a metropolitan level as well as globally.”) but see Moser and
This is not to say that “mutual coercion, mutually agreed upon” at the global level is not necessary to avert catastrophic climate change, but rather it is insufficient. Ostrom’s polycentric approach and similar calls for pluralist regimes argue that the ultimate success of global action will rest on a set of nested commitments and monitoring structures that go down to the household level. In other words, an effective mitigation regime will require not just an international agreement but also national implementation legislation, sub-national monitoring and enforcement, local experimentation, community support, and most importantly, individual action.\textsuperscript{44} A polycentric model of climate regulation seeks to broaden the analysis and assign a fuller role to actions at the sub-global level in climate regulation. And to the extent that global action is bogged down in an ineffectual, largely dysfunctional regulatory regime, this shift of emphasis points to a way forward.

A key advantage of the overlapping, sometimes competing authority structure of a polycentric system lies in its ability to fit policy responses to scale.\textsuperscript{45} Actors in a polycentric system do not simply operate in a hierarchy, implementing mandates from above which may be insensitive to local conditions but rather “compete and cooperate, interact and learn from one another, and responsibilities at different governmental levels are tailored to match the scale of the public services they provide.”\textsuperscript{46} A polycentric model thus helps to differentiate between the issues that require international negotiations and action at the global level versus those which more appropriately fall within the domain of lower levels of government. Traditional local government power over zoning and building codes, for example, can shape constituents’ preferences and behaviors, and curb underlying demand for carbon intensive development and activities, in ways that cap and trade regimes or carbon taxes imposed from above cannot.\textsuperscript{47}

As with any regulatory design, a polycentric model must contend with inherent vulnerabilities as well. Perhaps most importantly, a decentralized authority structure runs the risks of regulatory fragmentation. Commentators have fingered a fragmented natural resources management structure in the United States as the culprit behind agency inaction, a lack of inter-agency learning, and neglect of climate change issues.\textsuperscript{48} At the local level, overreliance on technical climate planning specialists and weak ties between these specialists and other government officials hampered early adaptation efforts in Boston.\textsuperscript{49} These problems underscore the

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\textsuperscript{44} See Cole supra note __.


\textsuperscript{46} Cole supra note __, at 10; see also Eleanor Ostrom, supra note __, at __. (noting that “a polycentric system exists when multiple public and private organizations at multiple scales jointly affect collective benefits and costs.”).

\textsuperscript{47} See, e.g., Katherine Trisolini. \textit{All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation}. 62 STAN. L. REV. 669, 745 (2010).

\textsuperscript{48} Camacho supra note __, at 26; see also William W. Buzbee, \textit{The Regulatory Fragmentation Continuum, Westway and the Challenges of Regional Growth}, 21 J.L. & POL. 323, 344-348 (2005)(describing various types of regulatory fragmentation).

importance of institutional linkages and bidirectional feedback loops in a polycentric model. These linkages and feedbacks help to ensure that different jurisdictions streamline processes and do not repeat the same errors, and that system design at higher levels incorporates lessons from local experimentation. Networks such as the CCP campaign have created value through horizontal transfers of policy, and through a bi-directional learning process between local and higher level governments, as well as private institutions like the ICLEI.

Unfortunately, like Kyoto, action on climate change at the local level remains a largely nominal force in reducing GHGs, despite some notable success stories. Ostrom argues that this results precisely from the view of climate change as a global collective action quandary, for which individual or community level action is futile. Shifting the emphasis to climate adaptation may therefore serve a critical function in reframing the popular conception of climate change, and what can be done about it at the local level. The experience of many U.S. cities’ efforts to reduce GHG emissions suggests that stimulating more widespread action at the local level could reap considerable gains. In Portland, Oregon, per capita GHG emissions have fallen by 12.5% during a period in which the rest of the United States per capita emissions have grown. Such success stories reflect the unique opportunities for local governments to reduce GHG emissions, and the potential for scaling policy responses down.

III. B. Adaptation in a Polycentric Model

The local character of climate change impacts should serve as an advantage in stimulating ground level support for adaptation. There is no reason to wait for the United Nations to act before diversifying the local water supply or updating flood maps. By virtue of association, however, both efforts to adapt and mitigate climate change have tended to share the same regulatory architecture, as evidenced by the presentation of local climate change adaptation plans within larger mitigation or “green” plans.

While adaptation work remains in its infant stages, it is important to avoid a “lock-in” effect whereby a globalist mentality becomes an impediment not just to solving the climate change problem but to dealing with its impacts as well. Specific adaptation policies often carry significant mitigation co-benefits but, as noted above, a focus on adaptation at the national, state

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51 Cole *supra* note __ at 11.
52 See, e.g., Heike Schroeder and Harriet Bulkele. *Global Cities and the Governance of Climate Change: What is the Role of Law in Cities?*, 36 FORDHAM URB. L. J. 313, 359 (2009) (“Given the gaps in action among the different levels of government, the role of law has been limited in urban climate governance to date. Emphasis has remained on governance by providing new energy infrastructure and enabling public-private partnerships to emerge that provide services that help reduce urban emissions.”).
53 E. Ostrom, *supra* note __, at 15 (“Part of the problem is that ‘the problem’ has been framed so often as a global issue that local politicians and citizens sometimes cannot see that there are things that can be done at a local level that are important steps in the right direction.”).
54 See Trisolini, *supra* note __, at 734-35 (“one of the few studies to review the collective impact of local climate change initiatives found in 2008 that if only the 684 signatories to the Mayors Agreement succeeded in reaching their GHG goals, they would reduce projected 2020 emissions by seven percent. Since 2008, over 300 more signatories have joined, cities have improved programs, and other networks have added members and iterated programs.”)
55 E. Ostrom *supra* note __, at 12.
56 See, e.g., PlaNYC, *supra* note __.
and local level may prove most valuable by setting in place institutions and procedural frameworks that facilitate local GHG reduction plans. This is all the more true considering that the non-linear rates of change associated with climate change impacts may, as concern grows, prompt a similarly abrupt global policy response that needs to draw on a broad support structure of capable local governments.

What legal designs will enable this support structure, install an effective system of regulatory checks and balances at multiple levels, create value through experimentation and, identify and curb regulatory failures, transmit and adapt successful strategies, and provide adequate and predictable funding? An extensive body of literature seeks answers to these and other quandaries. One promising approach, detailed by J.B. Ruhl, is to apply the same principles that guide the development of resilient ecosystems and adaptive built environments to envision the attributes of “resilient and adaptive climate change adaptation law.”

Ruhl’s analysis favors flexibility and dynamism in adaptation policy, since the impacts of climate change at the local level are fraught with uncertainty. Conventional environmental regulatory models, such as environmental assessments under the National Environmental Policy Act, tie an assessment of climate change and other environmental conditions to some discrete regulatory or permitting decision under what Ruhl terms “assumptions of stationarity.” Such static decision frameworks serve as poor guides to climate change adaptation policy, however, because of the rapidly changing information, non-linear feedback loops, and wide scope of impacts that characterize climate change. Instead, adaptation should draw on an ongoing updating process that incorporates public input, monitoring of past project impacts, and newly available data and technology to inform policymakers. In a similar vein, an overlapping, polycentric model of governance should rely on a breadth of policy instruments, from “hard” mandates to “soft” incentives and information sharing tools, in order to make progress on multiple fronts. Ruhl also endorses increased reliance on “transgovernmental networks” to share information and identify best practices without the need for going through formal hierarchies and with fewer institutional constraints.

These policy prescriptions, while straightforward in theory, have proven elusive in practice. The few examples of national level action to address climate change adaptation in the United States, such as EPA’s Climate Ready Estuaries Program, and the joint federal Climate Change Science Program, have been limited in scope and lacked a long-term presence around which to foster the linkages and information sharing critical to adaptation policy. On the other hand, various local experiences suggest some possible avenues for designing a polycentric adaptation model, and where some of the deficiencies may lie in the current regulatory structure.

57 See supra note 1.
61 Camacho supra note ___ at 61-63.
Adaptation to climate change cannot occur in a vacuum. It relates to specific places and contexts. At the national level, a country might build its resilience to climate change by improving its disaster-preparedness, or establishing technical capacity at the national level to guide adaptation planning, but the actual drought, storms, flooding, forest fires, heat waves, coastal erosion and inundation, disease epidemics, and myriad other planning challenges will occur in particular places and contexts. Their resolution and management will depend to a great extent on local government. National policies in the U.S. have only weakly influenced many critical land use and resource management decisions made at the local level. And as local conditions become increasingly volatile, mirroring the uncertainty surrounding the earth’s climate, the federal government’s ability to craft flexible, context-sensitive policy responses will come under more strain.

This local character of climate adaptation may seem banal, but it implicates important policy considerations. Climate change will primarily exacerbate existing social and environmental problems. George W. Bush and the Federal Emergency Management Administration (FEMA) rightly received condemnation for their inept response to Hurricane Katrina. But local officials in New Orleans, particularly local law enforcement, might have averted much of the tragedy. Adaptation efforts should seek to identify these types of institutional vulnerabilities, and wherever possible, tap into local expertise for managing local problems that climate change exacerbates. National governments may take action in the event of an emergency, or partially regulate an area’s natural resources through air and water pollution statutes, or through the operation of specific resource management jurisdictions, but “local government is the key locus for action on adaptation.”

IV. Adaptation and Urban Development

Climate change is both a symptom and an increasingly important cause of a broader disjunction between economic growth and the natural resources that economic activity depends upon. Urban

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64 This is not to say that in the future local policymaking authority should not be more diffused. See, e.g. Daniel A. Farber, Climate Change, Federalism, and the Constitution, 50 ARTZ. L. REV. 879, 914 (2008) (“Traditionally, state and local governments have been the major regulators of land use and urban development. Responding to climate change may result in changes to this tradition. Given the national and international scope of climate change, the need for an integrated national strategy for controlling emissions and planning adaptation is strong.”).

65 See, e.g., Grow Sun supra note __.

66 Moser and Satterthwaite supra note __, at 14 (noting that “urban populations in high-income nations take for granted that a web of institutions, infrastructure, services and regulations protects them from extreme weather/floods, and keep adapting to continue protecting them.”).
development is the quintessential manifestation of this conventional economic growth,\textsuperscript{67} and in order to adapt the economic growth process to the pressures of climate change, urbanization will need to adapt.\textsuperscript{68} Hence, focusing adaptation resources on cities makes sense. It also makes sense because climate change will affect different places in different ways, and so the specific policies to manage impacts must respond to local conditions. These policies tend to fall within the gambit of traditional local government powers—zoning, water and waste management, emergency response—and so adaptation aid can help local governments, as well as non-governmental organizations, community groups, and local businesses,\textsuperscript{69} to exercise these powers in a way that steers economic growth and urban development towards more sustainable practices. This is not to say that “cities alone can deliver” a solution to climate change and all of the other ecological problems that stem from conventional economic development.\textsuperscript{70} But cities must figure prominently in the eventual solution, and action now at the local level can facilitate that solution.

Another reason that cities matter is that most people now live in a city,\textsuperscript{71} and even more are projected to do so in the future. Some 71\% of GHG emissions are attributable to urban areas, according to a recent World Bank estimate, and this share is expected to rise as well.\textsuperscript{72} The global population is rapidly urbanizing, and while today just over half of the world lives in cities, at current rates, the global urban population is projected to double in 43 years, and come to represent three-quarters of the entire global population by 2050. Perhaps more daunting, between 1990 and 2000, “the annual growth rate of urban land cover was twice that of the urban population,”\textsuperscript{73} meaning that “urban land cover will double in only 19 years” if trends persist.\textsuperscript{74} Modern urbanization is thus a story of both mass migration to cities, and the expansion of cities to encompass once rural locations.

To be sure, the most rapid declines in urban density have occurred in the developing world,\textsuperscript{75} and the authors of the Lincoln Land Use Institute study, cited above, are quick to point out that living conditions in ultra-high-density slums, such as those in the Kowloon Walled City in Hong Kong during the 1980s, or New York’s lower east side in the late 1800s, pose public health hazards and implicate basic human rights that justify this trend in many areas of the world. But the

\textsuperscript{67} See generally James Howard Kunstler, The Geography of Nowhere: The Rise and Decline of America's Man-Made Landscape (1993).

\textsuperscript{68} Ileana M. Porras, The City and International Law: In Pursuit of Sustainable Development, 36 FORDHAM URB. L. J. 537, 593 (2009) (“That cities North and South are disproportionate contributors to global ecological dysfunction and, not coincidentally, the sites of a significant proportion of economically productive activity is not in dispute.”).

\textsuperscript{69} See Moser and Satterthwaite supra note __, at 1 (“A substantial part of adaptive capacity relates to the ability of local communities to make demands on local governments and, wherever possible, to work in partnership with them.”)

\textsuperscript{70} Porras supra note __, at 543 (noting that cities may have difficulty pursuing global sustainable development objectives because city governance is increasingly privatized, city’s environmental impacts extend beyond their jurisdictions, and local notions of sustainable development may conflict with responses to climate change.).

\textsuperscript{71} According to a recent study of the Lincoln Land Use Institute, “the world urban population is expected to increase from 3 billion in 2000 to 5 billion in 2030 and to 6.4 billion in 2050.” Shlomo Angel, Jason Parent, Daniel L. Civco, and Alejandro M. Blei. “Making Room for a Planet of Cities.” Lincoln Land Use Institute Policy Focus Report (2011), at 45 [hereinafter “Lincoln Report.”].


\textsuperscript{73} Lincoln Report, supra note __, at 3.

\textsuperscript{74} Id.

\textsuperscript{75} On average, cities in developing countries house four times as many people per square mile than urban areas in North America, and they are undergoing both the most rapid increase in urban population and the most rapid decline in urban density. Lincoln Report, supra note __ at 3.
decline in urban density is occurring in almost every urban area on the planet, even in places like Europe that have comparatively restrictive urban growth laws. What accounts for this “very powerful and sustained global tendency for urban densities to decline”?76 So called “in-fill” development must confront challenges that grow out of various property rights, place-based dependencies, and claims and preferences of the local community. These challenges “are a primary reason why the property development industry, and the financial industry that supports it, show preference for new-build or ‘greenfield’ projects which in turn result in the urban sprawl that is a worldwide urban growth phenomenon.”77 Put simply, current regulatory structures make constructing new urban development cheaper, more predictable, and more profitable than investing in existing areas.

For various reasons, auto-centric urban sprawl performs poorly as a system in the face of climate change. In addition to its carbon intensive nature,78 the sheer scale of the transportation and other infrastructure needed to sustain growth centered on ownership of private automobiles is already becoming an economic liability in places like Texas, where recent droughts have caused significant damage to roads and water infrastructure.79 Projections of increasing heat and drought intensity as a result of climate change means that the costs of expansive road and water line networks will go up with the costs of repairing similar damages. Moreover, the conventional pollution problems associated with these inefficiencies, such as stormwater runoff pollution, ozone and particulate matter pollution in the air, and habitat fragmentation, are intensified by climate change impacts like flooding, heat waves, and ecological stress. Consequently, as climate change intensifies, many investments in sprawl growth development may be lost or require significant retrofits.

The global character of urban sprawl is disquieting, but it also suggests that policy solutions for managing sprawl in the U.S., where the phenomenon largely originated,80 could be amplified through their influence on urban growth trends abroad. Such an alternative model of urban growth is sorely needed considering that the single most costly impact of climate change is projected to be its impact on urban infrastructure and associated crises.81

76 Id. at 27.
77 Brugman, supra note __, at 33.
78 The carbon-intensive character of sprawl has been well-documented and is fairly intuitive. The further apart housing, school, employment, and shopping is located, the more residents must travel, usually by automobile. As a result, the Sierra Club estimates that in North America, locating new development within already built areas on average yields 50% less CO2 emissions on the basis of driving reductions alone. http://www.sierraclub.org/sprawl/globalwarming.pdf
(Aug. 4, 2011)( “In cities like Houston and Fort Worth, clay soil is drying up because of the blistering summer heat, bursting water pipelines, buckling house foundations and splitting asphalt roads. . . . The new cracks are opening as city workers continue to mend fissures in the streets from the 2009 drought.”).
80 See Michael Lewyn, You Can Have It All: Less Sprawl and Property Rights Too, 80 TEMP. L. REV. 1093, 1095-96 (2007) (discussing the history of sprawl in the United States and noting that “[a]s late as the 1940s, most American cities were booming” but “America became far less pleasant for nondrivers during the second half of the twentieth century.”); Michael Lewyn. Sprawl in America and Europe, 46 SAN DIEGO L. REV. 85, 112 (2009) (comparing European and American experiences with sprawl to argue “that affluent societies need not be as suburbanized and automobile dependent as the United States.”).
81 See Brugman supra note __ at 17 (noting that “in spite their variances in cost estimates, the top-down models share one clear conclusion: that the dominant portion of future adaptation costs will be in infrastructure and urban areas.”).
Adapting cities and urban growth will require policymakers to view cities within the context of their specific ecologies, including food production systems and other local ecological services. The ICLEI’s definition of “resilience” turns on this systemic emphasis, in the tradition of Jane Jacobs, and proposes to reframe adaptation “from its primary focus on risk reduction to a broader focus on increasing the performance of the area or system in which the investment is to take place.” Toward this end, procedural reforms to mainstream climate considerations into the development decision-making process—updating flood plain maps and building regulations, for example—will likely prove more valuable than capital improvement projects, such as a seawall, simply because the level of private investment in urban infrastructure dwarfs that of public expenditures. Directing this private investment towards better performance of the city as a system thus presents a valuable leveraging opportunity.

IV.B. Strategies for Building the Resilient City

U.S. cities are taking important steps to adapt to climate change, from disaster planning to transit-oriented development and renewable electricity generation. As discussed below, these policies are mutually reinforcing, with many opportunities for “no regrets” policies that serve both economic and environmental interests. For example, buildings less susceptible to hurricanes or typhoons are often more energy efficient and cost-effective as well. But conflicts are inevitable between adaptation strategies, and between adaptation and mitigation objectives. The specific mix of strategies should reflect local conditions and priorities, taking into account the specific climate change vulnerabilities that have been identified. A closer look at some of the local level adaptation strategies that are already being adopted across the United States gives an idea of this dynamic.

More frequent natural disasters may represent the most universal threat of climate change. And for many local governments, developing emergency response preparedness remains a top priority. The increased frequency of extreme weather events also requires more prospective loss avoidance strategies. Local governments can use their authority to dictate how and where to construct buildings and infrastructure to undertake flood planning and control, strengthen buildings to withstand major storm events, and prevent ridgeline development susceptible to landslides. The tools for undertaking this planning are the basic stuff of local government--“comprehensive plans, floodplain regulations, zoning, building codes, overlay zones, and

83 Brugman supra note __, at 11; see also Sheila Foster, The City as an Ecological Space: Social Capital and Urban Land Use, 82 NOTRE DAME L. REV. 527 (2006) (“Reformers' focus on physically redesigning existing urban space to create social capital is ironically inattentive to existing social ties and networks [because] accounting for the integrated relationship between decisions about physical urban space and impacts on a community's social capital necessarily requires rethinking how we manage and regulate the urban commons.”).
84 To take an example from abroad, in Chinese cities alone, one recent analysis estimates that investment in urban fixed asset expenditures will top $46 trillion in the period between 2005-2020, or over $2 trillion per year, twenty times more than the $100 billion per year by 2020 that was pledged in Copenhagen. See Brugman supra note __, at __. Unfortunately, in practice a demand for tangible benefits from adaptation aid may distort these policy options, with the Red Cross noting that “often the ‘hardware’ (concrete visible measures like seawalls) tend to dominate the ‘software’ (like capacity building of the most vulnerable people, DRR and health programmes).” Red Cross Adaptation Guidelines, supra note __.
85 One example already in widespread practice would be the provision of fans and air conditioning to vulnerable residents during a heat wave. See also Sussman et al. supra note __, at 154: (noting that “siting a new facility above a future floodplain may require users today to travel long distances in GHG-emitting transit modes.”).
stormwater regulations. These tools are also fundamental for undertaking broader environmental protection and GHG mitigation initiatives.

Related to flood control, wetland preservation also ranks as an important urban climate change adaptation strategy. Wetlands provide a critical buffer against storm surges in coastal areas, and also help to control water quality and flood management in inland areas. Section 404 of the Clean Water Act gives the U.S. Army Corps of Engineers limited authority over activities to fill or otherwise destroy wetlands, but in practice, local land use decisions largely determine wetlands preservation. To respond to the need for wetlands preservation in the face of coastal erosion and rising sea levels, some local governments have instituted “rolling easements” that automatically adjust as sea levels advance, creating opportunities for new wetlands creation and accommodating coastal property owners, while encouraging them to plan on the basis of sea level rise projections.

In many areas, climate change will stress already scarce fresh water supplies. Local government authority over wetlands, stormwater runoff, solid waste management, and even the location of water supply facilities, is key to building resilience to water supply disruptions. In the U.S., state governments have traditionally exercised a great deal of authority over water allocation decisions, and much debate surrounds the extent to which state and local authority is capable of making these allocation decisions, with many arguing for a larger federal role in arbitrating the various competing interests across jurisdictions. Self-interested local government action, however, can also create positive spill-over effects at the regional or basin-wide level. For example, urban forestry initiatives can help to bolster water supplies, and measures to reduce storm-water runoff can both ease the pressure on local wastewater treatment infrastructure, and improve freshwater supplies for jurisdictions downstream. Other measures, such as safeguarding sewage and water supply infrastructure against flooding, may require external financing but nonetheless fall within the gambit of local authorities. As the ICLEI points out in its adaptation planning guide for cities, such capital improvements should be undertaken with a long-term planning perspective in order to identify opportunities for adding value. For example, a municipality may decide to “piggyback” a reclaimed water system onto a wastewater treatment facility expansion. Some cities, such as Delray Beach, Florida, have even integrated their wastewater treatment operations with conservation efforts to create popular wildlife reserves.

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87 See Trisolini supra note __.
88 See, e.g., Paula Schauweker, Shifting the Focus of Wetlands Protection to State and Local Governments, 22 NAT. RES. & ENV’T 66, 67 (2008) (“Local governments play a critical role in wetlands protection and restoration.”).
89 See Sussman et al. supra note __, at 71-72.
90 Byerly supra note __ at 184. (“Iowa City relocated its water supply facility to higher ground following severe floods in 1993. This prevented another disruption in the city's drinking water during serious flooding in 2008.”).
91 See, e.g. Glickman supra note __ at 1184 (discussing allocation of water from the Colorado River in the face of climate change impacts).
92 Sussman et al. supra note __, at 106.
94 Diane Ackerman. Emerald Cities. N.Y. TIMES (Aug. 15, 2011);
Water scarcity also implies a somewhat less intuitive overlap between climate change and mitigation in the area of energy policy. As a recent analysis of adaption in the New York metropolitan area explains, climate change will impact energy supplies because of the “inextricable link between energy and water.”\textsuperscript{95} It will also introduce scarcity, and favor less centralized power generation, because flooding and heat waves tend to stress energy transmission infrastructure. This dynamic implicates two quintessential local government functions—building regulation and transportation planning—as key drivers of resilience.

Improving the energy efficiency of buildings can help to avoid blackouts during heat waves and ease the impacts of energy shortages during emergencies. It also represents low-hanging fruit as a mitigation strategy, producing financial gains over the lifetime of a building in most cases, while achieving significant reductions in GHG emissions.\textsuperscript{96} Obstacles to making buildings more energy efficient include poor information about existing mature technologies, a focus on short-term costs versus long-term energy savings, and agency problems arising out of landlord-tenant relationships.\textsuperscript{97} Many local governments have overcome these obstacles through green building codes and policies that include both mandates, such as requirements that municipal or in some cases, new commercial and residential buildings, meet LEED standards, as well as less coercive incentives “including options such as fee waivers or reimbursements, subsidized LEED fees, discounted energy star appliances, property tax abatement, awards, green loan funding, training, and permit fee reductions.”\textsuperscript{98} While local governments often rely on external standards to guide building codes and permitting, these functions are well-suited to smaller scale government because “construction design tends to be site-specific.”\textsuperscript{99}

Simply removing some building and zoning codes would go a long way towards improving resilience in many cities, particularly in the United States. For example, zoning ordinances in most U.S. jurisdictions require developers to include a certain number of parking spaces based on the size of a planned structure. Some municipal governments have offered relief from these ordinances as an incentive for green building plans.\textsuperscript{100} Nevertheless, the enduring presence of parking and setback ordinances underscores the key role that local government has played in promoting sprawl growth in the U.S. through interconnected land use and transportation policies. It also points to local government’s potential for directing growth in a new direction.

Transit-oriented development or “smart growth” alternatives to conventional urban development are typically thought of as GHG mitigation strategies. But the environmental and quality of life benefits that accrue from smart growth policies make these strategies an important climate adaptation strategy as well. Smart growth aims to concentrate growth in developed city centers and enable residents to access employment, schools, shopping and other services by transit or alternatives to driving. Successful smart growth strategies depend both on land use and transportation policies. Land use includes issues such as the setback and parking requirements cited above and single-use versus multi-use zoning, while transportation policies include the

\textsuperscript{95} Sussman et al. \textit{supra note __}, at 105.
\textsuperscript{96} Trisolini \textit{supra note __}, at 699.
\textsuperscript{97} \textit{Id.}
\textsuperscript{98} \textit{Id.} at 705.
\textsuperscript{99} Glickman \textit{supra note __}, at 1189.
\textsuperscript{100} Trisolini \textit{supra note __}, at 706 (“Cities may offer similar incentives through other aspects of zoning codes by allowing developers to exceed limits on building height, ratio of floor space to lot size, or by reducing the amount of required parking.”).
design of the overall transportation network, decisions regarding how much to spend on transit versus highways (or repairs versus new capacity),\textsuperscript{101} the speed limits on central district streets, and the availability of sidewalks and pedestrian crossings.

There are many examples of local governments taking action to structure growth around transit and invest in city centers, while preserving valuable watersheds and agricultural production in the city surroundings. Urban containment strategies, such as Portland, Oregon’s, have received a great deal of attention, but more modest strategies can have a significant impact as well.\textsuperscript{102} In the United States, there are “geographically and demographically diverse efforts” to implement zoning and land use codes based on smart growth principles in cities including “El Paso, Louisville, and Miami—not jurisdictions usually associated with Berkeley-style environmentalism.”\textsuperscript{103} Similarly, “complete streets” policies have been widely adopted across the United States, forcing planners to design roads with the interests of pedestrians and other non-drivers in mind.\textsuperscript{104}

Local government exercises many other important functions that can build resilience—developing renewable energy resources, managing the local electric grid, solid waste disposal, hazardous waste cleanup, maintaining telecommunications infrastructure.\textsuperscript{105} This section offers just a few illustrative examples from the growing literature to illustrate the policy overlaps between adaptation and mitigation. Again, however, it is important to note that the most important tool for reducing GHG emissions may simply lie in the institutional capacity that adaptation efforts foster at the local level. Just as climate adaptation implicates a broad range of local government functions, so too do the challenges of mitigation and directing urban development that complements, rather than impedes, local ecological services. The following cases give an idea of how that capacity can evolve.

\section*{V. Climate Change Adaption in U.S. Cities}

In the United States, various studies have sought to shed light on climate change impacts at the national,\textsuperscript{106} state,\textsuperscript{107} and local\textsuperscript{108} levels. At the local level, climate change initiatives have tended to focus on GHG mitigation and other sustainable development goals. The scope of these efforts is substantial, with dozens of cities working through networks such as the ICLEI, the Mayors

\begin{footnotesize}
\textsuperscript{101} Local governments have considerable discretion over how federal transportation funding is used. See Keith Bartholomew, \textit{Cities and Accessibility: The Potential for Carbon Reductions and the Need for National Leadership}, 36 FORDHAM URB. L. J. 159, 209 (2009).


\textsuperscript{103} See Trisolini \textit{supra} note __, at 715.

\textsuperscript{104} See \texttt{www.completestreets.org}.

\textsuperscript{105} Sussman et al. \textit{supra} note __, 110-119.


\end{footnotesize}
Climate Protection Center, and C40, to inventory emissions and develop climate action plans. As of August 2011, 533 U.S. cities were members of ICLEI. As with climate regulation in general, for climate adaptation, “the largest U.S. cities are among the most engaged,” and New York, Boston, and King County Washington have a relatively long experience in honing adaptation policy. This section looks at these cities’ plans and potential federal roles for expanding on their efforts.

V.A. Urban Adaptation Planning in New York, Boston, and King County

Several U.S. municipal governments have taken steps to identify and adapt to climate change, but New York, Boston, and King County have among the most advanced adaptation initiatives in the United States, and have been relatively well-documented. A closer examination of how these programs evolved, and where they are now, offers some lessons for other local governments. In particular, they illustrate the importance of linkages between different branches of local government authority.

In many ways, King County exemplifies how mainstreaming climate change adaptation into urban policy can produce better policy. King County, which encompasses Seattle, began some of the earliest efforts to prepare for climate change at the local level. In 1988, then King County Councilmember Ron Sims proposed an ordinance to establish a county office of global warming. Sims later became the Executive for King County, and passed various executive orders aimed at reducing GHG emissions. In 2005, the County held a conference, entitled “The Future Ain’t What It Used to Be,” in order to foster collaboration between city and regional officials from a broad range of regulatory areas. Following the conference, a “Global Warming Team” was formed with representatives from all of the city’s major offices—budget, water planning, parks, transportation, economic development, among others—to guide adaptation as well as mitigation efforts.

These efforts have led to significant reforms. The County’s wastewater treatment, for example, now includes a program to make reclaimed water available for industrial and irrigation uses, thus relieving pressure to draw water from local rivers, where climate change impacts are stressing salmon and other wildlife. The city has also undertaken a flood buyout and home elevation program to avoid property losses in flood zones, and revised its Comprehensive Plan and Shoreline Master program to integrate climate change projections, and included specific policies to raise awareness of climate change impacts, assess and plan for flooding and sea level rise, update disaster preparedness plans, evaluate climate change impacts on biodiversity, and reform salmon and other wildlife conservation plans to reflect climate change stresses on

\[9\] Trisolini supra note __ at 679.
\[10\] Id.
\[11\] In particular, a comparative analysis of these cities’ adaptation plans, along with those of Toronto, Vancouver, and London was conducted in 2007 in conjunction with the Clean Air Partnership. Clean Air Partnership Study, supra note __.
\[12\] http://www.kingcounty.gov/environment/climate.aspx click on “Past King County climate action”.
\[13\] Clean Air Partnership Study at 37.
\[14\] Policy E-210.
\[15\] Policy E-211.
\[16\] Policy E-212.
\[17\] Policy E-213.
habitat. These policies illustrate both the breadth of adaptation policy and its potential for realizing environmental and economic co-benefits.

New York’s adaptation planning started early as well. In 1997, the federal government initiated a National Assessment of Climate Change Impacts on the United States, divided into 18 regional assessments. More than any other region, the Metropolitan East Coast (MEC) Assessment focused on urban issues. The MEC Assessment set the foundation for New York City’s climate change adaptation plan, and eventually, the establishment of a separate departmental adaptation program in the city’s Department of Environmental Protection. Currently, New York’s PlaNYC includes a major adaptation project to shore up the city’s water supply in the face of expected drought, and a tree planting program--“Greening the Bronx”—designed to reduce urban heat island effect. These projects, however, represent the end results of an ongoing process to build awareness and educate policymakers, assess risks and identify vulnerabilities, and evaluate appropriate courses of action. In its initial assessment, New York planners identified six urban systems susceptible to climate change impacts: coasts, wetlands, water, energy, infrastructure and health. They then held a series of workshops with mid-level officials from corresponding departments over a period of several years to encourage those agencies to mainstream climate change adaptation into their planning and operational decisions. At the same time, websites and other marketing efforts have been made to win public support for the program.

The greater Boston area illustrates some of the obstacles to adaptation planning. Compared to King County and New York, technical specialists took a greater role in the assessment stage and established weaker ongoing ties with a wide variety of stakeholders. As a result, the Boston initiative, which spent more money than most other jurisdictions on a highly technical and comprehensive adaptation assessment report—did not develop the same level of institutional mechanisms for incorporating adaptation options into broader policies for transportation, water management, and other affected areas. This is not to say that Boston area officials are ignoring climate change. Future sea level rise projections led the Massachusetts Water Resources Authority, for example, to change the site of a sewage treatment plant built in 1998, and the city has undertaken a major forestry initiative, a prime example of a “no regrets” adaptation policy. But while Seattle and New York appear to have moved beyond the assessment and policy evaluation stages of adaptation planning to more concrete actions, including major infrastructure projects, the 2011 update to Boston’s Climate Action Plan identifies the need to “develop an adaptation plan” and require “every municipal department and agency to undertake a formal

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118 Policy E-214.
119 Climate Change and a Global City: An Assessment of the Metropolitan East Coast Region, 2000.
120 Clean Air Partnership Study, supra note __.
121 Id.
122 Id. at
123 Clean Air Partnership Study, supra note __ at 17.
124 Id. (noting that the Report “Infrastructure Systems, Services and Climate Change: Integrated Impacts and Response Strategies for the Boston Metropolitan Area (also known as Climate’s Long-term Impacts on Metro Boston or CLIMB)(2004) . . . cost more than $800,000 . . . , took almost five years to complete and was less effective in motivating action” than a comparable London study that cost approximately $100,000 and took two years to complete.
125Id. at __.
review of consequences of climate change,” suggesting that the city has some catching up to do.126

The experiences of Boston, New York, and King County reflect unique local contexts, but they provide some insights into how climate change adaptation can succeed. The experiences underscore the importance of linkages between climate and environmental specialists on the one hand, and officials from other areas of local and regional government, such as transportation or solid waste management. The studies also underscore the importance of raising public awareness, and fostering public support. In this respect, King County’s focused attention to salmon fisheries is unsurprising. Perhaps most importantly, the cities’ experiences attest to a common process for mainstreaming climate considerations into municipal operations, which begins with identifying climate change impacts and disseminating that information broadly in a way that stimulates communication flows in both directions, then building on those linkages to craft policy strategies and, eventually, undertaking coordinated action to build resilience.

V.B. Top-Down Adaptation Planning: The Federal Role

Federal initiatives on climate change adaptation should provide an important source of finance, expertise, and political incentives for local policymakers. By bringing climate change adaptation into the limelight, moreover, the federal government can boost public awareness and educate individuals regarding climate change. A highly visible, national climate change adaptation fund could serve these purposes well, and help to make up for lost ground. For now, the federal government’s climate change adaptation work is neither very visible nor very effective.127

Federal action on climate change adaptation has proceeded slowly. On October 5, 2009, President Obama issued Executive Order 13514 requiring federal agencies to undertake various measures to reduce GHG emissions and to identify adaptation strategies, in conjunction with the interagency Climate Change Adaptation Task Force.128 Pursuant to the Order, all federal agencies were required to issue “an agency-wide climate change adaptation policy statement . . . that commits the agency to adaptation planning to address challenges posed by climate change to the agency’s mission, programs, and operations,” by June 2011.129 This process has highlighted important deficiencies. For example, the U.S. Department of Transportation (DOT) report


127 Robert L. Glicksman, Climate Change Adaptation: A Collective Action Perspective on Federalism Considerations, 40 Envtl. L. 1159, 1163 (2010) (“Despite the critical need for the development of adaptive responses to climate change, the federal government has done little to stake out its turf on adaptation policy or to coordinate the responses of lower levels of government.”); J.B. Ruhl, Climate Change Adaptation and the Structural Transformation of Environmental Law, 40 Envtl. L. 363, 412 (2010) (“T]he United States has compiled close to zero in the way of coordinated anticipatory adaptation policy for managing the risk in the United States of climate change catastrophe and crisis.”).Camacho- (“most existing state and federal regulatory programs are ill-prepared to adapt to the direct effects of climate change.”)

128 Exec. Order No. 13,514, § 2; 3 C.F.R. 248, 249 (2010). The Climate Change Adaptation Task Force is co-chaired by the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA). See http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation

129 http://www.whitehouse.gov/sites/default/files/microsites/ceq/adaptation_final_implementing_instructions_3_3.pdf
concedes that “[c]osts and benefits resulting from climate change impacts are currently not addressed or quantified in DOT evaluation processes.”\textsuperscript{130} DOT has pledged to “incorporate consideration of climate adaptation into [] planning processes and investment decisions,” but its success in doing so will depend in no small part on state and local transportation partners’ policy. Unfortunately, thus far federal initiatives have done little to stimulate adaptation planning in American cities.\textsuperscript{131}

This lack of coordination poses a clear challenge to establishing an effective polycentric governance structure for dealing with climate change. On the one hand, the weak federal policy fails to encourage, or even inhibits, the horizontal transmission of policy successes and best practices established in jurisdictions like King County and New York City. At the same time, where federal agencies have developed policies to incorporate climate change considerations into their operations and planning, disengaged local policymakers are largely free to override these considerations. For example, under the National Environmental Policy Act (NEPA), agencies are increasingly documenting climate change impacts in Environmental Impact Statements, but because the NEPA process does not inform so much as authorize decisions after the fact, even dramatic evidence of climate change vulnerabilities may be ignored or rationalized in environmental assessments.\textsuperscript{132}

In order to support climate adaptation planning at the national level, federal government should play a bigger role in fostering local adaptation efforts and engaging local policymakers. The National Oceanic and Atmospheric Administration’s proposed reorganization to create a national Climate Service is a good first step, filling an important coordinating role by centralizing federal sources of information on climate change adaptation and mitigation strategies. This type of information sharing role is one of the less intrusive possible relationships between federal and local governments on climate change adaptation.\textsuperscript{133} That has not stopped congressional Republicans from targeting NOAA’s revenue neutral reorganization in recent spending bills and cutting off funding to the Climate Service through September of 2011.\textsuperscript{134} Other NOAA initiatives, however, such as the Coastal Services Center Coastal Climate Adaptation website and information clearinghouse, continue to operate and in the past have provided substantial support for local initiatives such as the Boston, New York, and King County initiatives discussed above.\textsuperscript{135}
Increased federal financial support for state and local efforts to compile their own information and planning processes could be helpful too. The means of structuring such financial assistance could take the form of grant or loan programs specifically aimed at adaptation planning, or at financing infrastructure improvements linked to adaptation planning. The federal finance program for sewage treatment plants has been offered as one template for such a program. Other proposals have sought to condition federal transportation, energy, and other funding on compliance with prescribed adaptation planning objectives, following the example of Dutch lawmakers.

Reducing the role of federal funding as a driver of poorly adaptive urban development could have a significant impact as well. Some tentative steps have been taken in this direction. For example, as part of the federal stimulus bill in 2009, DOT’s TIGER Grant program targeted funding on the basis of performance measures including the environmental impacts and GHG emissions associated with proposed transportation infrastructure projects. These criteria have since been largely incorporated into the ongoing “TIFIA” loan program, and could help to shift its investment mix away from its current focus on highways and toll roads. The criteria fall short of any hard and fast requirements for sustainability, nor do they even mention climate change adaptation, but they move closer to a system in which federal transportation and other funding is awarded on the basis of performance. Eventually, such a performance-based system could provide important incentives to local governments.

V.C. A National Climate Change Adaptation Fund

A sizable population in the United States continues to believe that climate change is not an important problem, and that its impacts and the need for an aggressive policy response remain far in the future. So messaging is important. This gives appeal to the creation of a national climate change adaptation fund to finance adaptation planning at the local level.

136 Glickman \textit{supra} note __, at 1167 (“Under the Clean Water Act, for example, the United States Environmental Protection Agency (EPA) has administered a program of grants and loans to state and local governments for the construction of sewage treatment plants.”).

137 See, e.g., Damien Leonard, Directed Note, Raising the Levee: Dutch Land Use Law as a Model for U.S. Adaptation to Climate Change, 21 Geo. Int’l Envtl. L. Rev. 543, 561 (2009)(noting that “the federal government could require that each new federally-funded state or local project must conduct an analysis of potential impacts due to climate change and methods for mitigating those impacts within the larger context of the state-wide plan.”).


139 “The Transportation Infrastructure Finance and Innovation Act (TIFIA) program provides Federal credit assistance in the form of direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects of national and regional significance.” \textit{http://www.fhwa.dot.gov/ipd/tifia/}; “Notice of Funding Availability” 76 Fed. Reg. 16 (Jan. 25, 2011) (“Listed in order of relative weight, the TIFIA selection criteria are as follows: ...(iii) The extent to which the project helps maintain or protect the environment. This includes sustainability: Improving energy efficiency, reducing dependence on oil, reducing greenhouse gas emissions, and reducing other transportation-related impacts on ecosystems . . .”)

140 TIFIA has eighteen ongoing projects, of which only one is transit, three are “intermodal” stations, and fourteen are highway. \textit{http://www.fhwa.dot.gov/ipd/tifia/projects_project_profiles/tifia_portfolio.htm}

A national climate change adaptation fund, under that name, could serve a variety of purposes but simply sending a message could be the most important. Many Americans believe that climate change is a hoax. But the more powerful force against reducing GHG emissions is neither so extreme nor unreasonable.\textsuperscript{142} Most American policymakers, whether they care to admit it, are concerned about climate change, but unpersuaded that it represents a very immediate threat.\textsuperscript{143} This sentiment is encouraged by classical economic analysis. For example, Steven Levitt’s \textit{Superfreakonomics} claims that bioengineering provides a more economically efficient means of addressing climate change than reducing emissions now.\textsuperscript{144} In a similar vein, Bjorn Lomborg’s \textit{Cool It} argues that the money required for a major climate change mitigation program would be better spent on priorities like reducing malaria.\textsuperscript{145} Unfortunately, the scientific literature on climate change discredits these economic arguments and paints an increasingly dire picture of what will be needed to avoid catastrophic global tipping points, such as the melting of the Greenland ice sheet.\textsuperscript{146} Conventional economic analyses of climate change also tend to understate more immediate costs, such as soaring food prices, that have resulted from climate change triggering more localized tipping points of ecological degradation.\textsuperscript{147}

As the reality of the science sinks in, concern in the U.S. and abroad may force political tipping points,\textsuperscript{148} accompanied by more aggressive policy at the global and national level on mitigation and adaptation. But as Olstrom and others point, such aggressive policy at the top cannot be implemented without a support structure of local and ultimately individual action.\textsuperscript{149} Simply familiarizing residents of many American cities with the fact that climate change already requires an adaptive response could go a long way towards building that support structure. And of course, a national adaptation fund would provide incentives for the local planning and policies that ease the transition to a warmer world.

\textsuperscript{142} See id.
\textsuperscript{143} In recent years, many American policymakers, particularly Republicans, have conceded that the climate is changing, but disputed an anthropogenic cause. See, e.g., Ashley Parker. \textit{A More Subdued Perry on the Trail in N.H.} N.Y. TIMES (Aug. 17, 2011) (quoting Texas governor Rick Perry).
\textsuperscript{144} Steven D. Levitt & Stephen J. Dubner, \textit{SUPERFREAKONOMICS : GLOBAL COOLING, PATRIOTIC PROSTITUTES, AND WHY SUICIDE BOMBERS SHOULD BUY LIFE INSURANCE} (2009).
\textsuperscript{145} Bjorn Lomborg. \textit{COOL IT: THE SKEPTICAL ENVIRONMENTALIST’S GUIDE TO GLOBAL WARMING} . (2007).
\textsuperscript{146} See IPCC Report supra note 22.

Our argument shows that the leading economic models of climate change’s impacts are methodologically limited in ways that systematically skew toward an understatement of costs. The models underestimate some impacts because of their optimistic assumptions about the rate and magnitude of warming and fail to account for certain categories of impacts that are difficult to quantify. In addition, leading models tend to adopt a myopic single economy view that does not account for international spillover effects.

\textsuperscript{149} Olstrom \textit{supra} note __.
Consistent with the principles of adaptive adaptation law, discussed above, a national adaptation fund should rely on a broad range of policy instruments, some more coercive than others. In the context of transportation, for example, the fund could award grants for projects to better integrate transportation, land use and natural resource planning, helping local government to phase out antiquated travel demand models and make realistic assessments of how planned development will affect the local water supply and air shed in a hotter world.\footnote{California has taken a step in this direction with Senate Bill 375, “which requires the state’s MPOs to include as part of their long-range transportation plans a ‘sustainable communities strategy’ that is designed to meet greenhouse gas reduction targets set by the state Air Resources Board.” Keith Bartholomew, \textit{Cities and Accessibility: The Potential for Carbon Reductions and the Need for National Leadership}, 36 FORDHAM URB. L. J. 159, 209 (2009) \textit{citing} 2008 Cal. Adv. Legis. Serv. 728.} It could also fund capital improvement projects, or federal reinsurance. Conditions on funding might include reform of local governance structures, such as consolidating multiple Metropolitan Planning Organizations in a single metropolitan area,\footnote{To cite one particularly fragmented example, four metropolitan planning organizations (MPOs) and two rural planning organizations (RPOs) share authority over transportation planning in the Charlotte metro area. \url{http://www.mumpo.org/PDFs/CharlotteRegion_MPO_RPO.pdf}} or revising zoning codes to relax requirements such as parking setbacks. Such reforms are often difficult for local policymakers to undertake because of local opposition, and so the enticement of federal funding could provide political cover. The prospect of creating jobs could also win support from local partners, with an adaptation fund possibly financing new staff positions in local government, and boosting employment through capital improvement and other projects as well.

Clearly, creating a new federal spending program with “climate change” in the title will encounter opposition.\footnote{See, \textit{e.g.} Kate Sheppard. “The CIA’s Weather Underground: Are Republicans putting the intelligence community's climate projects on ice?” \textit{Mother Jones} (Aug. 10, 2011) \textit{available at} \url{http://motherjones.com/environment/2011/08/cia-climate-change-national-security} (describing Republican opposition to military and intelligence programs to study climate change, including a budget amendment by Sen. John Barraso (R-Wyo.) to curtail the CIA’s Center on Climate Change and National Security).} But compared to the challenges of cap and trade, a climate change adaptation fund poses a less direct threat to powerful special interests, and has a common-sense, better safe than sorry appeal. And while the various efforts at the agency level to craft climate adaptation plans is encouraging, an immediate stimulus to local adaptation planning, where specific vulnerabilities to climate change can be identified, is sorely needed.

\textbf{VI. CONCLUSION}

Ultimately, adapting to climate change must include a stop to its underlying cause. Avoiding more than a two degree Celsius rise in average world temperature will require a herculean effort, and at every level of action, from international negotiating bodies to neighborhood coalitions. It will require linkages between climate specialists and a diverse body of policymakers and stakeholders, and it will require public awareness and the assumption of individual responsibility. Unfortunately, few policymakers appear inclined to embark upon this herculean effort anytime soon. Fortunately, local climate adaptation initiatives, with support from above, can help to set the stage for it. As the value of local initiatives like King County and New York City’s become more evident, other cities are sure to follow with their own assessments of vulnerabilities and action plans. Federal policy should encourage cities to undertake these
initiatives, and to continue developing those already in progress, setting the institutional foundation for tackling climate change head on.