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INNOVATION REVIEW

Strategies to Address Climate Change Risk in Low- and Moderate-Income Communities

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Community Development INNOVATION REVIEW

The *Community Development Innovation Review* focuses on bridging the gap between theory and practice, from as many viewpoints as possible. The goal of this journal is to promote cross-sector dialogue around a range of emerging issues and related investments that advance economic resilience and mobility for low- and moderate-income communities.

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Community Development INNOVATION REVIEW

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Foreword

Ian Galloway
Co-Editor, *Community Development Innovation Review*

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Without smart, proactive investments in adaptive capacity and resilience, low- and moderate-income (LMI) communities will likely be disproportionately affected by climate change-related events.[1] This issue of the *Community Development Innovation Review* explores these investment opportunities and calls on the community development sector to take a leadership role in preparing vulnerable regions most at risk for a "new abnormal."[2]

This issue would not have been possible without the extraordinary work of its guest editor, Jesse M. Keenan. A leading thinker on climate change risk–even adding the helpful term "climate gentrification" to the lexicon–Jesse recruited a remarkable group of thirty-eight authors to write for this issue. Their contributions, and Jesse's, advance the community development sector and help us better prepare for a changing world.

Despite the challenges that lie ahead, I'm encouraged by the work that's already begun. As recently as this summer, in fact, the Low Income Investment Fund–a national Community Development Financial Institution–issued a $100 million "Sustainability Bond," the first public offering directly aligned with the United Nations' Sustainable Development Goals.[3] If that's any indication, the community development sector has already begun to mobilize capital to address the impacts of climate change in LMI communities.

Enjoy this issue of the *Review*.

1 See, for example: Anderson, M. and McMinn, S. "As Rising Heat Bakes U.S. Cities, The Poor Often Feel It Most," *All Things Considered*, National Public Radio (September 3, 2019), available at https://www.npr.org/2019/09/03/754044732/as-rising-heat-bakes-u-s-cities-the-poor-often-feel-it-most.

2 Former California Governor Jerry Brown (November 11, 2018), as cited by Allison Brooks in her article, *Drawing a New Roadmap: The Resilient by Design Bay Area Challenge*.

3 Low Income Investment Fund, "$100 Million in Sustainable Bonds for Social Impact: Announcing LIIF's First Bond Issuance," https://www.liifund.org/news/post/100-million-in-sustainable-bonds-for-social-impact-announcing-liifs-first-bond-issuance/.

Climate Adaptation and Community Development

Jesse M. Keenan

Adaptation is defined as an "[a]djustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects."[1] A more complete definition of adaptation "involve[s] both building *adaptive capacity* thereby increasing the ability of individuals, groups, or organizations to adapt to changes, and *implementing* adaptation decisions, i.e., transforming that capacity into action" [emphasis added].[2] In this regard, a central hallmark of adaptation is about building a capacity for not only managing risks (i.e., moderating negative effects) but also for taking advantage of beneficial opportunities. As such, climate adaptation and community development are uniquely aligned in that capacity building has been a central tenet of community development.

Until recently, popular action driving climate adaptation has been squarely nested within the public and civic sectors. Yet, with a greater empirical foundation for understanding the true distributed costs of climate impacts, there is greater recognition that the private sector must play a more fundamental role in guiding and resourcing climate adaptation interventions and investments. The private sector has always adapted–one either adapts to new markets, products, or services or they go out of business. But the current calculus is more than a function of market share. It is a function of where there will be a market at all. In this regard, there are both risks (and uncertainties) and opportunities with climate adaptation.

Banks and lending institutions, including Community Development Financial Institutions (CFDIs), play a key role in shaping our economy and the general trajectory of private sector enterprise. Increasingly, the banking and financial services sectors have begun to understand the risks and uncertainties associated with climate change. Whether it is asset management or asset pricing, the methodological and technological capacity to measure and estimate costs are nearly commensurate with any other avenue of commercial and enterprise risk.[3] Perhaps what is less understood are the full range of potential opportunities that climate adaptation could engender in the advancement of sustainable economies and communities.

This issue of the *Community Development Innovation Review* highlights not only modes and degrees of interdependency and mutual interest, but also methodologies and models

1 U.S. Global Change Research Program. "Climate Change: Glossary" (2019), available at https://www.globalchange.gov/climate-change/glossary.

2 Adger, W.N., Arnell, N.W., and Tompkins, E.L. "Successful Adaptation to Climate Change Across Scales," *Global Environmental Change*, 15(2) (2005), p. 78.

3 Financial Stability Board. "Recommendations of the Task Force on Climate-related Financial Disclosures: Final Report," Bank of International Settlements (2017); Financial Stability Board. "Technical Supplement: the Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities," Bank of International Settlements (2017); and Mazzacurati, E., Firth, J., and Venturini, S. "Advancing TCFD Guidance on Physical Climate Risks and Opportunities: Report of the European Bank for Reconstruction and Development," Four Twenty Seven and Acclimatise (2018).

for engaging a new set of parameters defined by social welfare outcomes consistent with community development practices and domains of engagement. Through a diverse range of contributions from different sectors across the U.S., this issue allows readers to see that climate adaptation is not just about building seawalls and sea level rise. It's about agricultural economies and youth education and global financial systems and the hard realities of everyday low-to-moderate income (LMI) households. This issue highlights that, in fact, all of us have a stake in climate adaptation.

Analytical Discipline for Investment Analysis

This issue is not intended to be a methodological survey of how to analyze, design, plan and execute climate adaptation interventions and investments. For a more comprehensive review and practical approach, readers should reference *Climate Adaptation Finance and Investment in California*[4] and *Climate Adaptation Investment and the Community Reinvestment Act*.[5] Both of these freely accessible resources provide references for understanding conceptual and analytical distinctions within a broad field of allied knowledge that falls under the wider umbrella of climate adaptation, including hazard mitigation, engineering resilience, ecological resilience, community resilience, and maladaptation.

There are very often conflicts–sometimes as simple as opportunity costs–by and between different strategies. Likewise, the interventions and investments associated with these different concepts will yield different benefits to different people (and ecosystems) over different time horizons. For instance, engineering resilience may be maladaptive to an environmental constituency (e.g., grey infrastructure vs. habitat preservation) and ecological resilience may be in direct conflict with community resilience (e.g., habitat preservation vs. siting of affordable housing). The challenge is to translate subjective outcomes to discrete elements that can be evaluated based on objective criteria informed by empirical science, social science, and culturally derived knowledge of people and place.

Defining, measuring and analyzing synergies and conflicts by and between different courses of action (framed as different concepts) is central to providing the analytical discipline necessary to fully engage the private sector. As such, the analysis must reflect robustness and not simply net present value optimization. Likewise, it is highly desirable for the public and civic sectors to promote such discipline because it speaks to a more well-informed discourse that supports the development of public policies. Ultimately, it will be through a combination of market forces and democratic processes that society will determine what we should protect and what we should give up in the face of climate change–for better and for worse. The goal of this issue is to identify those elements of commerce and community development that provide a pathway for engagement with stakeholders in a variety of sectors in order to understand where investments can be made that advance collective interests in the face of impacts and uncertainties from a rapidly changing world.

4 Keenan, J.M. *Climate Adaptation Finance and Investment in California*, Routledge (2018).
5 Keenan, J.M. and Mattiuzzi, E. "Climate Adaptation Investment and the Community Reinvestment Act," Community Development Research Brief, Federal Reserve Bank of San Francisco (2019).

Navigating this Issue

The diversity of contributors to this issue demonstrates the wide ranging professional impetus driving engagement at the intersection of climate change, community development, and financial services. To fully navigate this issue, it is helpful to understand a little bit about the contributors and their frame of reference. The lead article is by Michael Berman, a former banking executive, advisor to a U.S. Department of Housing and Urban Development (HUD) secretary, and head of the Mortgage Bankers Association. Today, he is leading a high-level national effort to prepare our mortgage system for climate change. In his article, *Flood Risk and Structural Adaptation of Markets: An Outline for Action*, Berman provides a framework for understanding not only the challenges but a range of practical solutions. This article is juxtaposed next to an article by a group of leading young economists, Asaf Bernstein, Matthew Gustafson, and Ryan Lewis, who have provided the most robust and sophisticated evidence yet of the economic impacts of sea level rise on housing and real estate. Their article, *Real Estate as a Tool for Adaptive Banking*, presents the current evidence within the context of a more resolute understanding of the economic vulnerability of LMI households and communities. To this end, they lay the emerging empirical foundation for potential intervention through the Community Reinvestment Act (CRA). Together, these articles tackle one of the most immediate challenges to social welfare and the accrual of wealth: housing.

Next, the debate is shaped by contributors from two leading economic consulting firms as to whether insurance is a leader or a follower of more systematic adaptation to climate risk as it relates to everything from mortgage underwriting to land use patterns. Of course, these considerations are critical for community development, particular in post-disaster recovery and environmental justice contexts. Mark Northcross argues in his article, *Rebuild to Fail or Rebuild to Adapt: How CRA Lending Can Guide Climate Change Disaster Response*, that insurance is a perpetual laggard by virtue of the architecture and timing of the mechanisms of its various markets. He utilizes emerging insurance market failures following recent California wildfires as his case in point. However, he also provides a set of conditions that can mitigate risky behavior and incentivize investment in resilience and hazard mitigation that are linked with actuarially sound insurance products. In their article, *Insurance Innovation and Community-Based Adaptation Finance*, Shalini Vajjhala and James Rhodes argue that new insurance products are critical for supporting everything from large scale infrastructure to more distributive property level investments. More fundamentally, they suggest that new products can capture network level benefits from resilience and adaptation investments.

The next article carries forward the idea of instrumentalizing network level benefits from adaptation, resilience, and hazard mitigation investments. *Forest Finance Unlocks Opportunities for Rural Communities: Exploring the Triple Bottom Line Impacts of the Forest Resilience Bond Model*, by Nathalie Woolworth and Zach Knight, makes a compelling argument for how ecosystem services valuation of forest performance can provide the financial basis for debt instruments that catalyze investment in not only forests but rural communities. This partnership between civic-minded entrepreneurs and the U.S. Forest Service is grounded by an exploration of the

inaugural deployment of this investment model. The article provides a prescient exploration of the range of challenges facing rural communities and the extent to which climate adaptation can represent a net-positive contribution to economic development and social welfare, while also advancing responsible ecological management.

Natalie Ambrosio and Yoon Kim, in their article, *Community Resilience and Adaptive Capacity: A Meaningful Investment Across Assets*, carry forward the idea that investments in community resilience have reciprocal economic benefits to commercial enterprise. They provide a high-level discussion on emerging practices and for supporting measurement of the adaptive capacity of enterprises and communities. Adaptive capacity–often in support of organizational resilience and continuity of supply-chains–is an increasingly well-defined analytical frame in business scholarship and corporate governance practices.[6] However, this article challenges us to move beyond the four corners of an enterprise-level assessment. While resilience is generally understood to have limited functionality based on internal designs for known risks, adaptive capacity is understood in broader terms to utilize both internal and external designs to both known and unknown risks and other non-probabilistic phenomena. For this reason, adaptive capacity is a central and powerful frame for further exploration at the intersection of commercial and community organizations, structures, resources, and intelligence capacities.

Moving from an organizational and community scale, John Cleveland, Jon Crowe, Lois DeBacker, Trine Munk, and Peter Plastrik provide a roadmap for public finance and municipal jurisdictions in their article, *Hunting for Money: U.S. Cities Need a System for Financing Climate Resilience and Adaptation*. Building off recent initiatives in Boston, the contributors highlight substantive barriers that are thwarting standardization in financial products and services that, as a system, could support adaptation and resilience investments. The article provides a useful survey of ongoing innovations–tested and untested–that offer some hope for future development. The contributors highlight the practical role that philanthropy, CDFIs and CRA investors can play in stimulating and supporting experimentation with these innovations in the advancement of seeing what works and what does not.

A.R. Siders and Carri Hulet provide a link between municipal finance and governance with the long-term social welfare of displaced persons in their article, *Climigration and the Private Sector*. This contribution explores the potential role that the private sector can play in mitigating the negative impacts of population displacement. In their article, *Building Community Wealth through Community Resilience*, Johanna Bozuwa and Thomas Hanna take a different perspective on the role of the private sector to advance social welfare. These contributors challenge conventional practices of grants, subsidies and tax breaks that they see as "wealth extraction." Rather, the contributors challenge readers to draw upon examples of community

6 Engle, N.L. "Adaptive capacity and its assessment," *Global Environmental Change*, 21(2) (2011), pp. 647-656; Friedman, Y., Carmeli, A., and Tishler, A. "How CEOs and TMTs build adaptive capacity in small entrepreneurial firms," *Journal of Management Studies*, 53(6) (2016), pp. 996-1018; and Aggarwal, V.A., Posen, H.E., and Workiewicz, M. "Adaptive capacity to technological change: A microfoundational approach," *Strategic Management Journal*, 38(6) (2017), pp. 1212-1231.

wealth building that can take advantage of collateral benefits from public climate adaptation investments. Elizabeth Rogers, Anna Brown, and Keith Bisson frame the challenges for the state of Maine in similar community and economic development terms in their article, *Building on Shared Values to Communicate with Mainers on Climate Change*. This article highlights the collective engagement of community stakeholders to research and refine modes of community in order to fully engender a conversation and action on climate change in Maine. Through sophisticated opinion research, this collective was able to not only understand climate vulnerability, but they were able to frame actions and opportunities in a way that catalyzed support and provided a platform for a more robust public discourse.

Advances in climate communications are critical to the idea of building community coalitions, community wealth, and community resilience. In her contribution, *Embracing the Challenge of Climate Education and Engagement*, pioneering climate communicator Caroline Lewis provides some insight in how community development organizations may cultivate this conversation. This article highlights the full range of outreach activities and the equal measure of ways that climate science and adaptation science can be grounded to resonate with people's everyday lives. In the process, a more engaged citizenship can foster and support more effective advocacy for climate adaptation investments. One emerging area of climate communications where communities have organically organized is within the media landscape of podcasts. This low-cost, highly accessible format has been a productive avenue for sharing and distilling not only complex climate science but also stories and experiences of a variety of stakeholders who are often less visible in the popular climate change press. Doug Parsons and Dan Ackerstein highlight the global success and lessons learned from *America Adapts*–the world's most popular climate change podcast–in their article *America Adapts: The Value of Podcasting in Climate Communications*. The contributors highlight avenues by which community development organizations can think about content creation and the prospects of reaching new and expanded audiences through the power of narrative.

The next set of contributors challenge us to think, not just about expanded and diverse audiences, but also about the full range of demographics that should be engaged in the adaptation planning and investment process. A new generation of public health scholars, Seciah Aquino, Josefina Flores Morales, Max Aung, Mary Keovisai, and Jennifer K. McGee-Avila, propose a broad framework for understanding climate changes unique to an aging society. In *Healthy Aging: A Conceptual Model of Community-based Solutions in the Face of Climate Change and Global Demographic Changes*, they pinpoint the central role that community investment can play in advancing everything from household savings to access to simple things like air conditioners. Deborah McKoy, Amanda Eppley, and Shirl Buss work in the other direction to highlight the unique capacities and insights of youth in *The Critical Role for Young People and Schools in Resiliency Planning*. The contributors argue that civic engagement and public education are central to the urban and climate planning processes. This is not merely a function of inclusivity for purposes of political mobilization, rather the benefits speak to a bilateral engagement that informs and shapes the scope and execution of climate investments.

The following contributors bring life to what it really means to shape equitable and inclusive engagement and participation in climate planning activities, offering insight into an expanded range of values and models that serve as overlays to our day-to-day challenges of infrastructure, regional governance and coordination, and environmental degradation. In *Drawing a New Roadmap: The Resilient by Design Bay Area Challenge*, Allison Brooks highlights an emerging process for matching professional and community expertise with real world challenges packaged in design projects that offer both inspiration and technical and programmatic specificity. The contribution highlights real-world experience in how to organize productive groups of stakeholders and how to maximize the value of design in catalyzing investments–albeit with many self-defining barriers along the way. Kokei Otosi extends this line of thinking in *Promoting Equitable Climate Adaptation through Community Engagement*, highlighting real world civic and public partnerships that have utilized participatory planning and design as a means of advancing distributive equity and procedural justice outcomes that are so critical for the validation and effectiveness of climate adaptation investments.

Robert Freudenberg, in his contribution *Investing in the Virtuous Cycle*, argues that any such public and civic investments should be reinforced by an institutional investment in community development and regional economic development and urban planning research. The article provides impactful examples from where such partnerships have provided the information and the data necessary to give underrepresented populations and communities the resources necessary to advocate for the appropriate investments to advance community resilience and climate adaptation. Finally, Laurie Schoeman returns to where we started–housing and community development. *Pre- and Post-Disaster Investments in Housing and Community Development Under the CRA* gets to the heart of the community development sector and asks us to think about structural challenges and interim opportunities for investing in hazard mitigation, community resilience, and engineering resilience within the context a broader interpretation of the CRA. This contribution provides a salient blueprint for expanding the reach of CRA to include both pre- and post-disaster investments. From urban data, research and communications to "mortgage financing 101," the opportunities are already yielding benefits in existing practices. Together, these contributions highlight not only the nature of emerging practices but also a vision for systems of finance, models of engagement and investment conduits that offer potential pathways for supporting efficient, effective, and equitable climate adaptation.

Conclusions

Unfortunately, there are no conclusions. Adaptation is a process that has no end. This issue of the *Community Development Innovation Review* simply offers a window into the diversity of ideas and people shaping climate adaptation and community development. Through responsible stewardship of communities and the environment, there are opportunities to advance investments that offer collective benefits to a variety of constituencies, sectors, and communities. The contributions in this issue have been made by people whose careers have

intersected with climate change in unexpected ways. They have chosen to address, head-on, a set of challenges that will take many generations to firmly resolve, even under the best-case scenarios. Nevertheless, they share a sense of obligation and hope that climate adaptation will open new pathways for redefining and addressing perennial challenges. They share a vision for collective prosperity and uniform opportunity. Together, these contributors offer a glimpse into a field of practice and an area of scholarly inquiry that–even in its earliest stages–will yield benefits across asset classes and life-cycles to impact the social welfare of everyday people.

Jesse M. Keenan is a social scientist and a member of the faculty of the Graduate School of Design at Harvard University. He is the guest editor of this issue of the Community Development Innovation Review.

Flood Risk and Structural Adaptation of Markets: An Outline for Action

Michael D. Berman

Current flood risk assessment tools are too blunt and outdated to accurately measure flood risk and the impact of hazard mitigation investments. As the frequency and severity of floods in the U.S. continues to increase due to climate change, the shortcomings of our current tools will be increasingly insufficient to quantify flood risk. Financial institutions and property owners have always had flood risk in their portfolios. However, they have no accurate, standardized way of measuring and understanding that risk and uncertainty. Instead, they generally look exclusively to the Federal Emergency Management Agency's (FEMA) flood insurance rate maps (FIRMs) and make an annual decision whether to buy or require flood insurance. These maps are outdated, locally politicized, and inaccurate, as demonstrated most recently by the pluvial flooding from Hurricane Harvey (2017) and Hurricane Florence (2018), which have been classified by the National Weather Service as 500-year and 1,000-year events, respectively.[1] Further, these maps do not take into account climate change or other changing conditions, such as additional infrastructure on the ground.

Just as there are uniform engineering standards adopted to measure seismic risk, which include the specific resilience performance of structural components relative to the earthquake severity risk of a particular location, there should be a standard metric for evaluating flood risk for a specific building location with specific structural and material characteristics. These metrics should take into account structural vulnerabilities and corresponding resilience functionality and adaptive capacity of the buildings themselves. This new risk assessment tool would use the latest technology and corresponding performance standards to take into account not only building location, elevation, and the likelihood and severity of flooding, but also the extent of likely damage to a structure given its specific physical characteristics. For commercial properties, it should also account for some measure of business continuity disruption based on flooding events. Furthermore, this risk assessment tool should include a projection over the life of the investment of flood risk due to climate change and other changes in future physical conditions. Whether debt or equity, investment modeling of life-cycle analysis (LCA) should adapt to include future flood risk and potential impact on asset value and default risk. It appears that very few, if any, financial institutions or real estate owners currently analyze this LCA or life-of-investment risk, and there is certainly no standardized way of accomplishing that risk assessment. Armed with this new standard-

1 Irfran, U. "Hurricane Florence's '1,000-year' rainfall, explained," *Vox Media* (September 22, 2018), available at https://www.vox.com/2018/9/20/17883492/hurricane-florence-rain-1000-year.

ized risk assessment metric, lenders and insurers could provide various incentives and penalties to encourage prudent behavior by property owners who must learn to adapt and live with flood waters in new ways. This would also encourage a pathway for regional and municipal lawmakers to enact updated building codes and zoning ordinances, as well as to improve critical infrastructure. Further, these new standard metrics would create new opportunities for architects and building component manufacturers by increasing the markets for buyers and owners of properties who will prefer increased flood resilience functionality in their materials and building elements. Compare the current relative lack of action by lawmakers in flood prone areas to the proactive approach of lawmakers in California and Florida in revising building codes to address earthquake risk and wind risk, respectively. Fannie Mae and Freddie Mac (collectively, the GSEs), as well as the Federal Housing Administration (FHA) and major banks and other financial institutions, have an opportunity to engage with engineers, architects, environmental scientists, risk modelers, insurers, reinsurers, and other financial institutions to lead the way.

Major financial institutions should take four actions: (i) work together to articulate and advocate for the creation of these new standardized metrics, scoring systems, and risk assessment tools to be utilized at the time of mortgage origination, as well as in asset management for the life of loan and portfolio metrics; (ii) participate in and oversee the creation and updating of these metrics and tools; (iii) utilize these new metrics and tools to better understand the flood risk at the time of mortgage origination and in their portfolios over the life of each loan as future conditions change; and (iv) design and implement mortgage loan products that encourage prudent behavior in making property investments which increase resiliency. The result of these actions will catalyze a series of additional steps as municipalities, engineers, architects, and building materials manufacturers "follow the money" to promote behaviors and capture new markets to reduce flood risk, as public awareness is increased. The new initiatives will in turn reduce losses to property owners, lenders, insurers, municipalities as well as all of those who share in the direct and indirect losses from floods. The total positive impact on the social welfare of communities is truly beyond quantification.

The Problem and Current Prognosis

The Science—A Key Driver for Action

The scientific community is clear about the long-term trends for flood risk.[2] While a full description of the relevant literature is well beyond the scope of this article, a few findings should be articulated to set the frame. The estimated global sea level rise over the 20th century was an average of approximately 0.67 inches every ten years.[3] Yet, over the nine-year

2 Maxwell, K. et al. "Built Environment, Urban Systems, and Cities," *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Reidmiller, D.R. et al. [eds.]), U.S. Global Change Research Program (2018), pp. 438–478. doi: 10.7930/NCA4.2018.CH11

3 Solomon, S. et al. "Summary for Policymakers," *AR4 Climate Change 2007: The Physical Science Basis,* Contribution of Working Group I for the Intergovernmental Panel on Climate Change (IPCC) (2007), available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf.

period of 2007 to 2015, the sea level rise in Miami, Florida, progressed at the rate of approximately 3.6 inches. This measurement in Miami is an astounding rate of relative sea level rise which is nearly twice as fast as the prior 20 years at that same location.[4] Furthermore, this is over five times faster than the 100-year global rate. Importantly, this rate is predicted by many scientists to continue to accelerate.

Further, the number of serious floods that we have experienced in the U.S. in coastal and inland locations from rain storms and hurricanes is increasing and will likely continue to increase. In just the two-year period of 2016 and 2017, we have had ten floods, causing over $1 billion of damage per occurrence.[5] States experiencing these floods include Texas, Florida, California, North Carolina, Illinois, Missouri, Arkansas, Louisiana, and West Virginia plus Puerto Rico.[6] This is an alarming baseline that includes riverine and pluvial flooding, in addition to the more commonly reported hurricane storm surge flooding.

A recent study found that from 1949 to 2016, hurricanes have decreased their speed in the North Atlantic by 20 percent resulting in a proportional increase in rainfall from these storms.[7] That is, a 20 percent slowdown in hurricane speed produces about 20 percent more rainfall. The study further suggests that global warming is causing this slowdown along with increased rainfall, slowing wind currents, and warmer areas of the Atlantic Ocean. "The unprecedented rainfall totals associated with the "stall" of Hurricane Harvey over Texas in 2017 provide a notable example of the relationship between regional rainfall…" and hurricane speed.[8] As Hurricane Harvey stalled over Texas for more than a week, it dumped upwards of 50 inches of rainfall on Houston in just five days, and in other locations, 24 inches of rain in just two days. As these tropical storms continue the trend of slowing down over population centers, the increased rainfall will cause an increase in flood risk. This is in addition to the broader set of observations associated with greater inundation from day-to-day rain events as the atmosphere warms and collects and holds more water.[9] The continued warming of the ocean waters, predicted by many global climate scientists, implies that we will have rain storms and hurricanes which will be more frequent and more severe, resulting in more dramatic losses. In addition, sea level rise will cause less severe storms to breach existing sea walls and flood barriers more frequently causing an increasing number of floods and flood damage in coastal communities.

Absent new assessment tools and standardized metrics, we are likely to be stuck in our current frame of assessing flood risk utilizing the 100-year floodplain (Special Flood Hazard Areas, or SFHAs)–an outdated assessment tool which reflects a political negotiation and the

4 McNoldy, B. "Observations and Projections of Sea Level Rise in Miami," Presentation to the Miami Design Preservation League (February 16, 2016), available at http://andrew.rsmas.miami.edu/bmcnoldy/papers/MDPL_17Feb2016.pdf.

5 National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI). "U.S. Billion-Dollar Weather and Climate Disasters" (2018), available at https://www.ncdc.noaa.gov/billions/.

6 Ibid.

7 Kossin, J.P. "A global slowdown of tropical-cyclone translation speed," *Nature*, 558 (2018), pp. 104-107.

8 Ibid, p. 104.

9 Maxwell, K. "Built Environment, Urban Systems, and Cities" (2018).

state of technology of the 1970s and not the best available scientific knowledge today. This historically-based metric is ill-suited to the dynamics of climate change, flood risks from tidal and pluvial flooding, and current advances in technology. Furthermore, by its own internal standards, it is inaccurate due in part to lack of federal funding and in part to the local politicization of many designated SFHAs. So not only are many of the flood zone demarcations wrong in historical terms, but the assessments do not take into account various types of changes in flood risk due to expected future conditions tied to sea level rise and climate change.

Potential Disruption in the Mortgage and Property Markets

A recent study demonstrates that the rate of price appreciation of single-family properties in Miami-Dade County over the period 1971 to 2017 is "positively related to and correlated with incremental measures of higher elevation."[10] It was also observed that properties at lower elevations appreciated at lower rates. Furthermore, this study found that since 2000, "as a reflection of an increase in observed tidal nuisance flooding and relative sea level rise" single-family properties in the lowest elevation cohorts "[have] not kept up with the rates of appreciation of higher elevation cohorts."[11]Another study of over 460,000 single-family property sales between 2007 and 2016 demonstrates that U.S. coastal properties sell for approximately seven percent less, if they are located where scientists project there will be an impact from long-term relative sea level rise of approximately six feet or more.[12] Interestingly, non-owner occupied, single-family properties sell for an approximate ten percent discount. This seems to reflect a more dispassionate view of the risk, since the intangibles of lifestyle and community engagement are generally not present in these investor property transactions.[13]

When these findings are combined with expected continued increases in sea level rise, as well as increases in flood insurance rates, as discussed below, this may well point to more pronounced consumer preferences that may have increasingly substantial impacts on the relative and absolute value of properties where there is perceived increased risk of flooding. Actual flood losses experienced, as well as perceived future flood risk impacting property values in these locations, may adversely impact the tax base of municipalities at the time when more tax revenue is needed for flood mitigation infrastructure and other adaptation investments. The confluence of these conditions could influence lenders to "blue-line" certain locations for unacceptable flood risk. At some point in the next 20 to 30 years, absent substantial new approaches to reducing and managing flood risk, there may be a threat to the availability of the 30-year mortgage in various vulnerable and highly exposed areas.

Given the fact that the average life of a 30-year loan is typically seven or eight years, the amortization of such loans to relatively smaller balances in later years may not be deter-

10 Keenan, J.M., Hill, T., and Gumber, A. "Climate Gentrification: From Theory to Empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5), 054001 (2018). doi: 10.1088/1748-9326/aabb32

11 Ibid.

12 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the horizon: the price effect of sea level rise," *Journal of Financial Economics* (2018), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3073842.

13 Ibid.

minative in the ultimate decision to make a 30-year guarantee in these high-risk locations. For example, if one projects a 30-year mortgage made in 2030, loans made in certain flood-prone locations may well have unacceptable flood risk characteristics if actuaries incorporate projected increased flood risk by 2060. Even a 10-year or 15-year balloon mortgage may become unacceptable to mortgage lenders and guarantors in some markets in the next 20 years due to the exit risk analysis of lenders, as they consider the time horizon of the next owner and/or lender for a given property. Note that the GSEs, banks, and other holders of this flood risk may protect themselves, in part, by purchasing reinsurance on their portfolios, as NFIP has done in 2016, 2017, and 2018.[14] However, at some point such reinsurance may be uneconomic for flood risk, and it is ineffective for exit and valuation risk. Furthermore, the GSEs and banks have a duty to serve and corporate responsibility to promote prudent flood mitigation actions–reinsurance simply masks that responsible engagement.

From December 2017 to July 2018, the author of this article conducted a series of unstructured interviews with over 20 national and regional participants in the mortgage and real estate industry. No lender, asset or portfolio manager, or buyer of commercial mortgage-backed securities (CMBS) first loss B-Pieces interviewed accounts for flood risk at the transaction date or over the life of the asset, other than determining whether a property requires flood insurance solely because it is in the 100-year floodplain at the initial transaction date. When specifically asked, no participant takes into account any of the following potential life of investment risk factors: (i) increases in flood insurance premiums, which may be substantial in light of the new FEMA risk rating system expected in 2020; (ii) adverse impacts on asset values and business interruption due to projected or actual increased flooding;[15] or (iii) increases in local real estate taxes, as municipalities and counties increase spending on infrastructure to mitigate flood risk and/or sea level rise. For instance, no respondent had taken into account substantial new and/or projected infrastructure costs such as the $500 million of bonds for flood mitigation in Miami Beach or the estimated multi-billion dollar cost of converting from septic to sewerage systems in Miami-Dade County.

There is a real possibility that real estate values in some communities will be decreasing due to increased flood risk just as the real estate tax base is being relied on for funding of new flood mitigation infrastructure. Furthermore, if and when a 30-year mortgage is no longer available in a particular neighborhood due to flood risk (or the prohibitive price or lack of availability of flood insurance), property values will undoubtedly be substantially adversely impacted. This can be disastrous for a homeowner whose house is their largest asset and a substantial portion of their net worth. This will have a disproportionate adverse impact on low- and moderate-income (LMI) households. Obviously, this can result in a downward spiral

14 Horn, D. and Brown, J. "Introduction to the National Flood Insurance Program (NFIP)," Congressional Research Service (April 2018), available at https://fas.org/sgp/crs/homesec/R44593.pdf.

15 Keenan, J.M. "Adaptive Capacity of Commercial Real Estate Firms to Urban Flooding New York City," *Journal of Water and Climate Change*, 6(3) (2015), pp. 486-500. doi: 10.2166/WCC.2015.097; and Union of Concerned Scientists. "Underwater: Rising Seas, Chronic Floods, and the Implications for the U.S. Coastal Real Estate" (June 2018), available at https://www.ucsusa.org/underwater.

of property values for such communities. While this is unlikely to be a substantial issue in the near term, the adverse impact on real estate portfolios of the GSEs, banks and other financial institutions may be substantial in the long run.

The Uneven Influence of Flood Insurance and FEMA Programs

The National Flood Insurance Program (NFIP) and FEMA have the potential to increase their influence on the behavior of owners of properties, as well as lawmakers to act more prudently in addressing flood risk. The NFIP has over five million insurance policies in place.[16] Examples of FEMA's behavioral incentives include NFIP flood insurance premium discounts, as well as claims payments issued under certain circumstances for elevating properties above the Base Flood Elevation (BFE). In addition, FEMA has various grant and assistance programs for state and local governments for flood mitigation action. NFIP's Community Rating System (CRS) is doing important work in the area of future flood risk mitigation by offering up to 45 percent discounts on flood insurance premiums if a community takes various flood mitigation actions. However, it remains an open question whether activities taken under the CRS model sufficiently warrant such a reduction. Furthermore, the actions by the NFIP and FEMA need substantial enhancements to adequately address the risk and influence wide-spread change of behavior.

Furthermore, the economic performance of the NFIP has been increasingly challenged, as it continues to pay claims in excess of its revenues, and it needs to borrow increasing amounts of funds from the U.S. Treasury in order to meet its obligations to pay insurance claims. On September 22, 2017, after borrowing $5.825 billion to fund claims from Hurricanes Harvey, Irma and Maria, the NFIP had reached its maximum U.S. Treasury borrowing authority of $30.425 billion in program debt. On October 26, 2017, Congress cancelled $16 billion of NFIP debt–the first time in the history of the NFIP that has occurred. Then on November 9, 2017, the NFIP borrowed another $6.1 billion to fund additional 2017 losses, including additional losses from Hurricanes Harvey, Irma and Maria.[17] New legislation is currently being debated on Capitol Hill to reform the program, as a series of short-term extensions have been passed in the last several months. But, there does not appear to be a consensus on Capitol Hill as to how to reform the NFIP.

The NFIP is clearly not properly pricing flood risk, nor is it adequately influencing prudent behavior by property owners and municipalities to sufficiently reduce or otherwise mitigate this risk. FEMA is working on a new risk rating system to be effective in 2020. This new rating system, known as Risk Rating 2.0, is expected to include repricing of premiums based on flood risk at the property level–an important step.[18] Stated objectives of the new

16 Horn, D. and Webel, B. "Private Flood Insurance and the National Flood Insurance Program," Congressional Research Service (July 2018), available at https://fas.org/sgp/crs/homesec/R45242.pdf.

17 Horn, D. and Brown J. "Introduction to the National Flood Insurance Program (NFIP)" (April 2018).

18 Federal Emergency Management Agency (FEMA). "National Flood Insurance Program (NFIP)," Community Risk Rating System (2018), available at https://www.fema.gov/national-flood-insurance-program-community-rating-system.

system include communication to homeowners of flood risks, steps that may be taken to mitigate risk, as well as a readily available "flood safety score" for each property.[19] However, because the final Risk Rating 2.0 has not yet been released, it is uncertain whether and to what extent those objectives will be achieved. In the FEMA 2018-22 Strategic Plan, FEMA is proactively working to build preparedness and help the nation deal more effectively with catastrophic disasters. In that regard, it has announced that it has a "moonshot" goal of doubling its flood insurance policies in place by 2022.[20] Among other foundational points, FEMA cites a recent study by the National Institute of Building Sciences that for every dollar that the federal government invests in flood hazard mitigation, taxpayers save an average of six dollars of future disaster recovery spending.[21]

It is also noteworthy that some proposals under consideration on Capitol Hill begin to promote prudent behavior in flood prone areas, but those proposals alone are not adequate. Private flood insurance, which is being encouraged by legislators in the current debate, is becoming increasingly expensive with rates in some flood prone areas escalating by alarming amounts in the last seven-to-ten years. While these steps should be incrementally helpful in shaping prudent behavior, they are not sufficient.

Municipal Building Codes and Zoning Ordinances

Relative to the substantial number of municipalities with heightened flood risk, there are only a few coastal communities and communities abutting inland waterways that have moved forward with implementing building codes or zoning ordinances that mandate appropriate building elevations, hazard mitigation components and other designs and standards that advance the resilience of buildings and the adaptation of land use locations. It is interesting and instructive to compare the pro-active approach to reforming and hardening building codes demonstrated by state and local lawmakers in both earthquake zones in California, and hurricane wind zones in Florida (following Hurricane Andrew in 1992), juxtaposed to the relative inactivity in addressing flood risks. There appears to be an aversion of municipalities to amending building codes and zoning regulations despite demonstrable heightened flood risk and increasing losses. However, in the opinion of this author, some of the blame rests with the real estate development and building industries which have influenced state legislatures and others to weaken standards in favor of their own economic self-interests.

19 Federal Emergency Management Agency (FEMA). "Insurance for Floodplain Managers–Where are we going?" (2016), available at http://www.floods.org/Files/Conf2016_ppts/E3_NealCecilStearrett.pdf.

20 Federal Emergency Management Agency (FEMA). "FEMA Strategic Plan 2018-22," U.S. Department of Homeland Security (2018).

21 National Institute of Building Sciences (NIBS) Multihazard Mitigation Council. "Natural Hazard Mitigation Saves 2017 Interim Report: An Independent Study" (Porter, K. [principal investigator]), National Institute of Building Sciences (2017), available at https://www.nibs.org/news/381874/national-institute-of-building-sciences-issues-new-report-on-the-value-of-mitigation.htm and https://www.nibs.org/page/ms2_dwnload.

Four Steps and Programs: A Path Forward

Flood risk mitigation and adaptation investment analysis needs to evolve to a new frame in order to effectively change behaviors of the key players: (i) property owners; (ii) regional, state, and local government officials; (iii) financial institutions, including banks, the GSEs, and flood insurers; (iv) architects; (v) engineers, and (vi) building materials manufacturers. One important goal of policy makers in this arena is to find a pathway for these critical behavioral changes. How can we enable municipalities to enact new building codes and zoning ordinances to encourage prudent behavior by owners and developers of real estate –both single-family and commercial/multifamily properties? The major financial institutions in the U.S. have the opportunity to lead the way in creating new ways to measure and promote prudent behavior to reduce and mitigate flood risk and flood losses through a series of steps, including new programs, products, and pricing. The lawmakers, architects, engineers, and building materials manufacturers will then find it easier to act by adopting various approaches where they "follow the money."

For the GSEs, analogous programs exist in the multifamily earthquake context, as well as the green and affordable housing contexts, where "good behavior" is measured, encouraged and rewarded. The institutions in the strongest position to lead the way in setting new standards for this arena are the GSEs, the FHA, and major banks. While these institutions can model future flood risk and simply purchase reinsurance for this risk, that course of action would miss the opportunity to move the market toward prudent behavior which would also mitigate their risk. And reinsurance would not address valuation risk due to flooding. The path taken by the GSEs and FHA in the "green" arena is a prime example of this strategy. The GSEs, FHA, and major banks can and should take the following steps:

(i) articulate and advocate for the creation of new standardized tools to: (a) identify when a property needs to be assessed for flood risk, then (b) measure flood risk at the specific property level both at the time of mortgage loan origination as well as for the life of each loan taking into account future changing conditions;

(ii) oversee the creation of three new standardized assessment tools and scoring systems at a major university which has expertise in this arena: (a) a desk-top assessment tool and scoring system for single-family properties for mortgage loans under $500,000, (b) an assessment tool and scoring system for engineering inspections of commercial/multi family properties and larger single-family properties working with ASTM International, and (c) an assessment tool for life of loan risk, taking into account future changing conditions;

(iii) adopt these new standardized tools to assess flood risk and property resiliency at the time of mortgage origination and in monitoring flood risk in mortgage portfolios for the life of each loan; and

(iv) create first and second mortgage loan programs using the new flood risk-resiliency scoring systems to promote flood resiliency at the property level through various incentives, such as first mortgage programs that allow higher loan-to-value ratios; loan

programs that have lower guarantee fees (G Fees) and interest rate spreads; and, special purpose second mortgage programs to retrofit existing properties for flood resiliency.

If the GSEs, FHA, and major financial institutions take these steps, then other financial institutions will follow their lead, including flood insurers and reinsurers. And, if the major financial institutions join in this approach to flood resiliency and climate adaptive planning, local municipalities will build on these standards by enacting new building codes and zoning ordinances that will promote prudent risk management behavior to encourage market adaptation, resilience performance and the mitigation of flood risk. At the same time, architects and building materials manufacturers will create more flood resilient designs and products at increasingly affordable prices. While these steps and programs obviously cannot solve the flood risk issues facing our real estate sector or our economy, they can be important incremental steps to increase the adaptive capacity of high-risk markets in the coming decades.

New Standards to Measure Flood Risk

Today, the key tool used to determine flood risk in the single-family residential and commercial-multifamily real estate arenas is the 100-year floodplain established by FEMA. Each flood map designates those areas with a one percent chance of flooding in any given year. These are also called SFHAs and indicate the required BFE–based, for instance, on the estimated height of waters in a "100-year flood" event. Statistically, during a 30-year mortgage, there is about a one-in-four chance of experiencing a 100-year flood. The FEMA mapping is based on a system adopted in the 1970s which relies on historical flood data and property elevation mapping. Although the maps are updated from time to time, this effort is under-funded and much of the U.S. mapping is now out of date. This process is sorely in need of augmentation. In the lending context of programs sponsored by the GSEs and FHA, there is a binary determination of whether a property is in or out of the 100-year floodplain, and flood insurance is required only if a property is in that floodplain. Most other lenders follow this same protocol.

In the aftermath of Hurricane Harvey in August 2017, approximately 80 percent of homeowners in the Houston area who experienced flood losses were uninsured, according to FEMA and a *Washington Post* study of FEMA data.[22] Importantly, other reports indicated that a large share of those uninsured properties were located outside of the 100-year floodplain.[23] This finding is a critically important example illustrating the inadequacy of the 100-year

22 Long, H. "Where Harvey is hitting hardest, 80% lack flood insurance," *The Washington Post* (August 29, 2017), available at https://www.washingtonpost.com/news/wonk/wp/2017/08/29/where-harvey-is-hitting-hardest-four-out-of-five-homeowners-lack-flood-insurance/?utm_term=.a79c788c28e4.

23 Condon, B. and Sweet, K. "About 80% of Hurricane Harvey victims do not have flood insurance, face big bills, *The Associated Press* (August 29, 2017), available at https://www.usatoday.com/story/money/2017/08/29/hurricane-harvey-houston-flood-insurance-damages-claims/611910001/.

floodplain tool.[24] FEMA has stated in its 2018 Fact Sheet entitled "Why Buy Flood Insurance," that 98 percent of counties in the US have experienced a flood, and more that 20 percent of flood claims come from properties outside the high-risk flood zone.

Also, since the 100-year floodplain is based on historical data (even if it is updated) and is subject to local political negotiations, there is generally no element of projected future conditions included in these maps. Even progressive cities like New York City have negotiated a political compromise to lessen the effect of sea level rise in the FIRMs. Furthermore, currently risk modelers in financial institutions generally do not factor any future flood risk in their loss analysis. Both lenders and property owners largely ignore these risks as well as the locally negotiated changes in the flood maps and, instead, assume that flood insurance will be adequate based on the 100-year floodplain–a determination which is inadequate both today and over any long time period. Projections of sea level rise, storm surge, tidal flooding, riverine flooding, and rain storm events as well as local infrastructure changes that impact flood risk need to be taken into account in any tool which relates to flood risk over the term of a 10, 20, or 30-year mortgage. A standardized assessment tool is needed for both individual properties as well as portfolio modeling.

An important impetus for this life of loan modeling may come, in part, from the new Current Expected Credit Loss (CECL) accounting standard adopted by the Financial Accounting Standards Board (FASB). This new standard is scheduled to be effective in 2020 for SEC registrants and in 2021 for non-SEC registrants.[25] The standard will significantly change the way in which financial institutions account for loan and credit losses. These institutions will be required to include reasonable forecasts estimating expected losses over the life of each loan. Accounting industry practices are expected to include more reliance on robust loan level data and various new methodologies for forward-looking modeling.[26] It would seem obvious that flood risk should be part of this modeling.

The engineering, technology, and scientific communities, flood modeling enterprises, as well as the flood insurance and reinsurance players have developed and continue to develop new tools that can provide the foundation of new standards to measure flood risk. Importantly, these tools include improved flood inundation mapping and LIDAR mapping. The most recently developed metrics and flood models currently in use are based on storm surge, severe rain events, river flooding, and tidal flooding–taking projected sea level rise into account. However, the risk rating methodologies of the flood risk modelers and private

24 Handy, R.M. and Osborne, J. "Thousands of Houston-area homeowners faced Harvey with no flood insurance," *The Houston Chronicle* (September 2, 2017), available at https://www.chron.com/news/article/Thousands-of-Houston-area-homeowners-faced-Harvey-12168384.php.

25 Office of the Comptroller of the Currency. "Current Expected Credit Loss (CECL) Methodology" (2018), available at https://www.occ.treas.gov/topics/bank-operations/accounting/cecl/current-expected-credit-loss-model.html.

26 ALLL Regulations. "CECL Model Changes: Life of Loan Concept" (2018), available at https://www.alll.com/alll-regulations/fasb-cecl/life-of-loan/.

insurers have no standardized scoring metrics. Furthermore, while these stakeholders can add substantial expertise to creating tools for the industry, they have generally been reluctant to be transparent in their rating metrics due, in part, to competitive differentiation.

Important steps also include the recent work of FEMA in updating the CRS, as well as the NFIP's current risk rating redesign project, Risk Rating 2.0. This new NFIP risk rating system scheduled to be announced in 2019 and to be implemented in 2020 could be an important foundational step in establishing risk and resilience metrics for property specific features. Until announced and implemented that remains uncertain, and it is also unclear whether a private sector initiative might be more effective at measuring and communicating flood risk and resilience when compared to this public sector NFIP initiative. Additional key steps are reflected in the research in North Carolina led by Professor Howard Kunreuther (Wharton School's Risk Management Center of the University of Pennsylvania) and John Dorman (North Carolina Division of Emergency Management) with regard to the impact of a building's base elevation on flood risk and fair pricing of flood insurance.[27]

However, while these are critically necessary elements, even these improved tools are not sufficient to address the totality of the hazards, understood as both shocks and stresses to buildings.[28] Current standards are almost exclusively a function of how high a flood might be relative to building structure elevation and, in some cases, the lowest point of water intrusion into a structure. While this is the single most important data point in predicting flood risk, these metrics do not adequately relate to the specific building components of a particular property and their resilience functionality in the case of a flood of any given particular severity. Just as building design and materials can provide resilience to seismic and wind risk, certain of these elements can be modified and adapted to provide substantial mitigation to flood risk and losses.

In part, as a reaction to the damage in New York City to affordable multifamily housing communities by Superstorm Sandy, Enterprise Community Partners has done some very instructive work in creating a manual for multifamily properties in New York City.[29] This manual serves as an audit tool to: (i) help owners identify flood risk; (ii) assess that risk to the physical vulnerabilities of the property, as well as the functional vulnerabilities effecting residents; and (iii) understand the implications for the continuity of programs operating within the property and in the community at large.[30] Resilience and adaptation strategies to protect, modify and create system redundancies are all considered in this manual. Of course, this approach can be adapted for all other property types–commercial as well as single-

27 Kunreuther, H. et al. "Structure of Specific Flood Risk Based Insurance: Proof of Concept and Preliminary Analysis," *Journal of Extreme Events*, 4(3), 1750011 (2017).

28 Kurth, M. et al. "Defining Resilience for the Building Industry for the U.S." *Building Research and Information*, 47(4), (2018) pp. 480-492. doi: 10.1080/09613218.2018.1452489

29 Enterprise Community Partners. "Ready to Respond: Strategies for Multifamily Building Resilience" (2015), available at https://www.enterprisecommunity.org/resources/ready-respond-strategies-multifamily-building-resilience-13356.

30 Ibid.

family—and it can serve as a guidepost for creating a scoring system for the risk and resilience performance of a property.

In contrast to the flood arena, there is a uniform standard adopted to measure seismic risk, which includes the specific resilience performance of structural building components of a particular property relative to earthquake severity. Fannie Mae, Freddie Mac, CMBS lenders, and many life insurance company lenders have incorporated special conditions for a loan on any multifamily or commercial property located in high risk areas determined by the latest technology measuring "peak ground acceleration." A certified engineer must perform a specific protocol inspection to generate a Probable Maximum Loss (PML) assessment score and a Scenario Expected Loss (SEL) score assuming the Design Basis Earthquake, in accordance with ASTM E2026-16A and ASTM E2557-16A.[31] The updated protocols using the latest technologies call for a locational heightened risk determination that is specific to a particular property, which is more precise than the old Zone 4 mapping criteria. The PML or SEL assessment takes into account the proximity of faults within the geographic area of a subject property, assumed magnitude of a seismic event, as well as the resilience design of the property. The property level resilience assessment takes into account the type of construction, building materials, design, and physical positioning of the property. The PML or SEL score determined by the engineer represents an estimate of the percentage loss in terms of the cost to restore the structure to pre-seismic event conditions. If the engineer finds that the score is 20 or greater, then the loan is generally conditioned on obtaining earthquake insurance and/or making structural modifications to the property so that the score is reduced below 20.

Why is there no up-to-date parallel risk and engineering resilience measuring tool, scoring system, and protocol in the flood risk arena? After interviewing numerous industry leaders from the single-family, and multifamily/commercial industries over several years, this author has concluded that there is no good answer, especially given the relative number of floods and flood losses in the U.S. compared to potential seismic events and losses in the U.S. Why do financial institutions rely solely on the outdated FEMA maps of the 100-year floodplain—a construct based on the best thinking and engineering of the 1970s? A standard protocol parallel to the uniform engineering standard adopted to measure seismic risk should be a created and adopted for measuring flood risk for specific building structural characteristics and their resilience performance to floods over the life of the asset (or investment). This new assessment system would take into account, not only proximity to the coast or a river, building elevation, and the likelihood and severity of flooding, but also the extent of likely damage to the structure given its specific physical and design characteristics.

31 ASTM International. "ASTM E2026-16a, Standard Guide for Seismic Risk Assessment of Buildings," available at https://www.astm.org/Standards/E2026.htm. doi: 10.1520/E2026-16A; ASTM International. "ASTM E2557-16a, Standard Practice for Probable Maximum Loss (PML) Evaluations for Earthquake Due-Diligence Assessments," available at https://www.astm.org/Standards/E2557.htm. doi: 10.1520/E2557-16A

Standards would need to be established for assumptions for the height, volume, and velocity of flood waters, as well as the duration of the flood condition at a given site, all of which are analogous to the accepted seismic standards in the relevant ASTMs. Examples of additional factors to be incorporated into the new metric include materials used for flooring on the first finished floor exposed to substantial flood risk (e.g., wood vs. carpet vs. tile on concrete), placement of HVAC systems and electric outlets and other utilities systems relative to elevation, materials used for walls (e.g., sheet rock vs. tile) up to a certain height on first floors subject to high flood risk, drainage from the first finished floor, water barriers, water pumps, back-flow valves, site grading, soil conditions, and the like. The new resilience metrics should even take into account local and regional flood mitigation projects which impact flood risk at the specific property location.

A two-tier rating system should be established. First, an inexpensive desk-top flood risk rating tool should be designed for single-family residences–much like a FICO credit report today. Adding a few data fields to the standard single-family appraisal regarding building elevation and materials could make this assessment tool more helpful. This enhancement of data could be mandated by the GSEs. For a very modest cost (say $25 to $75) and virtually no added processing time, this tool would be a significant improvement over the current state. A second, more granular assessment tool, which includes a specified engineering inspection should be designed for multifamily and commercial properties, as is the case in the seismic arena, with a cost similar to the seismic ASTM protocol performed by licensed engineers. Furthermore, these tools could be the basis for life-of-asset portfolio modeling, LCA, and CECL modeling.

Clearly, this is a complex undertaking requiring the coordination of public, private, and civic stakeholders. Ultimately, a new engineering standard should be developed by the National Institute of Standards and Technology (NIST) at the U.S. Department of Commerce. A major university could be the convener and lead the research necessary to begin to create these standards by bringing together environmental scientists, engineering, and architectural experts working with Fannie Mae, Freddie Mac, FHA, other major financial institutions, flood insurers and reinsurers, modelers and other important players using the most current technologies. Then ASTM International should create a universally accepted standard. As with sustainability, these standards are most effective with the federal government internalizes the standards into their own construction and asset management. There are many examples of industry groups working to create standards, including the work of the environmental and architecture industries in the context of the ASTM metrics for seismic events, LEED standards for energy efficiency, and vapor metrics for radon, as well as the work of the Mortgage Bankers Association work on the Mortgage Industry Standards Maintenance Organization (MISMO) in the mortgage data standard-setting context. It is noteworthy that there is already an ASTM for testing building materials used in construction below the base flood elevation: “Standard Test Method for Water Immersion and Drying for Evaluation of

Flood Damage Resistance."[32] This ASTM could be one part of the proposed new standard. The industry is not starting from scratch. The goal is to expand, amplify and institutionalize. Creating a new standard metric and scoring system for an accepted flood risk assessment tool is critical for creating and driving financial incentives in the form of new lending programs, insurance premium discounts, insurance claims payment incentives, and new flood resilient architectural designs and building materials, as steps toward promoting prudent behavior. Ultimately, this could be the catalyst for the adoption of new building codes, zoning ordinances, and land use planning in areas exposed to heightened flood risk over the long term.

Minimum Requirements for Certain Loans Collateralized by Properties with Elevated Flood Risk

The GSEs, FHA, banks, and other lenders should approach flood resilience in a manner similar to their approach to seismic risk in the multifamily and commercial property loan context as described above. This would be a standard of the GSEs, FHA and banks. Many lenders in the commercial real estate context have seismic requirements which are similar to those of the GSEs, and it is likely that these lenders would also follow the lead of the GSEs, FHA, and major banks in the flood risk arena. Flood risk, which in the last 50-plus years has demonstrated substantially more incidents of loss and more total losses than seismic risk, should require a modernized assessment approach that is at least as rigorous as that in the seismic context. A new flood risk scoring report prepared by a qualified engineer should be mandated in specified high risk flood locations. In order to qualify for inclusion in any multifamily or commercial loan program, when a designated score for flood risk is breached, the lender should require flood insurance or impose various flood mitigation retrofits to the property. As a condition of loan closing, if the property is covered by the requisite flood insurance or is modified to have such flood resilient building characteristics to lower the flood risk score to an acceptable level, then the loan qualification is achieved. Otherwise, the property will not qualify for the loan program.

In the single-family context, earthquake insurance is not generally required by the GSEs, FHA, and banks, except for single-family buildings in Puerto Rico. Accordingly, it is less clear that the GSEs, FHA, and banks would apply this same logic and protocol. A cost-benefit analysis would need to be performed. Lenders may well impose the proposed desk-top protocol given the substantial flood losses in the single-family arena. In the single-family lending context as well as the multifamily and commercial lending context, this protocol would be a significant improvement compared to today's simple binary yes-no based solely on property location in a SFHA, as shown on FEMA's 100-year flood maps, with exceptions only for properties with elevations above the BFE. Further, given the poor out-of-date quality of

32 ASTM International. "ASTM E E3075-18, Standard Test Method for Water Immersion and Drying for Evaluation of Flood Damage Resistance," available at https://www.astm.org/Standards/E3075.htm. doi: 10.1520/E3075-18

FEMA flood maps, engineering reports should be required in a much broader set of property locations. As noted above, in the last few years, a substantial amount of flood damage has been outside of the 100-year floodplain (e.g., Hurricane Harvey in Texas), the only zone in which flood insurance is required. Given the availability of technology which can assess flood risk outside of the 100-year floodplain and can also take into account future projections of flood risk in light of climate change, financial Institutions, including the GSEs and the buyers of their first loss risk in the Credit Risk Transfer (CRT) context should not be subject to this significant incremental risk of losses posed by the current flood insurance protocols.

Create Special Second Mortgage Program

New second mortgage programs for flood resilient building features should be established by the GSEs and FHA parallel to the existing multifamily second mortgage programs for energy efficiency or "green" second mortgages. In the green context, second mortgage proceeds are used to increase energy efficiency in order to reduce operating costs and property expense volatility. In the flood risk context, in order to encourage flood loss mitigation which would reduce both property valuation risk and default risk to the loan guarantor, new second mortgage programs should be created where the proceeds are specifically used for installation of flood resilience features. Just as is the case with the green second mortgage program, the Guarantee Fees (G Fees) or Mortgage Insurance premiums (MIP), as applicable, for such flood resiliency second mortgages should be reduced to reflect the lower risk. Further, as in the green lending programs at the GSEs, an extra five percent of loan proceeds could be made available to property owners. The new flood risk metric would be used to determine the requisite improvement in flood resilience performance.

Lower Premiums, G Fees, and MIP for Qualified Properties

In order to reflect reduced risk to the GSEs, FHA, as well as flood insurers, and as a public policy matter, to encourage prudent risk management behavior in designing building structures, the pricing of G Fees, MIP, and flood insurance premiums, should be reduced for properties in heightened flood risk locations that have specified resilience characteristics. Inclusion of specific flood resiliency building structural characteristics adds additional risk mitigation that reduces the risk of loss to the guarantor and insurer. The NFIP already discounts premiums based on certain building elevation conditions within the 100-year floodplain, but NFIP should have a much more robust premium discount program reflecting other important flood mitigation and resiliency building features. This is expected to be part of the new Risk Rating 2.0. As noted above, in an analogous area, multifamily green programs at the GSEs and FHA have been created which encourage conservation and reflect lower risk. For example, a green loan for a multifamily property from the GSEs may qualify for G Fees of 30 to 35 basis points below a standard loan pricing. Again, the new flood risk metric proposed in this article would be used to determine the requisite flood resiliency score for the reduced loan pricing available in such a program.

Conclusion

Given that the flood risks and losses in many coastal and inland areas are increasing and are likely to continue to increase at accelerating rates over the coming decades, we need policies and financial programs and products that can promote prudent behavior by property owners subject to these risks. Although some efforts have begun, most state and local municipalities have not moved forward in this arena. There is an important opportunity for the GSEs, FHA, and major banks to lead the way, along with flood insurers and reinsurers. These key stakeholders should work together with the industries of engineering, architecture, risk modeling, and environmental science using the latest technologies to:

(i) articulate and advocate for the creation of a new set of standardized property-based assessment tools and scoring systems for flood risk and resilience;

(ii) oversee the creation of these new standardized assessment tools and metrics;

(iii) adopt these new standardized tools to assess flood risk at the time of mortgage origination, for life of loan portfolio analytics, and as an asset management tool; and then

(iv) create mortgage loan programs and other financial incentives which encourage and/or mandate prudent risk mitigation behavior.

This will also require consideration of the equitable distribution of the costs and benefits of these programs and the extent to which LMI households are assisted in making these market transitions.

Once standardized protocols and metrics are established, other major financial institutions will follow, as will state and local governments in changing building codes, zoning ordinances, and land use plans. At the same time, the architecture and building materials industries will invest in creating new designs and materials to increase flood resilience functionality of buildings. While, obviously, these actions alone cannot stop tidal or storm event flooding, they can play an important incremental role in increasing awareness and educating those who are in a position to mitigate flood risk, thereby reducing losses to property owners and the associated risk of loan default and insurance claims. These steps have the potential to not only catalyze new approaches in the public and private sectors, but they will also help maintain liquidity and accessibility in the capital markets for housing and commercial real estate, as they mitigate future default risk and losses to property owners and financial institutions over the next several decades. The steps advocated in this article are not just sound economics–they are sound practices for the advancement of social welfare for generations to come.

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Real Estate as a Tool for Adaptive Banking

Asaf Bernstein, Matthew Gustafson, and Ryan Lewis

Recent economic research has made prescient the assertion in 1966 of Nobel Laureate Merton Miller that "[the idea] that financial markets contribute to economic growth is a proposition too obvious for serious discussion,"[1] but there is still limited research exploring the role financial institutions, such as banks, should play in adaptation efforts in the face of climate change. The *5th Assessment Report* of the Intergovernmental Panel on Climate Change (IPCC) includes an entire working group report focused on approaches for societal adaptation for climate change,[2] but still only includes minimal guidance on the way in which banks could adapt lending and asset management policies.[3] Rather than a lack of recognition of the role banks could play in the allocation of capital towards positive adaptive investments,[4] which include any investments meant to reduce future costs due to climate change, we believe the report omits this discussion because "adaptation is place- and context-specific" so it is challenging to provide a flexible solution likely to offer appropriate guidance in areas that face such heterogeneity.

How then are we to proceed in the face of such challenges? One possibility is to continue efforts with local government, but with an increased focus on potential feedback mechanisms through the local banking sector. However, such an approach sidelines banks that, evidence suggests, are critical in providing efficient local allocation of capital for investment,[5] which is exactly the problem being faced in determining adaptation outlays. Leveraging private financial institutions, such as banks, in the adaptation process, may provide substantial benefits to exposed communities. Or in the words of James Titus, former project manager for sea level rise at the U.S. Environmental Protection Agency (EPA), is there a "strategy [that] minimize[s] governmental interference with decisions best made by the private

1 Recent empirical evidence supports this as well, including: Guiso, L., Sapienza, P., and Zingales L. "Does Local Financial Development Matter?" *The Quarterly Journal of Economics*, 119(3) (2004), pp. 929–969; Bekaert, G., Harvey, C., and Lundblad, C. "Does financial liberalization spur growth?" *Journal of Financial Economics* 77(1) (2005), pp. 3-55; and Hsu, P., Tian X., and Xu, Y. "Financial development and innovation: Cross-country evidence," *Journal of Financial Economics*, 112(1) (2014), pp. 116-135, as just a small number of recent examples.

2 Miller, M. "Financial markets and economic growth," *Journal of Applied Corporate Finance*, 11 (1998), p. 14.

3 Intergovernmental Panel on Climate Change (IPCC). "2014: Climate Change, Synthesis Report," *Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (Core Writing Team, R.K. Pachauri and L.A. Meyer [eds.]) (2014), p. 151.

4 Or the strains economic distress could place on the banking sector, and subsequent amplification of such distress via a reduction in available credit from these institutions.

5 See the following for both theoretical and empirical evidence of the role of banks, especially small local banks, in capital allocation: Stein, J. "Information Production and Capital Allocation: Decentralized vs. Hierarchical Firms," *Journal of Finance*, 57 (2002), pp. 1891-1921; and Berger, A. et al. "Does function follow organizational form? Evidence from the lending practices of large and small banks," *Journal of Financial Economics,* 76, 2, (237) (2005).

sector?"[6] The *5th Assessment Report* of the IPCC therefore suggests that there may perhaps be "emerging economic instruments [that] can foster adaptation by providing incentives for anticipating and reducing impacts" but doesn't indicate yet exactly what instruments these may be.[7] In this article, we provide evidence of recent research which suggests that local property values may provide one potential economic instrument to assist in incentivizing adaptive banking.[8]

Challenges of Lending for Adaptation

Lending by private institutions, such as banks, for adaptive investments face two major hurdles in the form of externalities. The first challenge, concurrent externalities, is commonplace for virtually any investment project and has been one of the most basic concepts in modern economic theory since the work of Henry Sidgwick and Arthur Pigou in the late 19th and early 20th centuries, respectively. Namely, externalities for an investment made feasible with capital from a bank are unlikely to be accounted for in the allocation process. For example, the interest rate charged to provide financing for the construction of a noisy and odorous sewage processing plant may not be any higher if it is right next to a restaurant. One way to approach such a problem is to rely on local governments to provide the capital for projects with large positive externalities and regulation to limits those with negative externalities. This of course limits any assistance from those institutions, such as banks, likely to have local allocative knowledge and incentives.

If the goal is to gain the assistance of private institutions, while maintaining appropriate incentives, the work of Nobel Laureate Ronald Coase provides some guidance. In simplified terms, the Coase Theorem shows that if transaction costs are sufficiently low, and there exists an economic instrument to trade an externality, bargaining will lead to a Pareto efficient[9] allocation regardless of who receives the instrument initially.[10] While there are a broad set of potentially reasonable critiques of the Coase Theorem in practice,[11] what should be clear is that the existence of an instrument tied to the value of the externality has the potential to provide more appropriate allocations if properly used. If a bank had an asset tied to the value of restaurants in the area, they would be less likely to provide an inappropriately low-cost loan to the sewage plant discussed earlier. Unfortunately, in the case of adaptive banking, equity prices do not appear to respond to long-run climate risks and so won't respond to

6 Titus, J. "Strategies for Adapting to the Greenhouse Effect," *Journal of the American Planning Association* (1990), pp. 311-323.

7 IPCC. "2014: Climate Change" (2014), p. 107.

8 By "adaptive banking" we mean any role banks play in reducing future costs associated with climate change. While these include "adaptive investments," they could also include other banking policies, such as lending or risk management, that alleviate future distress due to climate change.

9 In simple terms, a Pareto efficient allocation is one in which there is no way in which to reallocate without making at least one individual worse off.

10 Coase, R. "The Nature of the Firm," *Economica*, 4(16) (1937), p. 386; Coase, R. "The Problem of Social Cost," *Journal of Law and Economics*, 3(1) (1960), pp. 1-44.

11 As argued by Coase himself in reality transaction costs of bargaining are almost always non-zero and often fairly high.

adaptations intended to reduce those risks.[12]

Therefore, the second challenge, and likely the most difficult, when encouraging adaptive lending practices for climate change is the extremely long-term nature of the externalities caused by many of these investments. There is an expansive literature showing that "short-termism" on the part of decision makers, can lead to adverse long-run outcomes.[13] By the same logic, political terms, loan lengths, and bank manager turnover make it unlikely that gains or losses from adaptative investments will be realized in time to alter these parties' current behaviors. Or, as was noted in the 5th IPCC report, "poor planning or implementation, overemphasizing short-term outcomes or failing to sufficiently anticipate consequences can result in maladaptation, increasing the vulnerability or exposure of the target group in the future or the vulnerability of other people, places or sectors."[14] Once again, one approach is to find a financial instrument that tracks the value of the externality and uses that to align incentives. In the next section, we will argue that unlike equity prices, real estate not only has the potential to price long-run risks, such as climate change, but already appears to be doing so.

Property Values and Climate Change

Empirical evidence from recent research suggests that current house prices are already altered by temporally distant climate change-related risks because of the concerns of real estate investors. Why might this be true in real estate, when it appears to be absent in other asset classes like equities? Real estate is much more likely to have value even far into the future, long after many current firms may have gone bankrupt from excessive risk-taking. Also, anecdotally, property is something households appear to consider as bequest motives for passing on to future generations, in which case, concerns even very far into the future may have the potential to alter the value of property in the present day. In fact, research indicates that people are willing to pay ten percent more for a 700-year lease than they are for an identical property with a 100-year lease.[15] This suggests that potential real estate owners appear to care substantially about ownership and value of the property even 100 years into the future.

12 Hong, H., Li, F.W., and Xu, J. "Climate risks and market efficiency," Working Paper (2015).

13 Von Thadden, E. "Long-term contracts, short-term investment, and monitoring," *Review of Economic Studies*, 62 (1995), pp. 557–575; Stein, J. "Efficient capital markets, inefficient firms: A model of myopic corporate behavior," *Quarterly Journal of Economics*, 104 (1989), pp. 655–669; Bolton, P., Scheinkman, J., and Xiong, W. "Executive compensation and short-term behavior in speculative markets," *Review of Economic Studies*, 73 (2006), pp. 557–610; Cristina, C., Ellul, A., and Giannetti, M. "Investors' horizons and the amplification of market shocks," *Review of Financial Studies*, 26 (2013), pp. 1607–1648; and Edmans, A., Fang, V., and Lewellen, K. "Equity vesting and managerial myopia," *Review of Financial Studies*, 7 (2017), pp. 2229-71.

14 IPCC. "2014: Climate Change" (2014), p. 20.

15 Giglio, S., Maggiori, M., and Stroebel, J. "Very long-run discount rates," *The Quarterly Journal of Economics*, 130 (2014), pp. 1-53.

What does this mean for the relationship between climate change and property values? In addition to anecdotal reports by news media,[16] researchers in 2017 conducted 48 semi-structured interviews in Miami-Dade County (MDC)–a location with overwhelming exposure to climate change from sea level rise–with local officials, researchers, real estate developers, investors, financiers, residents, and activists and found a consensus that "high-elevation property would increase in value over the long-term with SLR [sea level rise] and that preferences relating to flood risk (climate-change related or not) were increasingly being recognized among consumers and real estate actors."[17] This consensus was supported by the researchers empirically by examining 107,984 single family home transactions in MDC from 1971-2017. After including linear controls for age, square footage, and transaction date, the authors found evidence in support of the hypothesis that higher elevation properties had appreciated more quickly than lower elevation properties over the last 47 years in MDC. The authors are careful to note that "since elevation was the only locational factor, it is possible that the results simple demonstrate a correlation between location and price appreciation."[18] What this means is that since higher elevation properties tend to differ systematically along other dimensions from lower elevation, the observed price appreciation may have been driven by aggregate trends over time in the value of other characteristics, or even something as simple as actual flooding damage. While these results can't be taken as causal, the finding of faster appreciation for higher elevation properties in MDC is suggestive evidence that SLR may already be affecting house prices and consistent with first-hand accounts from the interviews these researchers conducted.

Concerns about interpretation have been alleviated in complementary concurrent research by providing the first evidence of a direct casual effect of SLR on property values by showing that coastal properties exposed to projected SLR sell at an approximately seven percent discount relative to otherwise similar properties in a nationwide sample.[19] There is a broad set of empirical challenges in obtaining causal interpretation of the price effect of SLR exposure on coastal real estate, the most prominent of which is that exposure probability decreases with distance to the coast and properties closer to the coast differ systematically from those that are farther away. The main method used in this paper to address such identification concerns is to compare more than 465,000 residential property transactions from 2007-2016 within a quarter mile of the coast that are identical on observable dimensions, except SLR exposure. In the workhorse specification, the authors compare exposed and unexposed homes with the same property characteristics (e.g., bedrooms, property type), sold in the same month, within the same ZIP Code, in the same 200-foot band of distance

16 See, for example: Urban, I. "Perils of Climate Change Could Swamp Coastal Real Estate," *The New York Times* (Nov. 24, 2016).

17 Keenan, J.M., Hill, T., and Gumber, A. "Climate Gentrification: From Theory to Empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5) 054001 (2018). doi: 10.1088/1748-9326/aabb32

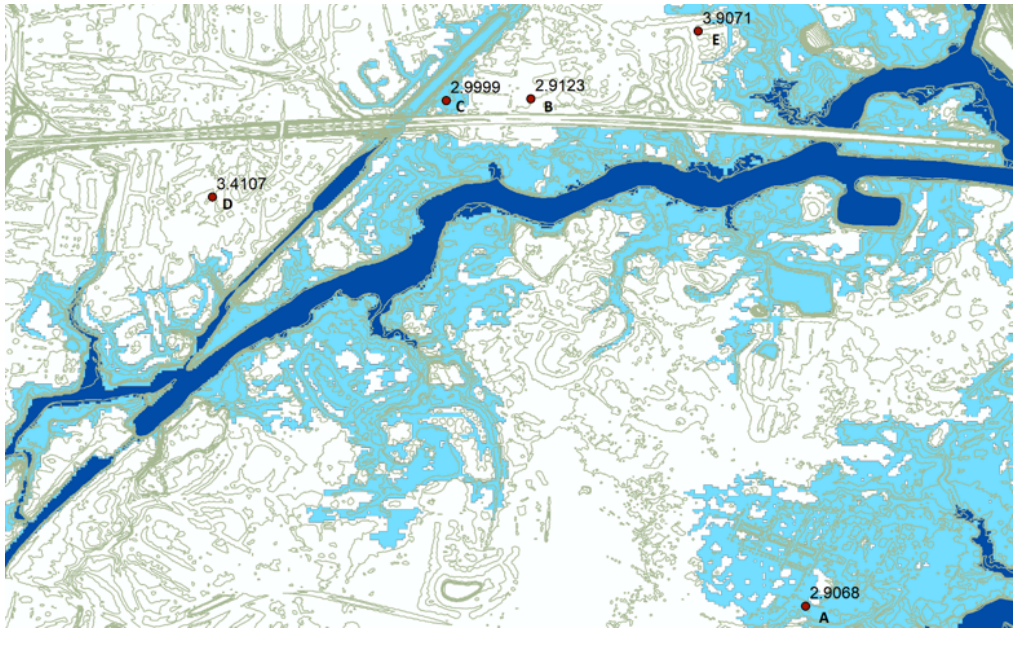
18 Ibid.

19 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the Horizon: The Price Effect of Sea Level Rise," *Journal of Financial Economics* (May 3, 2018), available at http://leeds-faculty.colorado.edu/AsafBernstein/DisasterOnTheHorizon_PriceOfSLR_BGL.pdf.

to coast, and in the same two-meter elevation bucket, as well as controlling separately for any price differences due to property square footage. Within each fixed effect bucket, some of the variation in SLR exposure is due to very granular changes in elevation (even within a two-meter elevation bin the expected time until inundation can vary by over a century), but directly observable factors like elevation and coastal distance of a property combine to explain at most 45 percent of the residual SLR exposure.

An example of the kind of variation exploited is depicted in Figure 1 which plots the elevation and location of all transactions in July of 2014 in ZIP Code 23323 (in Chesapeake, VA) that involve a property that is (1) between 0.16 and 0.25 miles from the coast, (2) elevated between two and four meters above sea level, (3) four bedrooms, (4) a non-condominium, (5) owner occupied, and (6) bought by a non-local buyer.

Figure 1. Example of Within Bin Variation in SLR Exposure

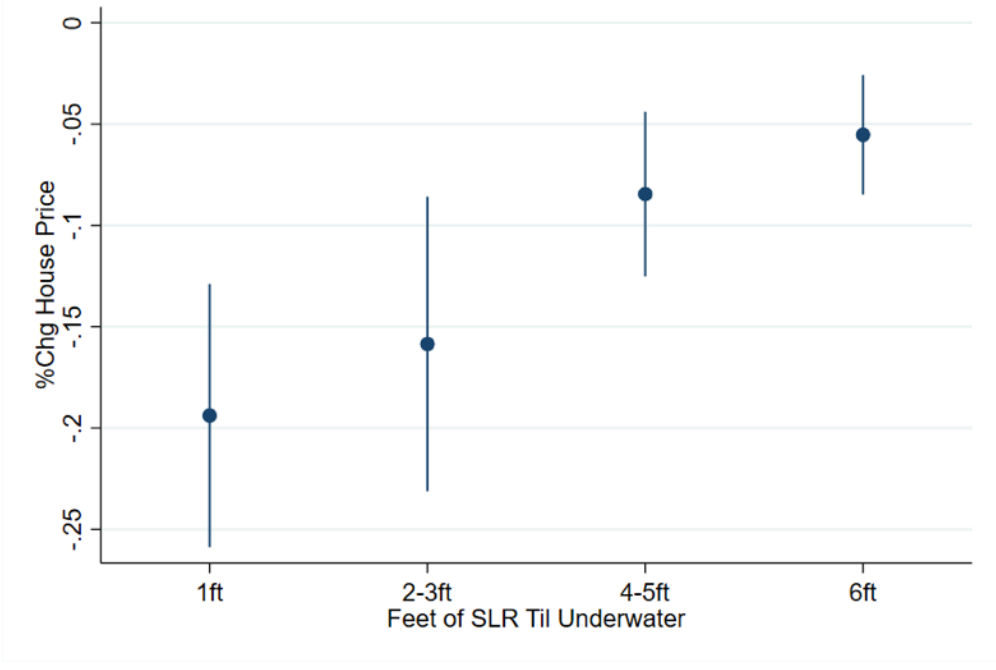


Source: Bernstein, Gustafson, and Lewis (2018)

The figure shows that Properties D and E are approximately 0.5 to one meter higher in elevation than properties A, B, and C and are unexposed to a six-foot SLR. Thus, there is variation in SLR exposure within each fixed effect bucket that is due to very granular changes in elevation. Figure 1 also shows that exposure is not monotonically associated with elevation. Comparing properties, A, B, and C in the figure shows that property C is higher than A and the same distance from the coast, but A has higher elevations between it and the coast (as well as a highway) that appear to reduce SLR exposure.

Using the type of variation illustrated in Figure 1 the authors estimate that SLR-exposed properties trade at a 6.6 percent discount relative to comparable unexposed properties. They then further break this into exposure buckets, with properties that will be inundated after one foot of global average SLR trading at a 14.7 percent discount, properties inundated with two-to-three feet of SLR trading at a 13.8 percent discount, and properties inundated with four-to-five and six feet of SLR trading at 7.8 percent and 4.4 percent discounts, respectively, as illustrated in Figure 2.

Figure 2. SLR Exposure and House Price Effects



Source: Bernstein, Gustafson, and Lewis (2018)
Note: These price effects are in line with scientific models of SLR projections[20] if we assume full loss at the outset of inundation and use prior estimates of long-run discounts rates.[21]

The presence of a more than four percent SLR exposure discount in samples not expected to be inundated for almost a century suggests that coastal real estate buyers price long-run SLR exposure risk. Placebo tests using rental properties further bolster this interpretation as there is no relation between SLR exposure and rental prices using the main

20 Parris, A.S. et al. "Global sea level rise scenarios for the united states national climate assessment," NOAA Technical Report (2012).
21 Giglio, S., Maggiori, M., and Stroebel, J. "Very long-run discount rates," *The Quarterly Journal of Economics*, 130 (2014), pp. 1-53.

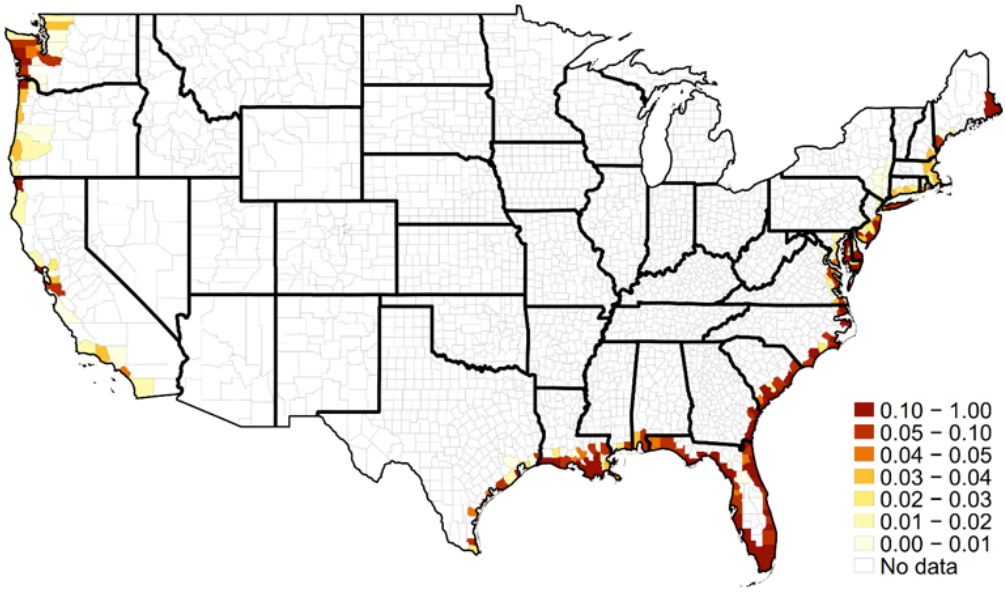
specification, mitigating the possibility that the SLR exposure discount is due to unobservable differences between exposed and unexposed properties. Indeed, to the extent that a difference in current property quality or flood risk contributes to the SLR exposure discount, rental rates should also be lower for exposed properties. The significance and magnitude of the SLR exposure discount being robust to (i) the inclusion of controls for a wide range of observable property characteristics; (ii) the exclusion of areas with recent flood incidents; (iii) the exclusion of properties listed as having attractive features such as waterfront views; and, (iv) the exclusion of properties likely to have been recently remodeled (i.e., properties listed as having been remodeled, properties that change characteristics over time, or older properties) supplies further evidence that current property quality is not the primary driver of the SLR exposure discount. Instead, the primary conclusion to make from recent empirical evidence is that there is already a causal nationwide effect of climate change risks, and, in particular, SLR risks, on house prices. This suggests that real estate could be exactly the kind of "economic instrument," described by the IPCC and Coase's Theorem, that could be used as a tool to help align incentives of the private sector.

Property Values and Climate Change

One of the clearest costs associated with future climate change is made evident by rising sea levels. This may give rise to a vision of idyllic wealthy coastal enclaves with more than enough resources to engage in adaptive investments as needed to protect their communities. But such a representation would not be accurate. As has been noted by the Union of Concerned Scientists (UCS), and is made clear in the plots of county-level exposures in Figure 3, the risks of climate change for even something that seems like it should be concentrated among the wealthy, are anything but.[22]

22 Union of Concerned Scientists. "Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate" (2018), available at https://www.ucsusa.org/sites/default/files/attach/2018/06/underwater-analysis-full-report.pdf.

Figure 3. SLR Exposure and House Price Effects



Source: Bernstein, Gustafson, and Lewis (2018)

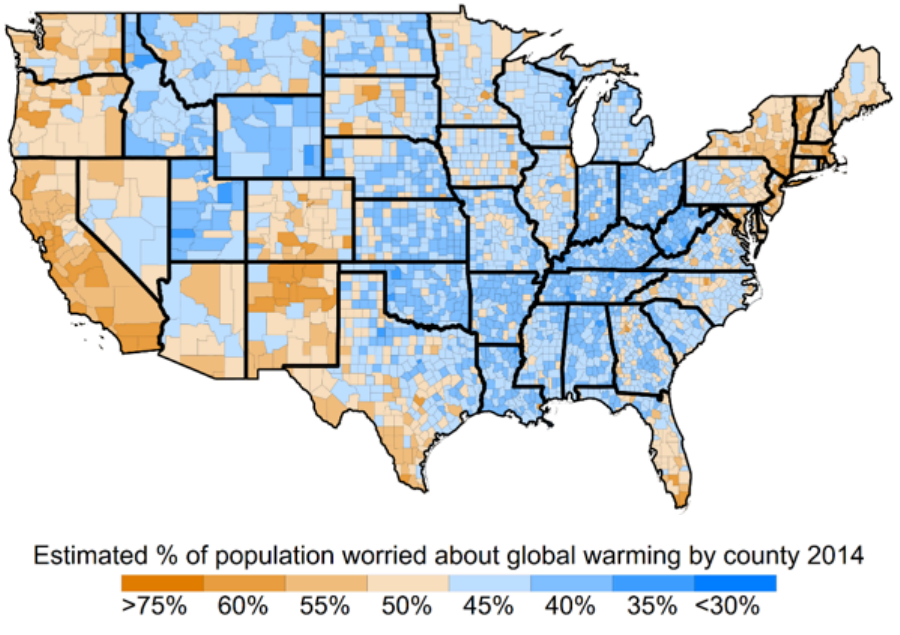
As noted by the UCS, "nearly 175 communities nationwide can expect significant chronic flooding by 2045, with 10% or more of their housing stock at risk. Of these, nearly 40%–or 67 communities–currently have poverty levels above the national average."[23] This analysis was carried out using granular property level data provided for academic research by Zillow, called ZTRAX. Zillow itself found similar results when exploring the exposure of communities noting in 2017 that "[o]ne-third (32%) of underwater homes would be valued in the bottom third nationally, meaning $123 billion in losses… in urban areas homes in the bottom value tier are more likely to be affected."[24] What this suggests is that low- or moderate-income (LMI) individuals are likely to be adversely affected by SLR, and likely by other risks of climate change as well.

In fact, the risks for these communities could be even larger than they appear at first glance.[25] They show that SLR exposure is a first-order consideration for certain segments of the coastal real estate market, but not others. They consistently find evidence that the SLR exposure discount is driven by sophisticated investors, who are not sensitive to local beliefs regarding the effect of climate change and who incorporate new information regarding climate change into their home buying decisions. They find little evidence of SLR exposure

23 Ibid, p. 9.
24 Bretz, L. "Climate Change and Homes: Who Would Lose the Most to a Rising Tide?" Zillow Research (2017).
25 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the Horizon" (2018).

discounts among less sophisticated buyers, except in the counties most concerned about climate change, even though housing likely constitutes the majority of their savings.[26] Thus, even if sophisticated investors are perfectly pricing the effects of expected SLR exposure, this absence of a current house price discount in less sophisticated market segments raises the possibility of a large wealth shock to coastal communities unless strategies are undertaken to mitigate the effects of SLR.

Figure 4. Percent of Adults Who Are Worried About Global Warming



Source: Yale Climate Opinion Maps (2014), available at http://climatecommunication.yale.edu

Areas of Louisiana are a perfect illustration of the potential dangers for certain LMI communities. Figure 4 shows the results of the 2014 Yale Climate Opinion Survey which indicates the response to the question "How worried are you about global warming?"[27] What is clear when comparing Figures 3 and 4 is that while the southern coast of Louisiana has some of the lowest concern about climate change, they are also some of the most at-risk communities in the entire country. Indeed, the UCS notes that "the largest share of these [communities] is in Louisiana, where there are 25 communities with above-average poverty rates and with 10% or more of the homes at risk by 2045."[28] This is a common finding

26 Campbell, J.Y. "Household finance," *The Journal of Finance*, 61 (2006), pp. 1553–1604.
27 Howe, P. et al. "Geographic variation in opinions on climate change at state and local scales in the USA," *Nature Climate Change*, 5 (2015), pp. 596-603.
28 Union of Concerned Scientists. "Underwater" (2018), p. 9.

throughout the country since there is a statistically significant negative relationship between county-level concern about climate change in the Yale survey and SLR exposure.

In the absence of the ability of LMI communities to engage in sufficient adaptive investments on their own behalf the Community Reinvestment Act (CRA) could be a useful regulatory framework to implement adaptive banking policies. Not only are these exactly the communities likely to need additional assistance in raising funds for adaptive investments, they are also the least cognizant of the risks they face.[29] The CRA could allow banks to act as not only financial intermediaries, but also act as information intermediaries in a way that should be immediately salient for communities requiring financing.

Conclusion

In light of growing empirical evidence that distant risks of climate change are already affecting current property values, we believe banks can play a pivotal role in arbitrating climate risks. By aligning the performance of loans with long-term property values, Coasean bargaining suggests that banks could be incentivized to subsidize adaptive projects when doing so provides a net benefit to the community. Since communities without substantial financial resources are both the ones most likely to need bank assistance and the most likely to be unaware of the risks they face, the CRA could provide a potential vehicle for incorporating real estate as a means of incentivizing adaptive banking. In addition, banks have the capacity to serve as information intermediaries by providing borrowers with comprehensive information about the long-term risk of individual properties. Nevertheless, we would caution policy makers that, as with all tools, such instruments could lead to adverse consequences, such as increased exposure for banks or unintended migration.

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29 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the Horizon" (2018).

Rebuild to Fail or Rebuild to Adapt: How CRA Lending Can Guide Climate Change Disaster Response

Mark Northcross

Disaster recovery drives climate change adaptation in the U.S. at present. While there is planning for climate change adaptation going on in major urban areas,[1] the actual work of designing, planning, and managing climate adaptive infrastructure takes place primarily after disasters. The question this article tries to address is whether disaster-driven climate change adaptation implementation—as opposed to planning—really addresses the needs of climate change adaptation. Beyond this concern, this article looks at a wildfire risk mitigation plans as a model for promoting adaptive reconstruction after climate change-related natural disasters. This approach represents a middle ground between disaster recovery and long-term risk associated with climate change.

This articles uses the California wildfires of 2017 and 2018 as case studies. In California, we like to say that we have four seasons: fire, flood, earthquake, and drought. One of those "seasons," fire, has recently caused great loss of property, as well as loss of human life. The California wildfires of 2017 and 2018 collectively destroyed over 34,000 structures, and the loss of at least 138 lives.[2] Of the 20 most destructive fires known in California history, eight occurred in 2017 and 2018.[3] These fires are seen by California public safety officials as being at least partially the result of climate change.[4] Losses from the 2018 fires alone are projected by CoreLogic, an insurance industry risk management consultancy, to range between $15 and $19 billion.[5] As former California Governor Jerry Brown noted "[m]anaging all the forests everywhere we can does not stop climate change—and those that deny that are definitely contributing to the tragedy, the chickens are coming home to roost. This is real here."[6] Our

1 Examples include: Rebuild by Design, available at http://www.rebuildbydesign.org and Resilient by Design: Bay Area Challenge, available at http://www.resilientbayarea.org.

2 CalFire. "Top 20 Most Destructive Wildfires" (2018), available at http://www.fire.ca.gov/communications/downloads/fact_sheets/Top20_Destruction.pdf.

3 Ibid.

4 Kasler, D. "California wildfires will grow 77 percent as climate warms. Should forests be thinned?" *Sacramento Bee* (August 4, 2018).

5 Corelogic. "The Camp and Woolsey Wildfires in California Cause Devastating Losses Between $15 Billion and $19 Billion According to CoreLogic" (November 27, 2018), available at https://www.corelogic.com/news/the-camp-and-woolsey-wildfires-in-california-cause-devastating-losses-between-15-billion-and-19-billion-according-to-corelogic.aspx.

6 Marinucci, C. and Hart, A. "Gov. Brown, fire-besieged California hit back at Trump over blame tweet," *Politico* (November 11, 2018), available at https://www.politico.com/story/2018/11/11/california-disaster-declaration-fires-trump-983168.

nation has robust systems to support rebuilding and recovery: private sector casualty insurance, the Federal Emergency Management Agency (FEMA),[7] and bank lending. Let's consider the issues with each of these sources of funding for rebuilding after the California wildfires.

Insurance as a Catalyst

Many homeowners do not carry sufficient flood or fire insurance to rebuild to their prior condition after a disaster.[8] Even if they did, their insurance coverage is generally not enough to provide for the increased incremental costs of climate change adaptation. Buildings and communities as a whole need to be rebuilt to a standard beyond the conditions prior to the disaster if they are going to be adaptive to climate change in the future. The way the limits on casualty policies work at this time, they only rarely will cover the increased costs of true climate change adaptation, let alone full rebuilding costs.[9] This is particularly true for what public safety professionals are calling the Wildland Urban Interface (WUI).

The biggest obstacle for homeowners rebuilding to expanded climate change adaptation standards is the concept of "replacement cost" in their homeowner's insurance policy. Replacement cost is generally defined in homeowner's policies by a specific quantitative limit. In addition, most policies limit rebuilding funding to the pre-existing conditions. Some policies provide for funding to meet current building codes where the cost of current building code requirements exceed the pre-existing conditions.

Homeowners do not as a rule of thumb update their coverage limits to provide adequate funding for rebuilding to new building code requirements. The State of California recently adopted legislation requiring insurance providers to at least notify their policyholders of the need to review and update their coverage limits.[10] This is no guarantee, however, that the policyholders will actually choose to pay a higher premium in order to have adequate coverage.[11] Moreover, a significant portion of the costs for WUI fire risk mitigation are

7 While FEMA acknowledges the need for climate change adaptation planning, their policies do not allow them to fund infrastructure for adaptation if the infrastructure exceeds "pre-existing conditions." Consequently, since it is likely that climate change adaptation will require upgrades to existing infrastructure, FEMA is de facto very limited in its ability to fund climate change adaptation for disaster recovery. Federal Emergency Management Agency. "FEMA Climate Change Adaptation Policy Statement" (November 1, 2011), available at https://www.fema.gov/media-library-data/20130726-1919-25045-6267/signed_climate_change_policy_statement.pdf; Federal Emergency Management Agency. "Public Assistance is For Infrastructure Recovery" (February 20, 2013), available at https://www.fema.gov/news-release/2013/02/20/public-assistance-infrastructure-recovery.

8 Nash, M.W. "How Wildfires Are Making Some California Homes Uninsurable," *The New York Times* (November 20, 2018), available at https://www.nytimes.com/2018/11/20/business/california-fires-insurance.html.

9 Gill, L.E. "Last Year's Wine Country Fires in California Leave Homeowners Struggling," *The Insurance Journal* (August 29, 2018), available at https://www.insurancejournal.com/news/west/2018/08/29/499484.htm.

10 Office of Governor Edmund G. Brown, Jr. "Press Release: Governor Brown Signs Legislation to Strengthen Wildfire Prevention and Recovery" (September 21, 2018).

11 South, G. "Wildfire insurance out of reach for many Californians who need it," *Inman News* (January 9, 2018), available at https://www.inman.com/2018/01/09/wildfire-insurance-out-of-reach-for-many-californians-who-need-it/.

"off-site"—meaning that the fire risk mitigation is not specific to the parcel owned by a particular homeowner.[12] Fire risk mitigation is also done at a community and regional level in the form of brush clearing, controlled burns and other wildland "maintenance." The cost for these off-site improvements needed to mitigate WUI fire risk are not covered by homeowner's insurance policies.

While current building codes in portions of California officially designated as high risk WUI areas mandate a higher level of fire resistance in new construction,[13] homeowners must have purchased extra insurance coverage to pay for such additional costs for a replacement home after a disaster. Equally as important, there are no mandates in California requiring existing WUI homeowners to upgrade their homes to meet current WUI building code requirements for new construction. Consequently, if WUI fire risk mitigation really demands enforcement of an expanded building code, there is only limited funding available from the insurance industry for that purpose. Is the problem more fundamentally rooted in land use controls, rather than building codes?

While it may appear that this article is criticizing the insurance industry, this is not the intent. As noted above, estimated losses from just the 2018 California wildfires may be as great as $19 billion.[14] According to the California Department of Insurance, in 2017, total premiums collected for homeowner's multi-peril insurance were $7.8 billion against losses of $15.4 billion.[15] The wildfire losses in California may not be sustainable by the insurance industry at current premium levels. To give credence to this concern, the California Department of Insurance recently took over Merced Property & Casualty, with assets of about $23 million, but expected to have as much as $64 million in claims from the Camp Fire in Paradise, CA.[16] The California Department of Insurance reports also that the rate of non-renewal of homeowner's policies in California has increased significantly since 2010.[17] The California Department of Insurance also notes that 60 percent of these terminations have occurred in ZIP Codes within the state's high-fire risk zones.[18]

If the insurance industry decides that providing insurance in California's WUI high and very high fire risk areas is not a good business decision, up to one million homeowners

12 CalFire. "Fuels Treatment" (2019), available at http://calfire.ca.gov/resource_mgt/resource_mgt_EPRP_FuelsTreatment.

13 CalFire. "California's Wildland-Urban Interface Code Information" (2019), available at http://www.fire.ca.gov/fire_prevention/fire_prevention_wildland_codes.

14 Corelogic. "The Camp and Woolsey Wildfires" (November 27, 2018).

15 California Department of Insurance. "2017 California P&C Premium and Loss Distribution" (2018), available at http://www.insurance.ca.gov/01-consumers/120-company/04-mrktshare/2017/upload/PrmLssDist2017.pdf.

16 Koren, J.R. "Insurer Merced went belly up after Camp fire. Here's what policyholders need to know," *Los Angeles Times* (December 4, 2018), available at https://www.latimes.com/business/la-fi-merced-insurance-customers-20181204-story.html.

17 California Department of Insurance. "The Availability and Affordability of Coverage for Wildfire Loss in Residential Property Insurance in the Wildland-Urban Interface and Other High-Risk Areas of California: CDI Summary and Proposed Solutions" (2018), available at http://www.insurance.ca.gov/0400-news/0100-press-releases/2018/upload/nr002-2018AvailabilityandAffordabilityofWildfireCoverage.pdf.

18 Ibid.

could be impacted.[19] The state does provide a backup program, called Fair Access to Insurance Requirements (FAIR) for homeowners who cannot otherwise obtain the minimal insurance required by their mortgage lenders. At present, the state's FAIR program covers about 127,000 homes, 84,000 of which are in Los Angeles County.[20] FAIR coverage in portions of the state that are dominated by WUI is thin. For example, in Butte County, where over 18,000 structures were lost in the Camp Fire, FAIR provides coverage for just 415 homes.[21]

The FAIR program is funded by private sector insurers under a state mandate. However, these FAIR insurers are pushing back against the program in the aftermath of the recent wildfires. The California Department of Insurance issued a cease and desist order against the FAIR insurers on December, 2017 after FAIR insurers suspended writing new policies as a result of the huge losses in the North Bay Fires.[22]

California now faces an awful paradox as a result of the recent climate change-related wildfire disasters–at the same time that homeowner's insurance is inadequate to fund rebuilding to the resilience required by climate change, the state's insurance providers may not be able to sustain coverage at the current inadequate levels. This may indirectly lead to adaptation in land use planning, but the interim costs to households and communities is high.

Rethinking the Role of FEMA

FEMA guidelines limit FEMA funding for rebuilding to restoring facilities to their prior condition.[23] Consequently, FEMA functions de facto like the insurance industry. FEMA funds rebuilding, but from the perspective of climate change adaptation, FEMA funds rebuilding to fail. One example of this is the past use of plastic pipe for storm drains in the area devastated by the Tubbs and Atlas fires in 2017. The intensity of the fire was such that many plastic storm drain pipes melted. Consequently, the soil over the storm drains collapsed into the resulting void, and the melted plastic released toxic chemicals into drainage channels that feed to surface water streams. Despite this indication that concrete or other more fire-resistant materials for storm drains should be used instead of plastic for reconstruction, FEMA will only fund plastic pipe for rebuilding.

The reconstruction of infrastructure is crucial for the rebuilding of fire-devastated neighborhoods. Basic utilities must be available to a parcel before any lender will fund a construction loan for rebuilding of a home. FEMA has been the primary funding source for the rebuilding of utilities after natural disasters in the U.S. However, if FEMA will only fund rebuilt infrastructure to the standards existing before the disaster we are, again, rebuilding to fail. This practice has received the most attention in flood and hurricane prone areas of the U.S.

19 Ibid.
20 California Department of Insurance. "California FAIR Plan Exposure by County" (2018), available at https://www.cfpnet.com/wp-content/uploads/2018/11/Exposure-by-County-9-30-18.pdf.
21 Ibid.
22 California Department of Insurance. "FAIR plan ordered to cease and desist" (2017).
23 Federal Emergency Management Agency (FEMA). "Public Assistance is For Infrastructure Recovery" (February 20, 2013).

With respect to WUI fire risk mitigation, utility undergrounding and the use of fire-resistant storm drain pipe are two adaptive utility practices that should be considered. Unless they were pre-existing conditions, neither will be funded by FEMA.

Follow the Leader

Bank lending indirectly follows the patterns and limits set by insurers and FEMA. Banks lend to property that can obtain the appropriate casualty or flood insurance. Bank loans are secured by liens on specific parcels. Current practice then is to lend to insurable parcels owned by borrowers with adequate credit. However, successful climate change adaptation measures for WUI fire risk are not exclusively parcel specific. As noted above, WUI fire risk mitigation also needs to be at a neighborhood or community scale. Consequently, lending to rebuild a community devastated by a climate change disaster to a new, more adaptive, standard is not consistent with current bank lending protocols. As noted above, banks will lend where insurance is available. Consequently, as has been noted by many, if the federal flood insurance program promotes rebuilding in flood prone areas, the banks will continue to lend to those areas. That amounts to bank lending to rebuild to fail.

Fire risk in California is a different case. As noted previously, the state's insurers are accelerating the rate of fire insurance termination, particularly in the WUI. This is adversely impacting the ability of fire devastated areas to rebuild.[24] While the insurance industry may not be capable of funding climate change adaptation in disaster areas, it may be de facto leading the way into managed retreat in those areas. If insurance is not available to borrowers wanting to rebuild, the insurance industry has de facto mandated managed retreat. The only mitigation to this risk of a "backdoor" approach to managed retreat in California's WUI is the extent to which the state's FAIR program can be scaled up. Judging from California's Department of Insurance December 2017 cease and desist order, the insurance industry is likely to push back against such a scaling-up.

Finding Inspiration in the "Boulder Plan"

The county of Boulder, CO started a program called "Wildfire Partners" in 2013 to assist homeowners in mitigating wildfire risk to their homes to a level that would enable them to retain their fire insurance.[25] The program comprises: (i) a review by a fire safety professional of both the structure and the parcel; (ii) recommendations for fire risk mitigation; (iii) referrals to potential contractors; and (iv) a certificate that will actually result in fire insurance. As noted on the Wildfire Partners website:[26]

24 Nash, M.W. "How Wildfires Are Making Some California Homes Uninsurable" (November 20, 2018); Staff Report. "Ruin, recovery and reform: Tracking progress one year after the Wine Country firestorm," *San Francisco Chronicle* (October 6, 2018), available at https://www.sfchronicle.com/bayarea/article/Ruin-recovery-and-reform-Tracking-progress-one-13284796.php.

25 Wildfire Partners (2018), available at http://www.wildfirepartners.org/our-program/; CBS Denver. "Program Offers Wildfire Mitigation for Homeowners in High Risk Areas" (July 16, 2018).

26 Wildfire Partners (2018).

> After you (or your forestry contractor) successfully complete your Mitigation To Do List, we will return for your final inspection. After passing the inspection, you will receive your certificate and letter that you can send to your insurance company. Allstate and USAA Insurance recognize this certificate as proof of proper mitigation. State Farm recognizes this certificate for renewal business. We are not aware of any insurance company who has denied coverage for a Wildfire Partners certified home. The certificate is transferable and can be uploaded to your MLS listing to help you sell your home (the new owner just needs to participate in a free educational site visit).

In order to set up a program that can affirmatively result in fire insurance for WUI homeowners, the county worked directly with insurance providers. As shown by the quote above, three major insurers, Allstate, USAA, and State Farm participated in the program. The program also has a pre-certified list of contractors who can do both home retrofit and forestry work for a parcel owner.

The provision of fire insurance is crucial for rebuilding. Boulder County Wildfire Partners program shows how fire insurance can be turned from an obstacle to rebuilding into a mechanism for delivering climate change adaptation benefits to a community. The "Boulder Plan" serves as a model for how to promote adaptive rebuilding after a climate-change-related natural disaster.

How Bank Lending Can Address Climate Adaptation

We believe that bank lending guidelines, including the Community Reinvestment Act (CRA), need to address climate change adaptation. Whether through the insurance industry, FEMA, or banks, our funding systems for disaster recovery need to adapt to climate change too. Here are some ideas:

(i) ***Say "no" to lending in disaster recovery areas where there are no provisions to mitigate the risk of climate change through comprehensive adaptation.*** Rebuilding to fail has been tolerated by the NFIP program for decades. Public policy advocates normally are trying to get banks to say "yes" more often. That notion is core to CRA. Given the scale of climate change-related disaster our nation is facing, rebuilding to fail can no longer be tolerated. We simply cannot afford it.

(ii) ***Say "yes" to expanded lending in disaster recovery areas sufficient to fund climate change adaptation (e.g., the Boulder Plan).*** This means not just lending for rebuilding on a parcel by parcel basis, but lending to make sure the rebuilt neighborhood or community will have climate change adaptation features that significantly reduce future disaster risk. Lending protocols for this purpose need to be also community specific, as opposed to just parcel specific.

(iii) ***Coordinate with the insurers and FEMA on a complete funding package for community rebuilding.*** If sufficient climate change adaptation features are incorporated into the rebuilding process, the insurers will continue to write coverage. This is particularly important for fire disaster recovery, where the private sector is the prime carrier. This also means that FEMA funding limits needs to be changed to fund climate change adaptation measures above and beyond restoring the prior condition of facilities. This means bringing FEMA guidelines into an overall "Boulder Plan" framework.

(iv) ***Lend for managed retreat.*** Perhaps the most politically explosive issue with climate change adaptation is the question of managed retreat. What if vulnerable communities just need to be relocated? Excellent work by the state of Louisiana in the bayou country shows that managed retreat works best if the entire community is relocated and reconstructed, as opposed to just compensating individual property owners in some way for their loss.[27] How can banks lend in a way that supports the relocation and reconstruction of entire communities?

Moving Forward: The "Disaster Recovery Act"

The CRA is intended to promote bank lending in disadvantaged or otherwise distressed communities. What if we had a "Disaster Recovery Act" (DRA) to promote adaptive rebuilding to go with the CRA? The DRA could address the lending issues for climate change disaster recovery listed above, as well as others that experienced bank managers no doubt would identify. In other words, mandate that disaster-impacted communities do the equivalent of the "Boulder Plan" to make sure that both insurance and lending is available for rebuilding. The DRA should include compatible mandates for FEMA to fund rebuilding of infrastructure to a resilient climate change adaptive level, but on the condition that there is an integrated plan that brings both insurers and lenders into the process. Equally important, the goal of such a collaborative effort is that insurers commit to continuing to provide coverage on the condition that the plan for a disaster impacted community is actually implemented. There is urgency to address these challenges. Climate change is real. Climate change is now, and we are paying for it now. Our national system for funding disaster recovery needs to change to truly address climate change adaptation.

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27 Stein, M.I. "How to Save a Town from Rising Waters," *CityLab* (January 24, 2018), available at https://www.citylab.com/environment/2018/01/how-to-save-a-town-from-rising-waters/547646/.

Insurance Innovation and Community-Based Adaptation Finance

Shalini Vajjhala and James Rhodes

Governments traditionally act as "insurers of last resort." When disaster strikes, vulnerable communities turn to local, state, and federal government agencies for support and recovery assistance. More recently, as the frequency and severity of various disasters–from severe storms and floods to wildfires–have grown,[1] the gap between who has financial protection in the form of insurance and who does not has also grown. For example, in California, only 13 percent of homeowners carry earthquake insurance,[2] and after recent wildfires, other homeowners' properties could become entirely uninsurable in the future.[3]

This "protection gap" is particularly challenging to address in low-income and marginalized communities, where risk awareness and insurance affordability can be major barriers.[4] As a result, many government agencies have found themselves being expected to act as insurers of *first* resort. This is an unsustainable situation for both budget-constrained public entities and vulnerable communities and residents who face years of delays in getting assistance to get back on their feet after a disaster.

This article highlights how insurance can be a catalyst for implementing both engineering and social-ecological adaptation measures.[5] The following sections describe why insurance innovation is unlikely to occur on its own and offer three ideas for how local governments can work with the insurance industry to craft integrated resilience solutions that promote community-scale adaptation, measurably reduce risk, and improve long-term physical and financial protection for at-risk communities.

Insurance as a Catalyst for Climate Adaptation: Barriers

Insurers have long championed investments in physical risk reduction. Examples include seat belts to reduce the human and economic costs of automotive accidents, fire codes for

1 Walsh, J. et al. "Ch. 2: Our Changing Climate," *Climate Change Impacts in the United States: The Third National Climate Assessment* (Melillo, J.M., Terese, R. [T.C.], and Yohe, G.W. [eds.]), U.S. Global Change Research Program (2014), pp. 19-67. doi: 10.7930/J0KW5CXT

2 Fuller, T. "In Quake-Prone California, Alarm at Scant Insurance Coverage," *The New York Times* (August 31, 2018).

3 Walsh, M.W. "How Wildfires Are Making Some California Homes Uninsurable," *The New York Times* (November 20, 2018).

4 Calvesbert, G. "Why does the protection gap exist?" AIR Worldwide (2016), available at https://www.air-worldwide.com/Blog/Why-Does-the-Protection-Gap-Exist-/.

5 Davidson, J.L. et al. "Interrogating resilience: toward a typology to improve its operationalization," *Ecology and Society*, 21(2):27 (2016). doi: 10.5751/ES-08450-210227

urban buildings, and workplace safety standards, among other measures.[6] Common features of these cases are that clear and effective measures were available to reduce risk (and rising insurance industry losses), the measures were affordable for consumers and property owners, and advancing these measures aligned well with the established business models and financial interests of insurance industry firms.

The insurance industry has recognized that climate change poses similar industry-wide challenges. Many insurance companies have become active participants and leaders in global discussions and initiatives on building resilience, promoting adaptation, and reducing the protection gap in recent years.[7] However, advancing projects on the ground that deliver meaningful risk reductions has been elusive, for a number of reasons.

First, the terms adaptation and resilience encompass an enormous diversity of potential activities and risk-reducing measures, and there is no clear consensus on which solutions to implement. Projects range from hard engineering solutions–such as seawalls and flood barriers–to ecological interventions, like protecting and expanding wetlands and mangroves, to planning exercises and social capacity building.[8] The effectiveness of many of these measures for delivering quantifiable risk reductions has yet to be demonstrated for insurance purposes. For example, life-insurers have copious amounts of data available on the effect of smoking on life expectancy and can adjust premiums accordingly. The same is not yet true of green infrastructure measures designed to reduce flood risk. This challenge is made even more complex with climate change, since historical data is not a reliable predictor of future impacts. There are some emerging firms, such as MyStrongHome,[9] that are filling these types of data gaps and standardizing the process of capturing insurance savings to support resilience measures; however, the market is far from developed.

Second, many resilience projects have distributed beneficiaries and few existing mechanisms for coordinating the kinds of collective action required for effective implementation. Consider a coastal protection project that reduces surge and flood risk for hundreds of property owners in a protected area. Individual property owners generally don't have the capacity or authority to develop such large-scale projects on their own, and from an insurance perspective, property-level policies are generally provided by many different carriers. No single insurer has the incentive to invest time and resources in finding collective solutions when the benefits would also accrue to its competitors. Further, individual insurers often have a hard time setting premiums that reflect the full value of risk reduction measures due to a lack of visibility on projects, lack of standards for implementation, and lack of data on the resulting benefits (reductions in expected losses).

6 Ben-Shahar, O. and Logue, K.D. "Outsourcing Regulation: How Insurance Reduces Moral Hazard," *Michigan Law Review*, 111, 197 (2012), available at http://repository.law.umich.edu/mlr/vol111/iss2/2.

7 InsuResilience Global Partnership (2018), available at https://www.insuresilience.org/.

8 Davidson, J.L. et al. "Interrogating resilience" (2016); Meerow, S., Newell, J.P., and Stults, M. "Defining urban resilience: A review," *Landscape and Urban Planning*, 147 (2016), pp. 38–49.

9 MyStrongHome (2018), available at https://www.mystronghome.net/.

Cases where the insurance industry has effectively championed risk reductions for distributed beneficiaries have focused on sector-wide codes and standards rather than local projects or protection measures.[10] Risk modelers can help bridge the gap between insurers and project developers to quantify the (financial) benefits of resilience projects using industry-trusted models, but data alone is not enough to enable the coordinated investments required to deliver projected benefits. New business models are required to coordinate beneficiaries and consolidate benefits if they are going to help advance project implementation.[11]

Third, there is a mismatch in timing where adaptation is long-term and insurance is short-term. Most insurance contracts are renewed annually, while most risk reduction projects have far longer lifetimes and payback periods. This makes it difficult for insurers to amortize upfront costs even when risk reduction measures can help them meet their own longer-term financial objectives, such as reducing potential losses or diversifying their portfolio. This is an area ripe for new product development in the insurance industry. In 2015 the Canadian insurance firm, The Co-operators, created a new retail insurance policy called "Comprehensive Water" to provide coverage for climate change-related storm surge and riverine flooding, as well as more standard types of water damage.[12]

Fourth, the market structure of the insurance industry poses particular challenges for innovation. Complex regulatory obligations and large capital requirements make it difficult for innovative start-ups to enter the market, and the insurance sector doesn't benefit from the intellectual property protections available in other industries. As a result, insurance companies have limited incentives to pioneer new financial mechanisms that can take significant time and resources to develop when competitors can easily copy the resulting products.

Fifth, and finally, insurers do not have incentives to reduce premiums. Stated another way, every private insurer's profit motive creates a natural disincentive for them to advance initiatives that reduce their top-line revenue. Fostering competition across the whole industry is the only way to overcome these last two disincentives.

The result of these barriers to insurance innovation is that local governments and at-risk communities face significant challenges in aligning physical protections, like resilient infrastructure, with financial protection, including private insurance. Investing in cost-effective adaptation and economic development projects is hard. In most of these projects success is something that does not happen–a storm hits, but the community isn't flooded. The lack of transparency in insurance pricing and the uncertainties created by annual changes in

10 Ben-Shahar, O. and Logue, K.D. "Outsourcing Regulation" (2012).

11 Kahn, M.E., Casey, B., and Jones, N. "How the Insurance Industry Can Push Us to Prepare for Climate Change," *Harvard Business Review* (August 28, 2017), available at https://hbr.org/2017/08/how-the-insurance-industry-can-push-us-to-prepare-for-climate-change.

12 Staff Report. "The Co-operators Offers Storm Surge Insurance to Homeowners in Atlantic Canada," *The Insurance Journal* (August 27, 2018), available at https://www.insurancejournal.com/news/international/2018/08/27/499165.htm.

pricing for policy renewals makes it challenging for any individual policyholder to negotiate to reduce premiums and capture insurance benefits. (Picture calling your health insurance company to negotiate a premium discount for going to the gym more often.) Despite the many obstacles above, insurance is one of the best ways to monetize benefits that are realized in the form of "avoided losses." So how can local governments work with the insurance industry to improve physical and financial protection for at-risk communities?

Opportunities for Insurance-linked Finance for Community-Based Adaptation

Resilience Bonds are a new mechanism to link catastrophe insurance with infrastructure projects–serving both engineered and socio-ecological resilience functionality–that are designed to measurably reduce expected losses.[13] The aim is to translate insurance savings into a revenue stream that helps communities tap new sources of project capital for adaptation and economic development and get major resilient infrastructure projects off the drawing board and into the ground. This insurance product works best when there is a large risk (high expected losses), existing insurance coverage (from which to capture savings), and a significant risk reduction solution–like seat belts. These are ideal conditions for monetizing and capturing insurance benefits. But most communities across the U.S. are not dealing with ideal conditions, so this article offers three complementary ways that communities can take a proactive approach to using insurance-linked finance for adaptation.

Financing Large-Scale Protection Projects

In January 2016, the U.S. Department of Housing and Urban Development (HUD) awarded nearly one billion dollars for resilience projects in 13 communities across the country as part of the National Disaster Resilience Competition.[14] Most of these communities' proposals included large-scale engineering solutions to protect areas that were previously devastated by disasters. Although a billion dollars is an enormous sum, many communities still need to fill significant project funding gaps. One example is the city of Minot, ND.

In 2011, the Souris River flooded at unprecedented levels, leading to evacuations of approximately 11,000 residents and causing hundreds of millions of dollars in infrastructure damage in Minot. Since then, the city has developed plans for a comprehensive $800 million flood protection project. Funding from HUD and other federal sources is expected to cover part of the total project cost, but the city and state are working with FEMA, the Army Corps of Engineers, and others to explore options for financing the remainder.

13 Vajjhala, S.P. and Rhodes, J.S. "Leveraging Catastrophe Bonds as a Mechanism for Resilient Infrastructure Project Finance," re:focus partners (2015), available at http://www.refocuspartners.com/wp-content/uploads/2017/02/RE.bound-Program-Report-December-2015.pdf; Kahn, M.E., Casey, B., and Jones, N. "How the Insurance Industry Can Push Us to Prepare for Climate Change" (August 28, 2017); and Vajjhala, S.P. and Rhodes, J.S. "A Guide for Public-Sector Resilience Bond Sponsorship," re:focus partners (2017), available at http://www.refocuspartners.com/wp-content/uploads/pdf/RE.bound-Program-Report-September-2017.pdf.

14 U.S. Department of Housing and Urban Development. "National Disaster Resilience Competition" (2018), available at https://www.hud.gov/program_offices/economic_development/resilience/competition.

Insurance-linked finance offers a pathway to help smaller communities like Minot that have spent years designing comprehensive protection projects to get those projects financed and built. The key steps include:

- Design a large-scale resilient infrastructure project to optimize reductions in expected losses and deliver insurance benefits. Project developers should engage risk modelers and analysts early in the design process to help set design criteria (minimum thresholds) based on the optimal level of financial protection.
- Establish contractual or administrative mechanisms to consolidate and transfer risk, such as:
    (i) Develop risk pooling agreements to bring together large asset holders with shared insurance coverage and loss mitigation priorities;
    (ii) Create a new special district to pool distributed property risks by requiring property owners to purchase specified insurance coverage or pay an assessment to cover the cost of a new protection project; and
    (iii) Establish a pooled reinsurance program that requires property insurers providing coverage in a designated area to purchase reinsurance linked to specific risk reduction projects.
- Engage private finance partners and structure the project finance based on the projected future insurance savings captured through the loss mitigation project. Just as private investors in a toll road use forecasted toll revenue as the basis for investing in the project, investors in a protection project would provide the upfront capital to implement a protection project based on the forecasted insurance savings.
- Build the project and capture the insurance benefits over time to cover finance payments.

Aggregating Distributed Property-Level Interventions

Unlike Minot, many small- and medium-sized communities do not have the option to design and build comprehensive engineering projects to protect a single at-risk area. In these communities, coordinated action by individual property owners that opt-in to programs to meet higher levels protection can deliver more scalable and replicable community-wide resilience benefits.

Communities that could benefit from this approach include California residential communities devastated by wildfire, cities like Houston with large-scale residential flood damages from events like Hurricane Harvey, and smaller West Coast cities facing serious earthquake risks. Examples of administrative approaches that can help motivate, align, and capture the benefits of distributed household and property-level resilience retrofits and improvements include:

- Develop a program modeled on Property Assessed Clean Energy (PACE) programs for residential and small commercial adaptation measures and resilience upgrades. Capital for property-level interventions could be provided from public or private sources and payments could be coupled to property insurance and property taxes similar to PACE.
- Establish a special district with finance and taxing authority to implement area-wide risk reduction in collaboration with a private loss mitigation partner (such as MyStrongHome). Payment shortfalls from insurance savings (e.g., due to failure of property owner to renew coverage with participating carrier) can be added to property taxes/assessment reflecting the "special benefit" for each participating property-owner.

Capturing Network Benefits of Resilience Upgrades

A third area where local governments and authorities can work with the insurance industry to enable community-scale adaptation is by focusing on network improvements, such as transit, transportation infrastructure, and water system upgrades. Weather-related events (such as heavy rainfall and heat waves) can both disrupt daily system operations and pose major long-term financial liabilities. For example, heat has been attributed as a cause in major train derailments and service disruptions from Washington, DC and Chicago to Los Angeles.[15] Because transit disruptions have the greatest impact on low- to moderate-income (LMI) riders with limited alternatives, engineering adaptation projects to improve system performance can have the greatest benefits for LMI communities.

Designing projects that can reduce climate- and weather-related revenue and cost impacts can also help create new sources of project funding for risk-reduction and resilience projects and facilitate reinvestment in a virtuous cycle of adaptations and system improvements. Some steps that transit and utility leaders can take include:

- Conduct a rapid assessment of recent budget documents to identify key downstream costs created by weather and climate risks, such as extreme temperature and rainfall. Examples include increased operations and maintenance costs, business disruption, asset depreciation, and reduced revenue. Benchmark the potential for savings and value capture.
- Identify relevant ongoing, planned, and underfunded projects and programs in current capital plans, strategic plans, and resilience strategies that have the potential to significant address the risks identified above.

15 Schwartz, H.G. et al. "Ch. 5: Transportation, Climate Change Impacts in the United States: The Third National Climate Assessment" (Melillo, J.M., Terese, R. [T.C.], and Yohe, G.W. [eds.]), U.S. Global Change Research Program (2014), pp. 130-149. doi: 10.7930/J06Q1V53

- Develop an insurance-linked project finance and risk transfer program to make payouts to the relevant authority when pre-designated events or system failures occur and capture value from ongoing and planned projects that measurably reduce risks (in a revolving fund) and fill funding shortfalls for other priority projects.

Conclusion

Often the most cost-effective solutions to reducing disaster risk are the ones available to communities prior to a disaster that protect against a loss occurring in the first place. Yet cities are struggling to fund even basic infrastructure projects, let alone more complex investments in resilient systems. Public cash reserves and budgets for insurance are increasingly constrained, and the capital cost of large-scale resilient infrastructure, such as coastal protection projects or flood barriers, is often too high to be absorbed by local governments or utilities. Too often the benefits are diverse, diffuse, long-term, and non-monetary, making the same types of infrastructure investments unattractive to private investors.

Local governments have both the means and the opportunity to redefine how communities invest in adaptation and engage with the insurance industry to reduce risk, make resilient economic development investments, accelerate recovery–if and when disaster strikes–and more effectively manage the volatility and uncertainty associated with our evolving exposure to both natural hazards and the broader financial risks of climate change. This article offers three new ways of approaching the problem to empower local governments and communities to tap into innovative insurance solutions for adaptation finance. None of the pathways in this article are simple or easy. But together they offer new solutions that can help local governments bring in experts, including risk modelers and project finance firms, to deliver adaptation projects that would otherwise remain on the drawing board.

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Forest Finance Unlocks Opportunities for Rural Communities: Exploring the Triple Bottom Line Impacts of the Forest Resilience Bond Model

Nathalie Woolworth and Zach Knight

The Forest Resilience Bond (FRB) is a financial tool that enables private investment in forest enhancements on public land. The FRB promises to accelerate the pace and scale at which critical work to restore the health and functioning of the nation's forested landscapes is undertaken. It does so by engaging private capital to cover the upfront cost of activities to improve forest health and by bringing together stakeholders that benefit from this work to share in the cost of reimbursing investors over time. These beneficiaries sign contracts that jointly cover the project cost plus a modest return to investors, meaning that no one stakeholder shoulders the burden of repayment alone. The result is a collaborative finance model that yields clear ecological, social, and financial returns.

While perhaps less obvious, the FRB model also unlocks opportunities for positive social impact in rural communities across the country. In addition to the direct impact of job creation, FRB projects can catalyze infusions of capital into rural areas by sending signals to the market that there is a steady supply of raw material to fuel forest-based industries. Against a backdrop of declining rural prosperity, this article envisions how the FRB could play a role in assisting rural areas—especially those with historically forest-based economies—transition to a more resilient ecological and economic future.[1]

Threats to Forests and Communities

Healthy forests maintain clean and abundant water for human consumption, irrigation, industry, and power generation. They also control flooding, sequester carbon, support biological diversity, sustain rural economies, and provide opportunities for recreation. And yet, forests across the U.S. face an array of challenges that put at-risk the ecological and economic benefits these landscapes provide.

The impacts of wildfire, drought, flooding, and insect and disease disturbance are increasingly severe as the impacts of a changing climate and growing development pressures leave forested landscapes vulnerable. This combination of hazards has prompted increasing rates

1 Davidson, J.L. et al. "Interrogating resilience: toward a typology to improve its operationalization," *Ecology and Society*, 21(2) (2016), p. 27. doi: 10.5751/ES-08450-210227

of tree mortality in western forests,[2] with a 2017 U.S. Department of Agriculture (USDA) study estimating the state of California alone to have 129 million standing dead trees.[3] Decades of forest policy focused on suppressing fire at all costs have also prompted forests nationwide to become unnaturally overgrown and thereby susceptible to pests, disease, and fire.

While the FRB funds ecological interventions that mitigate all of these threats, its primary intent is to reduce risks associated with one growing, high-visibility hazard–large-scale wildfires. In western states, the frequency, scale, and severity of wildfire is increasing: nine of the ten worst fire seasons on record have occurred since 2000 and close to 47,000 fires burned more than seven million acres of forest in 2017 alone.[4] In 2017, U.S. Forest Service (USFS) spending on fire suppression exceeded $2 billion[5] for the first time and over the last five years wildfire has prompted more than $5 billion in property loss.[6]

Forest conditions and human development patterns suggest these alarming trends will continue. In 2017, USFS identified 58 million acres of National Forest lands as at risk of severe wildfire.[7] Climate change models show temperatures rising three-to-four degrees and precipitation declining up to 20 percent in western states by the end of the century–shifts that would intensify fire risk.[8] In addition, development along the wildland-urban interface continues to put people, homes, and infrastructure in harm's way. Approximately 40 percent of recent development in the American West has occurred in areas at high risk of forest fire.[9]

Rural communities are dealing first-hand with the impacts of environmental threats like wildfire, as well as an array of other challenges. Across the nation poverty rates in rural locales exceed those in metro areas.[10] Many communities have watched local working-class jobs in manufacturing, timber, and agriculture gradually disappear, without parallel opportunities for employment arising. Low access to jobs, health care and education services, and transit

2 van Mantgem, P.J. et al. "Widespread Increase of Tree Mortality Rates in the Western United States," *Science*, 323 (5913) (2009), pp. 521-524.

3 U.S. Department of Agriculture. "Record 129 Million Dead Trees in California" (2017), available at https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd566303.pdf.

4 National Interagency Fire Center. "Fire Information" (2018), available at https://www.nifc.gov/fireInfo/nfn.htm.

5 U.S. Department of Agriculture. "Forest Service Wildland Fire Suppression Costs Exceed $2 Billion" (2017), available at https://www.usda.gov/media/press-releases/2017/09/14/forest-service-wildland-fire-suppression-costs-exceed-2-billion.

6 Insurance Information Institute. "Facts + Statistics: Wildfires" (2018), available at https://www.iii.org/fact-statistic/facts-statistics-wildfires.

7 U.S. Forest Service. "Fiscal Year 2017 Budget Overview," U.S. Department of Agriculture (2016), available at https://www.fs.fed.us/sites/default/files/fy-2017-fs-budget-overview.pdf.

8 Melillo, J.M., Richmond, T.C., and Yohe, G.W. (eds.). "Climate Change Impacts in the United States: The Third National Climate Assessment; Highlights: Future Climate," U.S. Global Change Research Program (2014), available at https://nca2014.globalchange.gov/highlights/report-findings/future-climate. doi: 10.7930/J0Z31WJ2

9 Glickman, D. and Sherman, H. "Paying for the Forest Fire Next Time," *The New York Times* (June 17, 2014), available at https://www.nytimes.com/2014/06/18/opinion/paying-for-the-forest-fire-next-time.html.

10 Economic Research Service. "Rural Poverty & Well-being," U.S. Department of Agriculture (2018), available at https://www.ers.usda.gov/topics/rural-economy-population/rural-poverty-well-being#geography.

and broadband infrastructure limit the ability of rural populations to advance community resilience and bounce back from economic downturns, transitions in industry, natural disasters, and other events outside of their control.

Most relevant to the FRB model are rural communities that have historically relied on the timber and wood products industries to sustain livelihoods, services, and infrastructure. Communities across the country, from northern New England to the Sierras in California, have dealt with the repercussions of declining timber harvests and mill closures for the last 25 to 50 years depending on the region. The decline of wood-based economies has stagnated economic growth, eliminating communities' primary source of employment and prompting population drop-offs. In addition, the industry-specific knowledge and skills required to rebuild struggling communities has been lost.

While a dominant narrative of rural decline persists in media and politics, the experience of residents across rural America is more varied. A 2015 survey of nearly 17,000 rural inhabitants showed that in addition to the poor and underserved communities most often highlighted in popular discourse, prosperous areas with ample infrastructure and growing populations (as well as zones in economic transition) also exist.[11] Researchers found that regions with a history of economic strength tend to be more equipped for transitions to new industries and ways of doing business, even if they have fallen on hard times.[12] Communities with robust legacies in the forest products sector could be well primed for economic transitions if they were able to access catalytic investment through a mechanism like the FRB.

Threats to ecological and community resilience nationwide are intertwined. Environmental disasters like wildfire, the risks of which are exacerbated by overcrowded forests, put rural lives and property at risk. High density forests are less equipped to provide the clean air and water that support populations across rural-urban gradients. At the same time, the decline of forest-based industries has left many communities in search of new pathways to economic revitalization.

The Ecological and Social Returns of Forest Restoration

Just as the threats to forested landscapes and rural communities are connected, so too are the opportunities to address them. The FRB addresses these threats by funding activities that improve the functioning of ecological processes associated with forest health, a field of work broadly termed "ecological restoration." In the context of overcrowded forests, restoration activities contribute to ecosystem resilience by reducing the threat of hazards like wildfire, insects, and disease.[13]

11 Ulrich-Schad, J.D. and Duncan, C.M. "People and places left behind: work, culture and politics in the rural United States," *The Journal of Peasant Studies*, 45 (1) (2018), pp. 59-79.

12 Ibid.

13 U.S. Department of Agriculture. "U.S. Forest Service Fiscal Year 2015 Budget Overview" (2014), available at https://www.fs.fed.us/aboutus/budget/2015/FY15-FS-Budget-Overview.pdf.

Mechanical thinning and prescribed burning are two commonly employed restoration strategies, or forest health treatments. These techniques return overgrown forests to natural densities by thinning out small diameter and dead trees, and eliminating woody debris that builds up on the forest floor. Restoration work reduces the risk of large fast-spreading wildfire by removing these hazardous fuels. These activities slow the spread of pests and disease by increasing the space between trees. In addition to the techniques most relevant to fire risk reduction, ecological restoration can include work to restore meadows and riparian ecosystems, decommission roads, remove culverts, eradicate invasive species, and reforest landscapes.

These restoration methods have proven results. By reducing fire risk, forest health treatments protect lives, property, and habitat from the devastation of large-scale burns, prevent carbon stored in tree biomass from being released into the atmosphere, and keep sediment from ash, debris and erosion from impacting water quality and heightening treatment costs. Thinning forests also frees up water consumed by overly-dense vegetation to flow downstream for drinking, irrigation, industry, and hydroelectric power generation.[14]

Along with restoration activities come jobs that fuel a burgeoning "restoration economy." Economic output from environmental restoration, restoration-related conservation, and mitigation actions, is a growing driver for rural communities across the country.[15] A 2015 study estimates that the domestic restoration economy employs approximately 126,000 and yields $9.5 billion in economic output nationwide, while supporting an additional 95,000 jobs and $15 billion in economic output through increased household spending and other indirect linkages.[16] The employment effects of individual restoration projects appear to exceed those of the oil and gas industry, with restoration projects supporting up to 33 jobs per $1 million invested compared to the 5.2 jobs generated by oil and gas projects.[17]

In addition to creating on-the-ground jobs to thin, burn, and otherwise restore forests, the restoration economy yields new opportunities for employment in industries that utilize small diameter timber, dead trees, and other residuals generated through ecological restoration. The most promising of these opportunities include bioenergy plants that generate heat and electricity from the biomass of woody debris, and facilities that produce mass timber products that take advantage of small diameter wood to create solid panels for construction.[18] Other nascent industrial uses of these materials include the production of carbon sequestering biochar and extraction of tree-based chemicals. Forest restoration

14 Ge, S., Caldwell P.V., and McNulty, S.G. "Modelling the potential role of forest thinning in maintaining water supplies under a changing climate across the conterminous United States," *Hydrological Processes*, 29(24) (2015), pp. 5016-5030, available at https://www.fs.usda.gov/treesearch/pubs/48417.

15 BenDor, T. et al. "Estimating the size and impact of the ecological restoration economy," *PLoS ONE*, 10 (6) (2015): e0128339.

16 Ibid.

17 Ibid.

18 The Beck Group. "Dead Tree Utilization Assessment," CALFIRE and California Tree Mortality Task Force (May 2017), available at http://www.fire.ca.gov/treetaskforce/downloads/WorkingGroup/Beck_Group_Report_5-1-17%20.pdf.

directly addresses threats to forest health while also helping to grow a restoration economy that supports new opportunities for rural prosperity. The FRB model could play a pivotal role unlocking these opportunities at a scale that impacts forest health and rural lives across the country, while simultaneously contributing to large-scale efforts that mitigate the effects of climate change.

Understanding the Forest Resilience Bond

The FRB model is, most simply put, an investment in forest health. Its potential for impact is predicated on the idea that the long-term value of forest health exceeds the initial cost of restoration. Using an investment structure comparable to infrastructure project financing, the FRB relies on contracted cash flows to monetize the ecological and social outcomes associated with forest restoration.

The FRB accelerates the pace and scale at which restoration activities can be undertaken by raising private capital to fund the full cost of restoration upfront. Then, a range of stakeholders that benefit from project outcomes like reduced fire risk and improved water quality share the cost of reimbursing those investors over time at a modest rate of return. Depending on the project, beneficiaries may make contracted payments of two varieties: (i) fixed cost-share payments; or (ii) pay-for-success payments that reimburse investors at different rates based on project outcomes. In either case, contracting with beneficiaries–including but not limited to federal agencies, state governments, water and electric utilities, water-dependent companies, and private landowners–converts restoration benefits into cash flows for investors.

What differentiates the FRB from other approaches is not only its use of investor capital to fund restoration quickly and at scale, but the collaborative model of cost sharing between beneficiaries. This approach engages a range of stakeholders to split the cost of repaying investors and involves them in project development. As such, the FRB model encourages a collaborative systems-level response to forest health challenges that makes use of funds, experience, and expertise from a range of public, private, and civic stakeholders.

In November 2018, the project developer Blue Forest Conservation launched its first pilot, raising $4 million for a $4.6 million project to restore 15,000 acres of California's North Yuba River Watershed. Due to the perceived financial risk and smaller size of this initial launch, Blue Forest Conservation used a blended capital structure that relied on funds from concessionary sources that can tolerate higher risk as well as non-concessionary sources. Concessionary capital came from program-related investments (PRIs) made by mission-focused foundations that generate below-market-rate returns of one percent. Market rate investors–including an insurance company looking to diversify its portfolio, generate a market rate return, and reduce its risk of insured losses over time–will earn a four percent return. Investors will be repaid over five years by a local water utility and the State of California, both of which reap the benefits of increased water quality and quantity, as well as reduced fire risk.

Given the staggering scale of ecological need, Blue Forest Conservation plans to scale the FRB to fund projects in the $25 to $50 million range, as well as aggregate smaller planned projects into a fund structure. Working at this scale will allow access to larger institutional investors such as pension plans, endowments, and insurance companies that require a certain scale of opportunity to invest. In addition to opening doors to new investors, larger projects fund more acres of restoration, reduce transaction costs, and make the time and cost associated with investors' due diligence worth it. Blue Forest Conservation envisions future larger projects as fully market-rate transactions that mirror infrastructure project financing.

Growing the Restoration Economy through the Forest Resilience Bond

Bank lending indirectly follows the patterns and limits set by insurers and FEMA. Banks lend to property that can obtain the appropriate casualty or flood insurance. Bank loans are secured by liens on specific parcels. Current practice then is to lend to insurable parcels owned by borrowers with adequate credit. However, successful climate change adaptation measures for WUI fire risk are not exclusively parcel specific. As noted above, WUI fire risk mitigation also needs to be at a neighborhood or community scale. Consequently, lending to rebuild a community devastated by a climate change disaster to a new, more adaptive, standard is not consistent with current bank lending protocols. Banks will lend where insurance is available. Consequently, as has been noted by many, if the federal flood insurance program promotes rebuilding in flood prone areas, banks will continue to lend to those areas. That amounts to bank lending to rebuild to fail.

The FRB's potential to unlock opportunities for ecological and community resilience falls into four primary buckets. First and foremost, the FRB matches investment-ready capital with on-the-ground restoration projects that yield both environmental and social returns. Second, it accelerates the pace and scale at which restoration work can yield these dual returns by raising funds upfront. Third, it smooths out and stabilizes otherwise irregular funding from public sources, allowing work to move forward more rapidly and predictably. And fourth, it signals to the broader market a steady supply of woody biomass, encouraging investment in rural economies awaiting growth opportunities.

Putting Undeployed Conservation Capital to Use

A 2016 assessment of the emerging market of conservation investing–or investing motivated by profit generation as well as positive impact on natural resources and ecosystems–documents the sector's dramatic growth over the last decade.[19] Between 2009 and 2015 a total of $8.2 billion was committed to conservation investments worldwide, with the average annual capital committed doubling from $0.8 billion between 2009 and 2013 to $1.6 billion in 2014 and 2015. The assessment also tracked $3.1 billion in undeployed capital at the end

19 Hamrick, K. "State of Private Investment in Conservation 2016," Ecosystem Marketplace (January 11, 2017), available at https://www.forest-trends.org/publications/state-of-private-investment-in-conservation-2016/.

of 2015, indicating that investors are on the lookout for investable conservation projects. Unfortunately, barriers such as a lack of attractive risk/return profiles, small transaction sizes, and a lack of management track records are keeping investors from immediately deploying capital.[20]

The FRB could play a key role in connecting undeployed investment-ready capital with forest restoration projects, with Blue Forest Conservation playing the role of match-maker. As the project developer, Blue Forest identifies landscapes with ecological need, pre-designed and permitted restoration projects, land managers on the lookout for new ways to finance critical work, beneficiaries to repay investors, and partners to implement treatments. Building on its North Yuba River watershed pilot, Blue Forest Conservation will also pursue projects that do not rely on concessionary capital, thereby addressing investors' concerns about risk/return profiles and transaction size.

Accelerating the Pace and Scale of Restorations

Forest health treatments are expensive, ranging from hundreds to thousands of dollars per acre depending on the landscape and treatment prescription. Historically, the cost of restoration activities nationwide has been shouldered by individual land managers, such as the USFS, state governments, municipal water utilities, and private landowners like land trusts, private companies, and individuals. However, the work undertaken by both public and private stewards is severely constrained by financial resources, be they annually appropriated funds, philanthropic dollars, or companies' operating budgets. As such, forest restoration is proceeding at a pace and scale that does not meet the urgency or scale of the need. In the case of the USFS, resource limitations exacerbated by the rising cost of wildfire suppression have prompted a 30 to 45 year backlog of forest restoration work in California alone.[21] As these interventions are further deferred due to resource constraints, the costs of restoration continue to rise.

The FRB addresses this challenge by raising funds to cover the full cost of project implementation upfront. In the case of the North Yuba River watershed project, work that would have taken a decade or more to complete if relying on USFS annual appropriations is projected to finish in just two to three years. Speedy deployment not only allows work to get done faster, it saves land managers the compounding costs of inaction over time and helps create psychological momentum that moves communities from risk-averse mentalities to mindsets that embrace innovation and opportunity.

Providing Financial Flexibility

In some cases, financial resources already exist to fund restoration, but putting them to use on the ground can be difficult. Many federal and state programs provide reimbursable grants, meaning that organizations–often small resource-constrained nonprofits–must

20 Ibid.

21 U.S. Forest Service. "Ecological Restoration and Partnerships–Our California Story," U.S. Department of Agriculture (2018), available at https://www.fs.usda.gov/detail/r5/landmanagement/?cid=stelprdb5412095.

complete the work, or a portion of it, before they receive funding. Even after work has been finished, it can take months for project implementers to see funds deposited in their accounts. For cash-poor organizations, finding the upfront funds to implement forest health treatments in a timely manner can be a huge challenge.

By raising capital to cover full project costs upfront, the FRB directly addresses this barrier. Project implementers have funds in hand before work begins, meaning that restoration can happen on quicker and more predictable timelines than would otherwise be possible. Reimbursable grant dollars can still be used within the context of the FRB model, as a source of repayment with extremely low credit risk for investors. In the North Yuba River pilot project, the State of California is providing reimbursable grant dollars as work is implemented. Ultimately, the same state funds are still deployed to improve forest health, but the upfront use of FRB capital smooths out an otherwise irregular timeline of implementation and reimbursement.

Signaling the Market

Building strong rural economies in forested areas requires demand for forest-based products, as well as supply chains that can meet that demand. As demand for bioenergy grows globally, demand for low-grade raw materials to fuel bioenergy facilities is also on the rise.[22] However, the domestic biomass sector has had difficulty guaranteeing a steady supply of woody debris to meet the year-round capacity of existing generation facilities, much less new ones. While the trajectory of demand for mass timber products is less certain, supply can also be an issue for this emerging market.

The inconsistencies in supply hindering these markets are not due to a lack of raw materials. In California alone, an estimated 102 million dead trees were accounted for in 2016, which equates to more than 40 years of timber harvesting at 2015 levels.[23] A USFS inventory showed small diameter timber to be even more prevalent–an estimated 6.8 billion trees with diameters less than five inches filled California's forests in 2010.[24] Instead, insufficient financial and human resources have created a bottleneck when it comes to removing fuels and transporting them to biomass facilities and wood processing plants. Even with growing demand, these inconsistent supply streams discourage investment in the sector and in the rural communities that house these facilities.

FRB projects could prompt investment in rural economies by signaling to the market that restoration economies are primed for investment. Capital from the FRB signals that work to thin forests and remove trees will be happening, and happening more quickly and predictably, prompting a consistent stream of supply for both bioenergy and mass timber products. In the context of rural economic development, investments in harvesting equip-

22 Oliver, A. and Khanna, M. "Demand for biomass to meet renewable energy targets in the United States: implications for land use," *Global Change Biology Bioenergy*, 9(1) (2017), pp. 1476-1488.

23 The Beck Group. "Dead Tree Utilization Assessment" (May 2017).

24 Christensen, G.A. et al. "California's Forest Resources: Forest Inventory and Analysis, 2001-2010," U.S. Department of Agriculture (February 2016), p. 104, available at https://www.fs.fed.us/pnw/pubs/pnw_gtr913.pdf.

ment, biomass and wood processing infrastructure, and job training programs could be indirectly stimulated through the deployment of FRB capital. These auxiliary investments could come from public, philanthropic, or private sources with a variety of motivations and goals.

Overcoming Barriers Beyond the FRB

Opportunities for the FRB to create jobs and stimulate rural economic development are abundant. However, barriers persist that the FRB cannot solve alone. To best take advantage of the infusions of private capital generated through the FRB, progress is required in three additional areas: access to education and job training, availability of working capital to fund equipment and infrastructure, and investments in market-building activities.

- ***Education and Job Training.*** In many historically forest-based communities, skillsets that were once common have been lost. Workers with training in relevant areas have aged, and opportunities rarely exist for younger generations to acquire the same skills. Investments in accessible, low-cost education and job training opportunities could play major roles in jumpstarting local restoration economies.
- ***Infrastructure and Equipment.*** Investments in infrastructure and equipment for forest management, wood processing, and biomass utilization are also a critical piece of fueling local restoration economies. As many forest-based industries have declined, so have the infrastructure and facilities that supported them, including sawmills, biomass plants, vehicle fleets, and harvesting equipment. Further, a lack of visibility into woody biomass supply has limited investor interest in this critical infrastructure. Raising the upfront capital to fund the purchase or retrofitting of critical equipment is often prohibitive for small-scale enterprises, but grants or loans to assist with these costs could help get otherwise stagnated work off the ground.
- ***Wood Markets.*** Investing in markets that can utilize woody biomass extracted through restoration activities promotes forest health, as well as community resilience. Creating pathways for growth in industries like mass timber could include research into new products, promotion of local wood branding, and education and awareness-building around new materials. Strategically co-locating wood businesses, training facilities, and research centers could help to incubate emerging markets, encouraging idea exchange and reducing cost through resource-sharing efficiencies.

In the near term, public and philanthropic funds are the most readily available to jumpstart investments in these three critical areas. In some cases, programs supporting this work already exist but could be better taken advantage of, especially in the rural context. In other cases, there are gaps to be filled. Federal programs focused on economic development—including Opportunity Zones and New Markets Tax Credits—can help create conditions for growth by incentivizing long-term private investment. Many state and philanthropic

funding programs are focused on supporting economic development and/or rural areas. Pairing public and philanthropic investment in these three areas with private-sector capital raised through the FRB could help local communities to better reap the benefits of budding restoration economies.

Conclusions

Recent destruction caused by wildfires across the western U.S. has drawn major attention to forest management and the need for restoration. Public and philanthropic funds are increasingly focused on responding to this crisis, but alone will never be enough to meet the scale of capital required to restore forest health and reduce wildfire risk nationwide. Private sector engagement shines as a beacon of opportunity, with the FRB providing a pathway for accessing this untapped source of financing. By connecting investor capital with on-the-ground restoration projects, accelerating the pace and scale at which these projects happen, and stabilizing otherwise irregular funding streams, the FRB promises to increase the number and size of forest restoration projects undertaken.

In addition to the clear ecological benefits of accelerated restoration, the FRB unlocks new opportunities for rural economic growth in forest-based communities that have fallen on hard times. The model impacts communities through job creation and stimulates rural investment by sending signals to the market that there will be a steady supply of raw material. With FRB financing, rural communities can unlock new opportunities to build both ecological and community resilience as they transition to restoration-based economies.

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Community Resilience and Adaptive Capacity: A Meaningful Investment Across Assets

Natalie Ambrosio and Yoon Kim

In a dark lower Manhattan where most buildings had lost power due to Hurricane Sandy, Goldman Sachs' lights shone bright in October 2012. While sandbags kept floodwaters out of the office building and a generator kept the lights on, New York City subways were flooded and hospitals had lost power and were evacuating patients in the middle of the raging storm. Against this backdrop, Goldman Sachs was both lauded and criticized for being an "island of resilience."[1] This event underscores the fact that internal risk management focused on protecting a company's own assets, while necessary, is insufficient. It must be bolstered by efforts to develop institutional resilience, understand how local communities are addressing physical climate risks, and identify opportunities for collaboratively advancing shared priorities.

The U.S. experienced 16 distinct large-scale natural disasters in 2017, together costing over $300 billion.[2] Climate change is expected to lead to more frequent and severe acute hazards (e.g. hurricanes, floods, heat waves, and wildfires) as well as chronic hazards (e.g. water stress and rising sea levels).[3] Investors across nearly every asset class are exposed. For example, while businesses experience costly disruptions during events like Hurricane Sandy, as described above, real asset investments are directly affected by physical damage due to climate risks. Consumer behavior in certain markets is beginning to respond to this risk. In the U.S., real estate exposed to ongoing and future sea level rise is selling at a seven percent discount compared to less exposed properties.[4]

As credit rating agencies increasingly incorporate climate risks into municipal ratings, municipal bond investments may be affected by downgrades, reflecting a concern that extreme weather events will adversely affect a city's ability to repay its debt. For instance, Moody's downgraded Port Arthur from A1 to A2 following Hurricane Harvey, citing its "weak liquidity position that is exposed to additional financial obligations from the recent hurricane damage, that are above and beyond the city's regular scope of operations."[5]

1 Keenan, J.M. "Sustainability to Adaptation and Back: A Case Study of Goldman Sach's Corporate Real Estate Strategy," *Building Research & Information*, 43(6) (2015), pp. 407-422.

2 Ross, L. "The financial sector responds to physical climate risks," PreventionWeb (August 13, 2018), available at https://www.preventionweb.net/experts/oped/view/59928.

3 Intergovernmental Panel on Climate Change. "Special Report: Global Warming of 1.5°C" (October 2016), available at http://www.ipcc.ch/report/sr15/.

4 Bernstein, A., Gustafson, M., and Lewis, R. "Disaster on the Horizon: The Price Effect of Sea Level Rise," *Journal of Financial Economics* (May 3, 2018), available at http://leeds-faculty.colorado.edu/AsafBernstein/DisasterOnTheHorizon_PriceOfSLR_BGL.pdf.

5 The Bond Buyer. "Storm-damaged Port Arthur, TX receives a Moody's downgrade" (October 25, 2017), available at https://www.bondbuyer.com/news/moodys-downgrades-hurricane-harvey-damaged-port-arthur-texas.

Risks "Beyond the Fence" Matter

Both acute and chronic physical climate hazards can have impacts on local transportation, energy, communications and water infrastructure, and disrupt business by making facilities inaccessible for staff and customers. These impacts can in turn contribute to longer staff commutes or inability to get to work; damage or destroy facilities; and hinder the movement of people and goods. During Japan's destructive rainfall in July 2018, Mazda Motor Corporation closed one of its headquarters and a factory for days despite incurring no major damage. Operations were closed because the homes of more than 100 company employees had been flooded and in many cases they faced challenges getting to work safely.[6] After devastating fires in Sonoma County, California in October 2017, many vineyards, restaurants, and hotels still stood with minimal damage, but their workers lost homes and often had to leave the area, leading to significant challenges for businesses during recovery efforts.[7] Vineyards experiencing minimal damage themselves struggled to communicate this to prospective visitors who continued to cancel and postpone trips.[8]

Every investment, from real assets to corporate initiatives, is inextricably connected to the surrounding community. Thus, understanding how acute and chronic physical climate hazards will affect local communities and how these communities are responding enables investors to assess the full extent of the risks they face. This, in turn, cannot be done without considering a community's adaptive capacity, which mediates the impacts of climate hazards on communities and local infrastructure and has major implications for business continuity.

Adaptive Capacity is a Key Factor in Community Resilience

Understanding a local jurisdiction's exposure to climate hazards is the first step in evaluating the impacts that climate change may have on the community. However, the extent to which significant disruptions or losses occur will also depend on a city's adaptive capacity, defined as the ability to "adjust to climate change (including climate variability and extremes) to moderate potential damages, take advantage of opportunities, and cope with the consequences."[9] Local adaptive capacity can differentiate those cities that incur enduring damage from those that do not during similar events.

For instance, during Chicago's 1995 heat wave, local adaptive capacity strongly influenced outcomes for the neighborhood of Englewood, which experienced one of the highest

6 Kyodo. "Water outages continue in flood-hit areas across western Japan, as death toll tops 170," *The Japan Times* (July 11, 2018), available at https://www.japantimes.co.jp/news/2018/07/11/national/water-outages-continue-flood-hit-areas-across-western-japan-death-toll-tops-170/#.W4hz2ehKiM9.

7 Jordan, M. "As Fires Move On, Wine Country Wonders Whether Immigrants Will, Too," *The New York Times* (October 17, 2017), available at https://www.nytimes.com/2017/10/17/us/california-fires-immigrants.html.

8 McCallum, K. "Sonoma Country grapples with tenuous economic recovery after October wildfires," *The Press Democrat* (April 28, 2018), available at https://www.pressdemocrat.com/news/8245364-181/sonoma-county-grapples-with-tenuous?sba=AAS.

9 U.S. Global Change Research Program (USGCRP). "Glossary," available at https://www.globalchange.gov/climate-change/glossary.

death rates during the event, and Auburn Gresham, whose death rate was lower than many of Chicago's affluent neighborhoods.[10] Both neighborhoods have majority African American populations suffering from high poverty and unemployment rates. But the latter enjoyed greater connectivity, including sidewalks, restaurants, and other places that brought residents together. This fostered a sense of social cohesion that incentivized neighbors to look out for each other and check on vulnerable individuals, such as elderly people living alone.[11]

Adaptive capacity captures a wide range of interacting factors, including the policy context within a community; the strength and investment of public infrastructure; the local jurisdiction's fiscal means and personnel capacity; and its ability to design, plan, implement, execute and manage tangible adaptation investments. Understanding these complex and interacting characteristics provides an important indication of how a city may be able to manage its risks from climate change and how the assets within a community may be affected.

Assessing Adaptive Capacity at Scale

Adaptive capacity is a well-researched concept.[12] Four Twenty Seven, a climate risk analytics firm that helps investors, companies, and governments understand the economic and financial impacts of physical climate risks, has leveraged insights gained from working with cities and investors, and built on the extensive peer-reviewed literature to develop a methodology for assessing community adaptive capacity from a private-sector perspective. Key factors in local adaptive capacity include risk assessment, planning, budget and staff allocation, and community engagement. Is climate addressed reactively by emergency management teams, or is a local jurisdiction taking steps to proactively understand its risk and build resilience? Is there a specific department dedicated to climate change impacts or is it bundled into several other priorities? Is there evidence of adaptation in the built environment, through building codes, flood management or urban greenery? Is the community well-informed about its exposure to climate risks and ways to individually prepare?

Assessing these factors for a single city requires expertise and effort. Evaluating the elements of adaptive capacity across a portfolio of jurisdictions presents significant barriers in terms of obtaining comparable data that is informative across a set of communities characterized by different sizes, economies, and demographics. Effective budget allocation, efficient community outreach, and numbers of cooling centers, for example, will depend on a city's size, population characteristics, and risk exposure. Comparing these numbers across a set of jurisdictions does not provide an informative comparison of community adaptive capacity, for instance in terms of public health, unless the analysis is sensitive to jurisdictions' unique contexts.

10 Klinenberg, E. "Adaptation," *The New Yorker* (January 7, 2013), available at https://www.newyorker.com/magazine/2013/01/07/adaptation-eric-klinenberg.

11 Ibid.

12 Moser, S.C. and Boykoff, M.T. (eds.) *Successful Adaptation to Climate Change*, Routledge (2013); Smit, B. and Wandel, J. "Adaptation, adaptive capacity and vulnerability," *Global Environmental Change*, 16(3) (2006), pp. 282-292; and Engle, N.L. "Adaptive capacity and its assessment," '*Global Environmental Change*, 21(2) (2011), pp. 647-656.

With these caveats in mind, Four Twenty Seven begins by obtaining a high-level understanding of local jurisdictions' adaptive capacity through the examination of key factors. Focusing on high-level indicators provides a valuable comparison at scale, which can highlight cities that may warrant a closer inspection. Informative indicators include data on number of trees per square foot of impermeable surface; whether a city participates in the Federal Emergency Management Agency's (FEMA) community rating system for flood mitigation; and the existence of adaptation, local hazard mitigation, and other relevant plans that provide an indication of how a community is building its adaptive capacity through operations and capital investments.

To inform adaptation planning and risk analysis for specific assets, it is useful to obtain a more nuanced understanding of the surrounding city's adaptive capacity, and hazard-specific efforts are important elements of this assessment. For example, for investors with an interest in several coastal cities exposed to sea level rise, Four Twenty Seven examines cities' coastal adaptation efforts. Likewise, for cities in the Midwest or California's Central Valley that are often exposed to drought conditions, water management plans can be an important indication of adaptive capacity.[13]

Credit rating agencies provide one perspective on how investors can examine adaptive capacity, as they are actively considering the most effective ways to incorporate climate risk and adaptive capacity into their ratings. S&P Global Ratings asks questions about how climate risks will affect each component of its framework for rating cities: how will an extreme event affect the tax base? Are capital and long-term financial planning prepared for unexpected costs? Are risk mitigation capital projects undertaken wisely, or are risks deferred? What is the city's level of indebtedness, and how will it be affected by extreme events?

For example, during Hurricane Harvey about 60 percent of Rockport, Texas residents were displaced, and a significant number of buildings were damaged. S&P Global Ratings downgraded the city due to a decline in its tax base and revenues, as well as its weak budgetary performance and lack of fiscal flexibility.[14] In contrast, municipal utility districts were also damaged, but were not downgraded largely due to their significant debt reserves, suggesting a continued ability to repay.[15] Thus, the utility districts were understood to have greater adaptive capacity in terms of fiscal stability due to their reserves as well as the accounting and risk management processes that identified and accounted for such reserves.

Regardless of asset class, investors can identify priorities around community adaptive capacity and focus on understanding these comparable components across a set of cities. S&P Global Ratings emphasizes the challenges of matching time horizons and obtaining clear disclosures from issuers. Investors have the opportunity to address these challenges

13 Steinberg, N. et al. "Assessing Exposure to Climate Change in U.S. Munis," Four Twenty Seven (May 2018), available at http://427mt.com/wp-content/uploads/2018/05/427-Muni-Risk-Paper-May-2018-1.pdf.

14 Schroeer, L. "Assessing the Impacts of Climate Change on U.S. Municipal Ratings. Webinar: Building City-level Climate Resilience," Four Twenty Seven (May 2018), available at http://427mt.com/2018/05/24/webinar-building-city-level-climate-resilience/.

15 Ibid.

through their unique relationship with issuers. By engaging with companies, communities or property managers, investors can promote climate-related financial disclosures which will improve the availability of comparable data across the nation.

Fostering Organizational and Community Adaptive Capacity

Shareholder engagement is a powerful tool that benefits both corporations and their investors.[16] Four drivers of collaborative organizational resilience-building include: (i) fostering long-term sustainability to improve competitiveness; (ii) protecting the value chain including suppliers, clients, and employees; (iii) improving reputation; and (iv) capitalizing on opportunities to innovatively address climate risks.[17] Shareholder engagement promotes these outcomes.

Equity and fixed-income investors can engage with companies in their portfolio to promote adaptation efforts that look beyond internal resilience investment to the external community. For example, recognizing its own exposure to flood impacts while also acknowledging its dependence on the surrounding community, Facebook collaborated with the San Francisquito Creek Joint Powers Authority and contributed $200,000 to assess the regional impacts of floods and sea level rise. By engaging in community efforts to evaluate exposure and supporting community adaptation efforts, Facebook strengthened its understanding of its own vulnerabilities and inundation risks and also improved its local relationships and regional reputation.[18] As shareholders, investors have the opportunity to engage directly with companies in their portfolios and ask questions about the surrounding infrastructure and community to better understand a company's climate risks and organizational resilience, as well as encouraging the companies to improve their own understanding of these issues.

Municipal bond investors can incentivize community resilience by investing in those communities that have high adaptive capacity and are seriously addressing their risks to climate change, as demonstrated by efforts to assess their risks and implement tailored projects to address them. Engaging directly with potential investments allows investors to ask questions regarding a municipality's planning for climate change and how events such as an extreme storm or enduring heat wave may affect its tax base. Infrastructure and real estate investors can foster community resilience by engaging with communities and property

16 LaManna, M. "From Risk to Resilience–Engaging with Corporates to Build Adaptive Capacity," Four Twenty Seven (June 2018), available at http://427mt.com/wp-content/uploads/2018/06/Engaging-with-Corporates-to-Build-Adaptive-Capacity_427-June-2018.pdf.

17 United Nations Global Compact. "The Business Case for Responsible Corporate Adaptation: Strengthening Private Sector and Community Resilience. A Caring for Climate Report" (2015), available at http://427mt.com/wp-content/uploads/2015/12/Caring-For-Climate-Business-Case-Responsible-Corporate-Adaptation-2015-1.pdf.

18 Joint Francisquito Creek Joint Powers Authority. "SAFER Bay Project: Public Draft Feasibility Report" (October 2016), available at http://www.sfcjpa.org/documents/SAFER_Bay_Public_Draft_Feasibility_Report_Summary_Oct._2016_.pdf.

managers around planning for the duration of an asset's life cycle. Understanding the adap-tive capacity of the surrounding city provides a valuable indication of how an airport, toll bridge, or other infrastructure assets may be affected by changes in road conditions, struc-tural damage, and consumer behavior during an extreme event. It also lays the groundwork for effective public-private collaboration to build adaptive capacity that leads to climate resilience and reduced loss.

Insight into the vulnerabilities of specific assets can guide meaningful collabora-tion around climate resilience. For example, certain manufacturing facilities are particularly vulnerable to water stress as they rely on water for cooling and washing processes. Ques-tions around the intersection of climate risk exposure and adaptive capacity at a site and in the wider community enable investors to understand their climate risks and identify oppor-tunities for strategic engagement and investment. For instance, in areas that are prone to water stress, how are water supply and demand changing? How are local jurisdictions plan-ning to ensure that water supply continues to meet changing residential, commercial, and industrial demand? Can an investor foster climate resilient water practices within its own assets, that may help ensure a sustainable supply for both the community and assets for their full life cycle? Investors are in a unique position both to engage with prospective and current investments to understand their exposure to climate risks and also to leverage their position as shareholders to promote resilience and adaptation strategies that consider both internal processes and community adaptive capacity.

Conclusions

Acute and chronic climate hazards and stresses have financial consequences for busi-nesses, investors, and communities through direct impacts, such as damaged and destroyed assets, and indirect impacts such as damaged infrastructure that disrupts energy or water supplies and leads to inaccessibility for employees and customers. As assets are inextricably linked to their surrounding communities, understanding the potential financial risks that climate hazards pose requires understanding asset-specific climate vulnerability, as well as local and regional adaptive capacities. A community's critical infrastructure, adaptation plan-ning efforts, and financial resources are all important components of its ability to manage the impacts of climate hazards and can be effective entry points for businesses and investors to collaboratively build adaptive capacity. Investors cannot thrive unless the communities in which they invest do and each asset class has a unique relationship with the surrounding community that can be leveraged to foster climate resilient communities and economies.

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Hunting for Money: U.S. Cities Need a System for Financing Climate Resilience and Adaptation

John Cleveland, Jon Crowe, Lois DeBacker, Trine Munk, and Peter Plastrik

The growing number of studies and emerging innovations in climate resilience and adaptation financing for cities is setting the stage for developing a comprehensive system—a set of standardized products and services, practices and tools—that is able to overcome key barriers and to take advantage of opportunities posed by climate change. Emerging elements of standardization in public finance within the financial system are becoming evident, but it is up to cities to act collaboratively with the private sector and other levels of government to help bring it into existence.

Barriers to financing substantial urban resilience and adaptation investments and the need for an overarching system that meets cities' needs were laid out in a recent study for the City of Boston. By example, the $2 to $4 billion of investments called for the city's resilience plan would require a mix of creative solutions outside the bounds of traditional city financing strategies and reliable state and federal funding sources.[1] The research concluded that even if Boston could obtain 50 to 60 percent of what it might require from federal and state governments, the city would still need to borrow private capital, backed by local property taxes and/or fees on water and sewer users, to cover the gap.[2] It would also likely need to enable at-risk districts in the city to charge local property owners to cover the cost of engineering and community resilience projects that would directly benefit them. In addition, the city would need new standardized measures for the performance of resilience actions; strong justifications for private and public investment; new or revised financing mechanisms that address risks due to climate change; ways to make sure that financing burdens and benefits are fair and equitable; new governance arrangements; and revisions in state and city policies.

Similar conclusions have been reached in other cities where the initial need for resilience and adaptation investments, both public and private, cannot be met by the current fiscal system supported by state and federal subsidies and conventional local taxing powers. The Boston report was the latest in a series of studies by some individual U.S. cities and metropolitan regions—Miami Beach, Minot, ND, New York City, and the San Francisco Bay Area among them—to figure out how to pay for their climate resilience and

1 Levy, D. "Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks," Sustainable Solutions Lab, University of Massachusetts (2018), available at https://www.greenribboncommission.org/document/financing-climate-resilience-report/.

2 Ibid.

adaptation plans.[3] At the same time, C40 Cities, the Environmental Defense Fund, 100 Resilient Cities, and other organizations have produced white papers and case studies showing how specific types of climate resilience projects can be financed through particular mechanisms and instruments, such as green bonds.

Solving Boston's climate finance problems, or those of any U.S. city, is a complex task. But the difficulties at the local level are indicators of an even bigger challenge–how to revise the U.S. system supporting urban and infrastructure investment so that cities throughout the nation can obtain the financial resources–easily amounting to hundreds of billions of dollars–that they will need to build their climate resilience and adaptive capacity. As the report for Boston put it, "[a] systematic approach to fund or incentivize pre-disaster resilience at these various scales does not exist."[4]

Climate Risk Disrupts Financing

Many U.S. cities report that a key barrier to implementing climate-resilience plans and projects is the availability of financial resources to cover the significant up-front and ongoing costs. Even large, affluent cities do not currently have the financial capacity in place to fund all of their plans. Some cities in weaker financial condition may hesitate to even start planning for resilience for fear they will not be able to afford to implement plans. Cities that have developed plans generally identify a large number of projects and programs across three broad categories:

- ***Infrastructure,*** the improvement, construction, or removal of built infrastructure;
- ***Services,*** the provision of programs and resources that reduce social vulnerability to climate hazards; and
- ***Risk management,*** the stand-by capacity, including property insurance, for emergency response and financial recovery.

Cities have historically paid for infrastructure, services, and risk management by tapping into a complex array of local, state, and federal government funding sources (taxes, user fees, grants, tax expenditures, etc.) and private financing mechanisms (municipal bonds, public-private partnerships, insurance, philanthropic grants and social investments), each with its own legal and administrative requirements, capital-managing institutions, and amounts

3 Northcross, M. et al. "Finance Guide for Resilient by Design: Bay Area Challenge Design Teams," NHA Advisors (2017), available at http://arccacalifornia.org/wp-content/uploads/2018/01/RBD-Financing-Guide-NHA-Advisors-171204-Final.pdf; AECOM. "Paying for Climate Adaptation in California: A Primer for Practitioners" (2018), available at https://www.aecom.com/paying-climate-adaptation-california-primer-practitioners/; and Keenan, J.M. *Climate Adaptation Finance and Investment in California*, Routledge (2019), available at https://www.routledge.com/Climate-Adaptation-Finance-and-Investment-in-California/Keenan/p/book/9780367026073.

4 Levy, D. "Financing Climate Resilience" (2018), p. 3.

of capital. But climate change has introduced new factors that complicate and hinder once reliable public funding and private financing.[5]

There is Insufficient Public Revenue

Cities already face an infrastructure investment deficit. Their general fund budgets are constantly under pressure, and they have intense competition for the use of their financial resources. They will need much more money for resilience and adaptation projects and most of it will have to come from public sources–taxpayers and public-service users. For many cities, though, raising new public revenue may be constrained by state laws limiting property taxes or requiring super-majorities of voter approval, and by local political, financial, and economic conditions.

Climate Change Poses New Risks and Uncertainties

Climate change increases the risk of destructive, acute, chronic, and catastrophic weather hazards, but the timing and severity of these impacts–their future patterns–has some degree of uncertainty. This disrupts traditional methods of calculating and pricing risk, a crucial factor for long-term investments, such as private lending for city infrastructure, for property and other insurance, and for real-estate financing. In addition, current risk-assessment methods tend to underestimate the potential damage from some climate events. Extreme weather events are already disrupting traditional city revenue streams. For example, post-Sandy communities lost revenue from falling property values, particularly from abandoned properties. Meanwhile, there are uncertainties about the performance and effective lifespan of some types of climate-driven projects, such as green infrastructure and sea barriers, which make it difficult to estimate the value of the protection they provide. Few design thresholds for physical infrastructure have been adapted to projected changes in weather and climate to ensure safe, effective, and efficient operation.

Inherent Imbalances between the Burdens and Benefits

Many resilience efforts involve short-term costs, but only produce value in the long term. Some reduce future climate damage and produce multiple future benefits, but do not generate financial returns for private capital. For example, existing utility business models struggle to capture the long-term value of resilience investments that produce an avoided cost rather than a positive cash flow. In addition, resilience projects typically entail investments by public agencies, but many of the benefits accrue to private property owners. The siloed structure of government agencies, budgets, and revenue sources gets in the way of investing in resilience projects with multiple benefits, such as green infrastructure, because

5 Northcross, M. et al."Finance Guide for Resilient by Design" (2017); AECOM. "Paying for Climate Adaptation in California" (2018); Coffee, J. *Money for Resilient Infrastructure: How to Finance America's Climate Changed Future,* Amazon Digital Services, LLC (2018); Keenan, J.M. *Climate Adaptation Finance* (2019).

it fragments government's interest and resources. Increasing public revenue to invest in resilience inevitably raises concerns about fairness and equity: who pays, how much they pay, and what benefits they obtain. Fairness, Boston's report explained, "means that the cost burden broadly reflects benefits provided. Equity means that the cost burden reflects ability to pay, and that resilience projects do not exacerbate inequalities. These two goals are often in tension."[6]

Public Policies and Markets are Misaligned

Some crucial government programs have been designed in such a way that they incentivize the wrong kind of behaviors relative to climate investments. Government "last resort" insurance tends to incentivize development in places at risk of climate damage, while "post-disaster" funding focuses mostly on rebuilding as-it-was rather than on building resilience and adaptive capacity to climate change. The federal government's flood insurance programs underestimate potential climate hazards and often underprice or overprice risk relative to projected future conditions. Some state insurance commissions prohibit risk-adjusted insurance premiums to shield risky properties from high premiums. The insurance sector has had little reason to signal increased climate risk or incentivize risk reduction—although recent hurricanes and forest fires have shifted that calculus, particularly in the reinsurance market. The industry sets rates based on historical data and focuses on providing widespread or affordable coverage. Competition among insurers limits their interest in offering incentives or issuing new coverage requirements. The insurance industry is further discouraged from offering incentives because of uncertainties about the effectiveness of risk-reduction measures and the difficulties of monitoring such efforts. Real estate markets do not provide climate-risk information and in some cases have resisted the potential adoption of public policies to require such disclosure. Climate risks are not factored into mortgage interest rates—yet.

Outside Traditional Municipal Jurisdictions

Climate impacts regularly cross municipal boundaries and affect multiple municipalities and interdependent built infrastructure and natural systems that are managed and regulated by separate government agencies. Responding effectively requires a level of collaboration for planning, budgeting, funding, and operations that is rare among siloed local government entities and may not be legal in some cases. Boston's report found that "[f]inancial and governance mechanisms don't yet exist for transfers across municipalities, for example, to enable fees from Boston buildings to pay for upstream investments, or for developers to offset stormwater impacts in Boston with mitigation measures in other communities."[7] At

6 Levy, D. "Financing Climate Resilience" (2018), p. 5.
7 Ibid, p. 23.

the same time, some climate impacts are experienced at the district, rather than citywide, scale. Although states and cities provide for various district financing mechanisms (e.g., tax increment financing, business improvement districts), they have not been designed for, and may not permit investment in climate resilience.

A Flood of Financial Innovations

Dozens of innovative efforts are underway to address these new challenges, and examples of successful implementation are emerging from cities across the country. They revise some of the financing mechanisms, analytic tools, investment standards, government regulations and policies, and governance and institutional arrangements that provide cities with money. However, most are "one-off" innovations developed through significant time and resource investment by an individual city, nonprofit organization, financial institution, or insurer for a specific project or financial mechanism. Furthermore, these many efforts are largely disconnected from each other. The public and private sector stakeholders engaged in climate finance efforts do not have a shared vision, common framework, or strategies for developing, as quickly as possible, a comprehensive, large-scale system for underwriting, capitalizing and managing urban climate investments.

These efforts provide potentially useful opportunities to learn what works and doesn't work–a testing ground for innovations. But they do not sum-up to a new system for meeting cities' climate capital needs. Our research identified 30 types of innovative activities that seek to address barriers and opportunities in climate financing and investment. Table 1 contains examples, categorized by the type of climate-resilience financial problem they address.

Table 1. Innovations in Climate Finance

Generating Public Revenue for Climate Investment
Improving comprehensive cost-benefit analysis (CBA) to make the case for public return on resilience-project and plan investments, including valuation of ecosystem services.
Requiring that city infrastructure projects and capital budgets incorporate climate risk and vulnerability analysis and adaptation plans to ensure that future spending contributes to resilience.
Expanding targeted federal disaster recovery funds (already in state government hands) for pre-disaster planning in eligible communities.
Issuing "resilience bonds" that generate risk-reduction rebates from a city's catastrophe insurance premiums to pay for resilience projects.
Creating local stormwater markets and credit trading that incentivize private property owners to invest in reducing stormwater runoff.

Managing Financial Risk Posed by Climate Changes
Developing metrics and disclosures that enable financial markets to incorporate risk more accurately into asset values and interest rates.
Packaging bonds for city resilience and adaptation projects with climate-risk insurance to serve as a credit-enhancement.
Using "pay for performance" design in "Environmental Impact Bonds," which make the amount of payments to lenders contingent on performance of the adaptation measures, such as green infrastructure.
Preparing and regularly updating accurate flood-risk maps for cities and making them available to the public.
Balancing Burdens and Benefits of Investing in Climate Resilience and Adaptation
Designing city climate investment plans to combine citywide revenues, district-scale revenues, and incentives for private investment in ways that are fair and equitable.
Using community-based organizations and financial institutions to develop and finance projects that advance economic and social equity in the city.
Aligning Public Policies to Support Investment in Climate Resilience and Adaptation
Replacing National Flood Insurance Program with lower-cost state programs.
Increasing participation in FEMA Community Rating System (CRS) in which municipalities earn credits (discounted NFIP premiums up to 45 percent) for different flood-reduction activities.
Using risk-adjusted insurance premiums and longer-term property insurance policies.
Requiring climate-risk disclosure for private real estate and public assets.
Leveraging/Catalyzing Private Capital for Climate Resilience and Adaptation
Issuing municipal "Green Bonds" to attract capital to bundles of resilience projects.
Establishing public-private partnerships to bring private expertise and capital to the design, financing, construction, operation and/or maintenance of a publicly-owned asset, with contracted payments based on project revenues.
Using green bank loan programs to property owners to increase engineering resilience functionality.
Using density bonuses and other development incentives to induce climate investment.
Revising Government Jurisdictions to Address the Geography of Climate Solutions
Jointly planning and financing infrastructure investments across municipal and utility jurisdictions, including the creation of single entities, such as flood and resilience districts, to conduct this integrated work.
Creating special-purpose resilience and/or flood districts.
Developing coastal master plans that cover multiple communities.

We believe that to scale the needed financial investment, cities need to move beyond reliance on "one-off" projects and adopt a systemic approach to climate-resilience finance. Cities need money for implementing their climate-resilience plans and, even more broadly, they and their capital-providing sources need to factor climate resilience into all future investments in the city's infrastructure and services. We envision this would take the form of a set of standardized practices and guidelines shaping the financial system capitalizing urban investment, with known rules for making financial transactions involving climate projects. This system would have three main elements:

- ***City transaction capabilities***, including climate resilience and adaptation planning, investment planning, governance arrangements at metro-regional and city district scales, and public revenue sources and funding mechanisms;
- ***State, federal, and regional government policies***, including climate resilience and adaptation planning requirements and support, climate standards, flexible governance structure frameworks, insurance market regulations and public "last resort" insurance, grant and loan funds for city climate-resilience projects; and
- ***Financial, insurance, and real estate markets***, including climate products and services, risk assessment, disclosure, and pricing, lending and investment standards.

The city climate financial system we envision would not be a single, centralized system or a one-stop shopping model for cities. Instead, it would be a system of systems—a distributed set of technical capacities, public policies, and standardized mechanisms for public funding and private financing that provide cities with pathways to capital for not only resilience and adaptation but also investments made in the name of climate mitigation. It would build on existing distributed urban financing systems, modified to address climate resilience and adaptation.

Accelerating Emergence of a New System

The abundance of innovative efforts presented in Table 1 amount to an early stage of experimentation that could transition into a more standardized and impactful system. This can be done by engaging cities, the private sector, and other levels of government in coordinated and strategic work focused on building the system's main elements. Collaborators would seek to: (i) enhance city capacities to conduct resilience and adaptation financing transactions; (ii) align state and federal government policies for climate resilience and adaptation; and (iii) scale-up promising innovations in the financial, insurance, and real estate sectors. A great deal of the burden for initiating a comprehensive effort of this sort would fall on cities acting collectively to build a system, not individually to solve immediate problems.

The many years of working with cities on climate and sustainability innovations convince the authors of this article that cities can be engaged to link, learn, and align with each other. They can act in concert with relevant private sector actors and other levels of government

to develop and implement projects that build a climate-sensitive financial system. But they don't yet have a collective path forward or the substantial and sustained support they will need to imagine and implement a new systemic solution to climate challenges. Philanthropic funding and convening power could play a crucial role in advancing the development of the needed system for climate finance and investment. Foundations have already backed many of the innovations underway, and they have contributed to the development of urban climate-resilience planning processes and capacities. Their relationships with cities and innovators in other relevant sectors, as well as their ability to provide financial support, position foundations and other community development organizations, such as Community Development Financial Institutions (CDFIs), to catalyze productive new collaborations to solve the pressing problem of the mobilization of systems supporting climate finance and investment.

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Climigration and the Private Sector

A.R. Siders and Carri Hulet

As the effects of climate change grow more severe, millions of people in the United States and around the world will relocate away from hazards. This climate-induced relocation, or "climigration," will have significant consequences for the private sector. Businesses that operate or serve populations in risky areas; developers and real estate agents who build or sell vulnerable real estate; banks, insurers, and financiers whose portfolios include at-risk properties should all consider what innovative and profitable paths they might create to facilitate this transformation. Rather than wait for government and civil society to develop proactive options, companies could devise ways to incentivize property owners and communities to move to safety before their homes and infrastructure are damaged or destroyed. Companies who engage early could enjoy a first-mover advantage and position themselves to mitigate the reputational, financial, and regulatory risks created by climate uncertainties. There are numerous benefits for private sector engagement in climate adaptation, which others have described.[1] Our purpose here is to highlight climate-induced relocation as a type of adaptation that involves unique risks and opportunities for those in the business of community investment and development.

Climigration

Climigration is occurring and will occur in many places in response to a range of climate hazards. As an example, consider U.S. coasts. Waterfront property is, today, some of the most valuable. Over 126 million people–40 percent of the U.S. population–live in coastal counties, and those counties produce more than $8.3 trillion in goods and services.[2] Faced with such prosperity, it is difficult to imagine a past when coastal areas were considered high-risk and undesirable for development. It is even harder to imagine a future where coasts are abandoned, becoming too risky for concentrations of commercial or residential use.

Yet, global sea levels are expected to rise three-to-six feet in the coming decades, placing millions of people and trillions of dollars' worth of infrastructure at risk.[3] Recent research

1 Agrawala, S. et al. "Private sector engagement in adaptation to climate change: Approaches to managing climate risks," *OECD Environment Working Papers*, No. 39, Organisation for Economic Co-operation and Development (2011). doi: 10.1787/5kg221jkf1g7-en; Biagini, B. and Miller, A. "Engaging the private sector in adaptation to climate change in developing countries: Importance, status, and challenges," *Climate and Development*, 5(3) (2013), pp. 242-252; and Terpstra, P. and McGray, H. "Adaptive to climate change: The private sector's role," World Resources Institute (November 14, 2013), available at https://www.wri.org/blog/2013/11/adapting-climate-change-private-sector-s-role.

2 National Oceanographic and Atmospheric Administration. "Coastal economics and demographics" (2014), available at https://www.coast.noaa.gov/states/fast-facts/economics-and-demographics.html.

3 Hauer, M.E., Evans, J.M., and Mishra, D.R. "Millions projected to be at risk from sea-level rise in the continental United States," *Nature Climate Change*, 6 (2016), pp. 691-695. doi: 10.1038/nclimate2961

suggests oceans are warming faster than previously projected,[4] which means sea levels may rise more quickly and hurricanes and other coastal storms may be even more frequent and intense, as they gather energy from warmer waters.[5] Some 4 to 13 million Americans are expected to be completely inundated by 2100.[6] The Intergovernmental Panel on Climate Change (IPCC), U.S. National Climate Assessment, Union of Concerned Scientists, and other experts all confirm that global climate change will pose significant threats to coastal infrastructure and communities. Already, weather-related disasters caused $307 billion in damage in the U.S. in 2017.[7] 2018 was the fourth-most expensive year since 1980 for catastrophe insurance.[8] Sea level rise threatens drinking water supplies and sewage infrastructure in Miami and South Florida.[9] Faced with these challenges, people move, seeking safety and new opportunities.[10] Some communities will be defended by sea walls, shoreline armoring, and beach nourishment,[11] but these solutions will only be possible in some areas and may be limited in duration. According to the 4th U.S. National Climate Assessment, in all but the most conservative estimates of sea level rise, relocation "will become an unavoidable option."[12]

4 Cheng, L. et al. "How fast are the oceans warming?" *Science*, 363(6423) (2019), pp. 128-129. doi: 10.1126/science.aav7619

5 Trenberth, K.E. "Warmer oceans, stronger hurricanes," *Scientific American*, 297 (2007), pp. 44-51. doi: 10.2307/26069374

6 Hauer, M.E. et al. "Millions projected to be at risk" (2016).

7 Mooney, C. and Dennis, B. "Extreme hurricanes and wildfires made 2017 the most costly U.S. disaster year on record," *The Washington Post* (January 8, 2018), available at https://www.washingtonpost.com/news/energy-environment/wp/2018/01/08/hurricanes-wildfires-made-2017-the-most-costly-u-s-disaster-year-on-record/?utm_term=.fcc152efc8da.

8 Ralph, O. "Swiss Re forecasts $79bn in catastrophe losses for insurers in 2018," *Financial Times* (December 18, 2018), available at https://www.ft.com/content/e6c4d79c-02d4-11e9-9d01-cd4d49afbbe3.

9 Flavelle, C. "Miami will be underwater soon. Its drinking water could go first," *Bloomberg Businessweek* (August 29, 2018), available at https://www.bloomberg.com/news/features/2018-08-29/miami-s-other-water-problem; and Harris, A. "A $3 billion problem: Miami-Dade's septic tanks are already failing due to sea rise," *Miami Herald* (January 10, 2019), available at https://www.miamiherald.com/news/local/environment/article224132115.html.

10 King, D. et al. "Voluntary relocation as an adaptation strategy to extreme weather events," *International Journal of Disaster Risk Reduction*, 8 (2014), pp. 83-90. doi: 10.1016/j.ijdrr.2014.02.006; Neumann, B. et al. "Future coastal population growth and exposure to sea-level rise and coastal flooding - A global assessment," *PLoS ONE* (2015). doi: 10.1371/journal.pone.0118571; and Hamilton, L.C. et al. "Climigration? Population and climate change in Arctic Alaska," *Population and Environment*, 38(2) (2016), pp. 115-133. doi: 10.1007/s11111-016-0259-6

11 Gittman, R.K. et al. "Engineering away our natural defenses: An analysis of shoreline hardening in the US," *Frontiers in Ecology and the Environment*, 13(6) (2015), pp. 301-307. doi: 10.1890/150065

12 Jay, A. et al. "Overview," *Impacts, Risks, and Adaptation in the United States: The Fourth National Climate Assessment*, (Reidmiller, D. et al. [eds.]), U.S. Global Change Research Program, Vol. II (2018), p. 64. doi: 10.7930/NCA4.2018.CH7

Some individuals will move across national boundaries. Others across town. All will face obstacles, challenges, and costs.[13]

In fact, retreat is already occurring. It happens in a haphazard fashion as individual homeowners, fed up with repeated floods and the threat of disaster, sell or abandon their homes and relocate to safer sites. In a few places, climigration occurs through managed retreat: a purposeful, often government-sponsored program to move people and infrastructure away from vulnerable areas.[14] Climigration, whether managed or unmanaged, tends to favor people with greater financial means because moving is costly and often involves changes to employment, schools, medical services, child and elder care options. The fact that approximately 40 percent of Americans living in coastal counties are socioeconomically vulnerable in some fashion (e.g., living in poverty, households where English is not the primary language, elderly)[15] means relocation for nearly half of coastal residents is particularly challenging.[16]

Relocation rates have been slow to date partly because the true risk of living in a coastal area is hidden from property owners and local governments. National Flood Insurance Program (NFIP) premiums do not accurately reflect risk.[17] After disasters, federal funds pay significant portions of the recovery costs. Because of this, the perverse reality is that the economically rational choice for most coastal property owners is to stay in place and wait for a crisis to force (and fund) them to relocate. This will not be the case for long. Relocation is expected to become more frequent and to occur at larger scales in the future as the effects of climate change become more apparent and regulatory changes reduce subsidies for at-risk living.

The Private Sector's Role

Currently, the responsibility of relocation rests largely on the shoulders of individuals and government. There are advantages to this, and no private sector solution is likely to unseat the government as the anchor institution for these efforts. However, government action is

13 Hori, M. and Schafer, M.J. "Social costs of displacement in Louisiana after Hurricanes Katrina and Rita," *Population and Environment*, 31(1–3) (2010), pp. 64-86. doi: 10.1007/s11111-009-0094-0; Binder, S.B., Baker, C.K., and Barile, J.P. "Rebuild or relocate? Resilience and post-disaster decision-making after Hurricane Sandy," *American Journal of Community Psychology,* 56(1-2) (2015), pp. 180-196. doi: 10.1007/s10464-015-9727-x; and Eray, S., Uçar, H.N., and Murat, D. "The effects of relocation and social support on long-term outcomes of adolescents following a major earthquake: A controlled study from Turkey," *International Journal of Disaster Risk Reduction*, 24(3) (2017), pp. 46–51. doi: 10.1016/j.ijdrr.2017.05.026

14 Siders, A.R. Managed coastal retreat: *A legal handbook on shifting development away from vulnerable areas*, Columbia Law School, Center for Climate Change Law (2013); Hino, M., Field, C.B., and Mach, K.J. "Managed retreat as a response to natural hazard risk," *Nature Climate Change*, 7 (2017), pp. 364-370.

15 National Oceanographic and Atmospheric Administration. "Coastal economics and demographics" (2014).

16 de Vries, D.H. and Fraser, J.C. "Citizenship rights and voluntary decision making in post-disaster U.S. floodplain buyout mitigation programs," *International Journal of Mass Emergencies and Disasters*, 30(1) (2012), pp. 1-33, available at http://www.ijmed.org/articles/589/download/; Siders, A.R. "Social justice implications of US managed retreat buyout programs," *Climatic Change* (2018), pp. 1-19. doi: 10.1007/s10584-018-2272-5

17 Craig, R.K. "Coastal adaptation, government-subsidized insurance, and perverse incentives to stay," *Climatic Change* (2018), pp. 1-12. doi: 10.1007/s10584-018-2203-5

often slow and, at times, stymied by private sector resistance. The private sector could have a role in facilitating sensible, equitable, and profitable climigration. Private sector engagement need not be viewed as charity; rather, actions to facilitate climigration should be seen as long-term, strategic moves that lead to market fit and capture. Climate change broadly poses risks to companies, according to the Financial Stability Board (FSB), through regulatory change, physical interference, market responses, litigation, reputation, and technological change.[18] When seen through the lens of relocation, some of these potential risks become even more acute. They may also be understood as opportunities.

So, what can the private development community do to be proactive in this area? This article provides a few suggestions to prompt further consideration–and perhaps creative thinking.

First, the private sector should anticipate regulatory reform; develop strategies to benefit from reform; and then support, rather than impede, those reforms. For example, politicians and economists have long argued that the NFIP needs massive reform to raise premiums, enforce mandatory insurance purchase, and expand enrollment. Three congressional bills to reform the process have been proposed over the last fifteen years, but numerous companies and trade associations have lobbied to prevent or repeal legislative change.[19]

Many companies oppose insurance reform because it poses short-term risks to profits through reduction of coastal property values and slowing of coastal development. Yet, opposing reform and continued investment in coastal areas creates long-term risks for the private sector. At some point, reforms are likely to occur, as the costs of continually bailing out a bankrupt NFIP become untenable to the federal government. Companies that prepare for these changes, and then support and adapt to reforms early on, could face lower reputational and regulatory risks than those who hold out in hopes that reform will never come. Early adopters may also achieve a competitive advantage.

A second suggestion is for companies to locate their interests in safe areas and partner with "receiving" communities to provide necessary public support for the people who will follow. This action both reduces physical risk exposure to company assets and operations and facilitates rational, non-crisis relocations by creating an economic draw to safer places. Physical risks are salient for businesses with operations, headquarters, customer base, workforces, supply chains, necessary public services (e.g., water, electricity, roads), or insured or financed portfolio holdings. Banks that have written mortgages for coastal properties face losses if those properties are damaged and the owners are unable to make payments. Such risks are not insurmountable, though. During Hurricane Sandy, the New York Stock Exchange closed,

18 Petkov, M., Plesser, S., and Wilkins, M. "Climate change-related legal and regulatory threats should spur financial service providers to action," S&P Global Rankings (May 4, 2016), available at https://www.scribd.com/doc/311698033/Climate-Change-Related-Legal-and-Regulatory-Threats-Should-Spur-Financial-Service-Providers-to-Action-04-05-2016.

19 Hunn, D., Handy, R.M., and Osborne, J. "Build, flood, rebuild: Flood insurance's expensive cycle," *Houston Chronicle* (December 9, 2018), available at https://www.houstonchronicle.com/news/houston-texas/houston/article/Build-flood-rebuild-flood-insurance-s-12413056.php.

but many traders had already established contingency plans following the terrorist attacks on September 11, 2001, including secondary headquarters in New Jersey and online trading platforms.[20] Companies could make long-term plans modeled after these examples to move their headquarters and operations to areas outside of floodplains. If numerous companies coordinate their moves to a common secondary location, they could preserve the benefits of an agglomerate economy. Beyond headquarters and branch offices, companies would do well to consider where their workforce will live and how they will get to work. If workers increasingly want to live in safe areas, companies with headquarters in those same areas will have a larger candidate pool. Inland roads, free from high-tide flooding, provide more reliable commutes. As consumers relocate inland, businesses may be inclined to relocate with their consumer base and logistical networks, if proximity is important to their business.

In addition to locating their headquarters in safer areas, businesses could offer remote positions to help workers who want to relocate but not change jobs. Companies could pay relocation expenses, not as taxable income but as a business expense, to encourage already remote workers to live in safer areas. Such a move would improve continuity of service as well, if employees are not disrupted by floods or other climate-induced weather events.

Tied to this consideration is the opportunity for the private sector to invest in safer geographic locations. Some real estate speculators are already purchasing land in cities where they believe coastal residents will move. Development in these towns would not only be safe, both physically and as an investment, but may help draw residents away from the coasts, speeding up climigration and directing it toward cities that will have the physical and social infrastructure necessary to accommodate growing populations. However, disinvestment in risky neighborhoods, and targeted investment in safe neighborhoods, if done solely in pursuit of profit, can lead to gentrification and a concentration of at-risk populations in vulnerable locations.[21] History is laced with examples of minority and poor populations being moved to make way for new developments or left behind as economic opportunities arose in other locations. There is an opportunity for the private sector to turn this trend around and use adaptation investment to right historic wrongs.[22] Private sector leaders who are cognizant of inequity and recognize the opportunity to facilitate development that serves the needs of the whole community may provide the most innovative solutions. They may also be first in line for mutually-beneficial private-public partnerships.

20 Brown, A. "What can close the NYSE? World war, presidential funerals and Hurricane Sandy," *Forbes* (October 29, 2012), available at https://www.forbes.com/sites/abrambrown/2012/10/29/what-can-close-the-nyse-world-war-presidential-funerals-and-hurricane-sandy/#5bc32acf11e6.

21 See, e.g., Keenan, J.M., Hill, T., and Gumber, A. "Climate gentrification: From theory to empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 5(13) (2018), 054001. doi: 10.1088/1748-9326/aabb32

22 See, e.g., Gibson, J.R. "Why climate change and equity matter for infrastructure: An interview with Chione Flegal of PolicyLink," *Union of Concerned Scientists Blog* (February 13, 2018), available at https://blog.ucsusa.org/jamesine-rogers-gibson/why-climate-change-and-equity-matter-for-infrastructure-an-interview-with-chione-flegal-of-policylink.

A third suggestion is for companies to disclose their risks and actions to their investors. Climate-related disclosures are already recommended,[23] and disclosures that specifically address climigration, both as risk and opportunity, could also be seen in a positive light by environmental-social-governance (ESG) investors who support companies that address both environmental and social issues. Companies that pay attention to social vulnerability and welfare in their plans to facilitate climigration may be able to secure additional support from government and civil society partners.

Fourth, the financial sector has a unique role in, and motive for, innovating climigration solutions. Already many insurance agencies and investors are taking action. Moody's Investor Service, Inc. considers the degree to which cities are preparing for climate risks when setting credit ratings for state and local bonds.[24] Cities at risk from extreme events are more likely to default, and cities whose property values are decreasing due to inundation, and therefore losing property tax revenue, may also be less likely to pay. By taking these factors into consideration, investors not only motivate local governments to take action on climate risks but also protect their own investments. Conversely, financial organizations may want to find ways to reward destination cities that are actively preparing to receive people and businesses that are relocating. Providing more favorable credit ratings for these cities could help them build the infrastructure they will need to accommodate larger populations and to subsidize the relocations of less privileged populations.

Mortgage companies may similarly want to offer different rates in vulnerable areas. A home in a 100-year floodplain has, in theory, a one-in-four chance of flooding during the course of a 30-year mortgage. However, this risk is very likely to be much higher given the inadequacy of flood insurance rate maps in the face of climate change and the politicization of the mapping process itself. If this occurs, the home may be substantially damaged and homeowners unable to pay their mortgage. It has been observed that foreclosure rates spike after disasters, or after post-disaster forbearance periods expire, if residents are unable to make payments.[25] Forbearance periods and insurance can temporarily mitigate this risk, but an estimated 40 percent of homes with federally-backed mortgages that are required to carry flood insurance remain uninsured in many parts of the country.[26]

23 Government Accountability Office. "Climate-related risks: SEC has taken steps to clarify disclosure requirements," *Government Accountability Office Fast Facts* (February 20, 2018), available at https://www.gao.gov/products/GAO-18-188; Task Force for Climate-Related Financial Disclosures. "Publications" (2018), available at https://www.fsb-tcfd.org/publications/.

24 Flavelle, C. "Moody's warns cities to address climate risks or face downgrades," *Bloomberg* (November 29, 2017), available at https://www.bloomberg.com/news/articles/2017-11-29/moody-s-warns-cities-to-address-climate-risks-or-face-downgrades.

25 DePillis, L. "How these hurricane-ravaged states have avoided a housing disaster–so far," *CNN Business* (April 22, 2018), available at https://money.cnn.com/2018/04/22/news/economy/hurricane-foreclosures-houston/index.html; Scotsman. "Foreclosures may tick up in hurricane-affected areas," *Scotsman Guide* (August 17, 2018), available at https://www.scotsmanguide.com/News/2018/08/Foreclosures-may-tick-up-in-hurricane-affected-areas.

26 Vecsey, L. "Coastal area residents stunned by flood insurance rate hikes," *Forbes* (October 22, 2013), available at https://www.forbes.com/sites/zillow/2013/10/22/coastal-area-residents-stunned-by-flood-insurance-rate-hikes/#1325ace34895.

Lenders could play a greater role in enforcing regulations and requiring homeowners to carry flood insurance. Lenders may also want to consider offering shorter terms or higher interest rates in areas where long-term repayment is risky. Such actions may affect coastal real estate markets by signaling the true extent of the risk to homebuyers, and this, in turn, could facilitate relocation away from at-risk areas. Such actions also run the risk of creating inequity so lenders should proceed with caution. Making coastal property more expensive, or accessible only to people who are able to pay higher down payments or shortened mortgage timelines, without providing some outlet for lower-income residents, could leave people trapped in risky areas or create coasts owned only by the wealthy. If lenders do pursue altered terms in at-risk areas, these policies may need to be paired with relocation support, provided either by private sector or government, to offer trapped populations a way out. Potentially, banks could explore options to transfer mortgages on coastal properties to post-foreclosure (REO) properties in safer areas as a way of facilitating relocation. Banks could then work with government agencies to purchase the flood-prone properties. This would require modification of existing federal buyout programs, and it is just one example of the type of creative thinking we hope financial institutions will apply.

As a final thought, companies should consider their moral obligations. Is it ethical for developers to build homes in areas they know face a one-in-four chance of damage or destruction over the coming decades? Is it ethical for realtors to conceal a history of flood damage from potential buyers? What disclosure should be required by due diligence? At some point companies may face legal liability for knowingly placing people in harm's way or for failing to learn about and mitigate risks.[27] Companies who exploit consumers' lack of risk awareness may face litigation and potential liability in the future. Current liability is likely limited, and the potential for and extent of future liability has yet to be determined, but lawsuits on this basis have been filed and are being heard. For example, one recent lawsuit in Texas has been filed on the basis that a flood-prone neighborhood should not have been built in an at-risk location.[28] Rather than continue to build in risky areas, developers, realtors, construction companies, financers, insurers, and investors could all seize the opportunity posed by climigration to develop new communities in safer areas.

The private sector has already shown remarkable vision in helping migrants in Europe through app development, skill matching, job search assistance, and other services.[29] This same spirit of innovation and community aid could help people as they relocate away from

27 Kusler, J. "Professional liability for construction in flood hazard areas," Association of State Floodplain Managers (2017), available at https://www.floods.org/PDF/ASFPM_Professional_Liability_Construction.pdf.

28 Shay, M. "'Neighborhood should have never been built': Homeowners file lawsuit against developer after flooding issues," *Eyewitness News* (September 27, 2017), available at https://abc13.com/homeowners-file-lawsuit-against-developer-after-flooding-issues/2461702/.

29 Sutherland, P. "Why the migration crisis needs a private-sector response," World Economic Forum (September 14, 2016), available at https://www.weforum.org/agenda/2016/09/why-the-migration-crisis-needs-a-private-sector-response.

areas at risk from climate change. For example, the private sector could develop technological solutions to help keep health services, elder and child care, or other social services in place throughout the relocation transition.

Conclusions

The ideas in this article represent a modest step forward. The goal of this article is to encourage private actors to think creatively about the actions they can take to benefit themselves and the communities both sending and receiving residents due to climigration. The same innovation that drives commercial success can, we believe, be applied to climate adaptation in general and climigration in particular. Companies play major roles in community development and can help drive solutions as society reimagines what it means to live in resilient, climate-safe communities and economies.

As we have noted repeatedly, climigration is rife with equity challenges. Communities are in need of the solutions that informed, progressive private sector actors might invent. We challenge those who recognize the tremendous business opportunities in climigration to deal seriously with these equity issues so private sector leadership leads to a more just society in the long run.

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Building Community Wealth through Community Resilience

Johanna Bozuwa and Thomas Hanna

Climate resilience and adaptation planning efforts often operate within a traditional political economic paradigm focused on risk, including climate risk. Often, these planning exercises do not adequately deal with underlying structural concerns, such as political enfranchisement, economic inequality, racism, and unrestrained growth. These and other problems have not only contributed to anthropogenic climate change, but they have exacerbated its impacts on those most marginalized, including minority and low-income residents. As La'Meshia Whittington Kaminski from the Just Florence Recovery group stated after Hurricane Florence hit the Carolinas, disproportionately affecting black residents, "[w]e are here to say that Hurricane Florence, and Matthew before it, are not just natural disasters. They are the logical outcome of society that believes certain people and lands are expendable."[1]

Evidence from climate-induced disasters, like the slew of hurricanes that have hit the coasts in recent years, demonstrates how black and Latinx communities are often the most immediately impacted because of historical redlining, affordable housing siting, general disinvestment, and the least access to recovery.[2] More chronic issues like increased small-grade stormwater flooding and the urban heat island effect prevalent in these neighborhoods also put its residents at public health risks over the long term–further increasing vulnerability during acute disaster events.[3] If climate planning efforts do not take concerns around equity, justice, and power into consideration during implementation, they have the potential to further segregate U.S. cities; contribute to widening economic, social, and health inequality; and even, in the extreme, create wealthy, ecological enclaves disconnected from the rest of society.[4] By contrast, community resilience planning can, and should, play a prominent role not only in limiting the harm to vulnerable residents but also in building vibrant, equitable, just, and healthy communities based on shared prosperity.

1 Kaminski, L.W. "Just Florence Recovery Press Conference Statement" (October 1, 2018), available at https://justflorencerecovery.org/october10statement/.

2 Bullard, R. and Wright, B. *The Wrong Complexion for Protection: How the Government Response to Disaster Endangers African American Communities*, New York University Press; Deaton, J. (2012). "Hurricane Harvey Hit Low Income Communities Hardest," *Thinkprogress* (September 1, 2017), available at https://thinkprogress.org/hurricane-harvey-hit-low-income-communities-hardest-6d13506b7e60/.

3 Jessdale, B., Morello-Frosch, R., and Cushing, L. "The Racial/Ethnic Distribution of Heat Risk-Related Land Cover in Relation to Residential Segregation," *Environmental Health Perspectives*, 121(7) (2013), pp. 811-817. doi: 10.1298/ehp.1205919

4 Anguelovski, I. et al. "Equity Impacts of Urban Land Use Planning for Climate Adaptation: Critical Perspectives from the Global North and South," *Journal of Planning Education and Research*, 36(3) (2016), pp. 333–348. doi: 10.1177/0739456X16645166

One such way is through community wealth building (CWB)–a new form of equitable community development that seeks to build, from the ground up and according to the principle of subsidiarity, a place-based economic system where democratic ownership and control creates more equitable outcomes, fosters ecological sustainability, and promotes flourishing community life. The CWB field has steadily grown over the past 30 years and includes a broad range of institutions and approaches that aim to improve communities by increasing ownership, anchoring jobs locally, and enabling active democratic participation.[5] CWB suggests that many of the investments made in community development (including public funds in the form of grants and loans and spending on education and other services, as well as private investments required by federal, state, and local policies) would be more effective and empowering if applied to wealth building rather than wealth extraction approaches, such as subsidies and tax breaks to lure large corporations from one jurisdiction to another.[6]

This article explores some real-world examples of institutions implementing CWB-based community resilience strategies, including: (i) alternative business structures (e.g., social enterprises and worker-owned businesses); (ii) mechanisms for community control of land and housing (e.g., resident-owned communities); (iii) municipal enterprise (e.g., public water utilities); and (iv) anchor institutions (e.g., large, nonprofit place-based institutions like universities and hospitals).

Alternative Business Structures

Building out adaptation and resiliency projects creates new opportunities for organizations that subscribe to theories of business that go beyond purely making a profit. In particular, social enterprises (i.e., mission-driven nonprofits with a fee-for-service component) and worker-owned companies could prove to be transformative institutions in building more resilient infrastructure across the U.S. Major determinants of a person's ability to weather the impacts of climate change include political influence and economic stability.[7] This requires jobs that provide families with not only good wages and benefits, but also wealth building opportunities and advanced training–principally for those historically left out from the job market. Unlike traditional businesses, which often seek to boost profits by cutting labor costs, social enterprises and worker cooperatives do not operate on a binary of the bottom-line.

5 Dubb, S. "Community Wealth Building Forms: What They Are and How to Use Them at the Local Level," *Academy of Management Perspectives*, 30(2) (2016), available at https://lamontanita.coop/wp-content/uploads/2015/04/2016_12_20-Community-Wealth-Building-Forms-What-They-Are-and-How-To-Use-Them-at-the-Local-Level.pdf.

6 Kelly, M. and McKinley, S. "Cities Building Community Wealth," The Democracy Collaborative, available at https://community-wealth.org/sites/clone.community-wealth.org/files/downloads/CitiesBuildingCommunityWealth-Web.pdf.

7 Bullard, R. "Dismantling Environmental Racism in the USA," *Local Environment* 4(1) (1999), pp. 5-19; Blaikie, P., Cannon, T., Davis, I., and Wisner, B. *At Risk: Natural Hazards, People's Vulnerability and Disasters,* Routledge (2004); and Enarson, D. *The Women of Katrina: How Gender, Race and Class Matter in an American Disaster*, Vanderbilt University Press (2012).

The social enterprise Verde Landscape, the worker-owned Thunder Valley Thikága Construction, and the Evergreen Cooperatives are all examples of how to build systemic resilience to climate change by redefining how business models operate.

Verde Landscape is a social enterprise based in the Cully neighborhood of Portland, Oregon–a largely Latinx and low-income area. The social enterprise's core mission is to ensure low-income people directly benefit from environmental investments. One of their major tactics is integrating green infrastructure (e.g., stormwater mitigation that harnesses natural assets, like trees and shrubs, to stem the flow of water) into the local built environment. This socio-ecological resiliency tactic not only limits stormwater runoff, but has a host of co-benefits, such as cleaner air, communal spaces to foster community, and job opportunities with low thresholds to entry.[8]

In order to implement the green infrastructure assets, like rain gardens, Verde Landscape explicitly recruits workers from the Cully neighborhood with barriers to workforce entry and trains them through a long-term investment program. It cultivates relationships with other local institutions to provide the Cully neighborhood with green development, such as 130 units of affordable housing with green infrastructure.[9] Tony DeFalco, Verde's executive director, explains that "we have been intentional that environmental issues need to be paired with social services, such as affordable housing, which was the genesis of Living Cully, and to build wealth among low-income and community members of color."[10]

Thikága Construction is a Lakota employee-owned construction company launched in April 2018 to address the shortage of affordable housing and employment opportunities in the Porcupine District on the Pine Ridge Indian Reservation. Nearly 40 percent of residents on the reservation are below the poverty line and 80 percent are unemployed.[11] There is also a vital need for better, healthier affordable housing–over 70 percent of the population lives either in U.S. Department of Housing and Urban Development (HUD) housing or trailer homes. The worker-owned construction company hopes to fill the critical housing needs in Thunder Valley by designing sustainable housing–including hyper-efficient buildings that cut utility costs drastically–installing solar panels, and integrating water management tactics as part of a larger development strategy for a regenerative community that "recognizes the bond between tradition and innovation by building upon our Lakota values with eco-friendly designs that will ensure the wellbeing of our people, planet, and prosperity."[12]

8 Lamback, S. "Exploring the Green Infrastructure Workforce," Jobs for the Future (2017), available at https://www.jff.org/resources/exploring-green-infrastructure-workforce/.

9 Verde. "Living Cully buys the Sugar Shack..!!" (July 1, 2015), available at http://www.verdenw.org/verde-news/2016/9/7.

10 Author interview with Tony DeFalco (April 1, 2018).

11 Thunder Valley CDC. "Building a Regenerative Community" (May 14, 2013), available at http://lab.community-wealth.org/uploads/2/2/4/8/22483474/tvcdcmaster-plan.pdf.

12 Ibid.

The project evolved out of a Thunder Valley Community Development Corporation (CDC) program that provides job training for Lakotan youth in a holistic manner.[13] More than a construction company, the worker-owned firm constructs pathways out of intergenerational poverty through jobs for reservation residents as well as through partnership with the local CDC to make homeownership a reality. Providing sustainable, efficient, affordable housing while providing jobs and workforce development has clear resiliency outcomes. For instance, Lakotan residents will arguably be less likely to suffer from energy poverty (i.e., payments of more than ten percent of income on energy bills) because of their homes' efficiency, which will be particularly important as more extreme highs and lows in temperature occur with climate change.

The Evergreen Cooperatives are a network of worker cooperatives linked together by a community-controlled corporation based in low-income, high-poverty neighborhoods in Cleveland, OH. Currently, the network includes three companies with a total of more than 200 workers.[14] All the cooperatives are green by design–including a laundry facility that uses less water and energy than competitors, a solar panel installation and lighting retrofit company, and an urban greenhouse–and linked to the procurement needs of nearby anchor institutions, mainly large nonprofit hospitals and universities.[15] In addition to paying good wages and benefits, workers build wealth through their capital accounts (when the cooperatives are profitable) and through Evergreen's homeownership program which has the potential to increase economic resiliency, in turn helping workers better "weather the storm" of climate-related events.[16]

Community-Controlled Land and Housing

Economic development and land use planning at various levels have often historically benefitted wealthier, whiter communities to the detriment of communities of color and low-income neighborhoods.[17] In the face of climate change, climate planning often appears in some instances to be taking a similar path, with higher-income, mostly white neighborhoods prioritized for investment.[18] High-income residents have also been shown to displace low-income communities that live in areas that appreciate in value due to their potential for

13 Thunder Valley CDC. "Workforce Development through Sustainable Construction" (2017), available at http://thundervalley.org/assets/uploads/documents/Initiative%20Reports/2017/2017%20WFD%20FINAL.pdf.

14 Grzegorek, V. "Employee owned Evergreen Cooperative Laundry takes over Cleveland Clinic Laundry Operation, Adding 100 Workers to Coop," *Cleveland Scene* (May 10, 2018), available at https://www.clevescene.com/scene-and-heard/archives/2018/05/10/employee-owned-evergreen-cooperative-laundry-takes-over-cleveland-clinic-laundry-operation-adding-100-workers-to-coop.

15 REDF. "Impact to Last: Lessons from the Front Lines of Social Enterprise" (2015), available at http://redf.org/app/uploads/2015/12/Evergreen-Case-Study-FINAL.pdf.

16 Funes, Y. "Own a Home in Just Four Years? This Coop Program Keeps Workers in the Neighborhood," *YES! Magazine* (August 24, 2015), available at https://www.yesmagazine.org/issues/the-debt-issue/own-home-four-years-evergreen-cleveland-20150824.

17 Green, J. and Hanna, T. "Community Control of Land and Housing," The Democracy Collaborative (2018), available at https://thenextsystem.org/sites/default/files/2018-08/CommunityControlLandHousing.pdf.

18 Anguelovski, I. et al. "Equity Impacts of Urban Land Use Planning for Climate Adaptation" (2016).

higher climate resilience–coined as "climate gentrification."[19] Integrating community land acquisition and management with engineering and socio-ecological resilience tactics, like stormwater infrastructure or local gardens, could make strides in stemming climate-based displacement and allow lower-income communities to experience the economic, health, and other benefits of community resilience. Pasadena Trails in Houston, TX and Eastside Community Network in Detroit, MI provide concrete examples of the power of community land ownership for enabling community resilience.

In 2017, 12 million people in the U.S. lived in manufactured housing.[20] It is one of the most affordable housing options for many families, with the average resident's annual income at just around $28,000.[21] In the traditional model for manufactured housing communities, the residents either rent or own their manufactured house and rent the land. This puts them at the whim of the landowner, who may decide to raise land rents, sell the community, or fail to keep up the grounds. Faced with severe disinvestment, the manufactured housing community of Pasadena Trails organized itself to buy their neighborhood's land in 2008 and turned it into a resident-owned community (ROC). By buying the land, they are able to make collective decisions to make their neighborhood more livable. One of the initial problems was flooding. Poor drainage left residents' front yards wet and the bus stop swamped consistently, so they borrowed capital to invest in a better drainage and stormwater management system. When Hurricane Harvey hit in 2017, Pasadena Trails fared much better than other income-equivalent neighborhoods and became a relief hub for neighboring communities.[22]

More than a thousand miles north, in Detroit, large swaths of the city still stand empty and vacant nearly a decade after the financial crisis. Eastside Community Network (ECN), a local nonprofit that has served lower-eastsiders in Detroit, a predominantly black, low-income area for over thirty years, repurposes the vacant land to rebuild a connected and sustainable community.[23] Using a resident-centered approach, ECN acquires vacant properties through creative land assemblies, including purchasing from the Detroit Land Bank Authority, the municipal authority that owns and resells foreclosed land in the city, outright or in partnership, to create productive spaces for its residents.[24] The nonprofit has community-driven development plans for the open space, including affordable housing, green infrastructure build-outs to alleviate stormwater overflows, and community gardens.[25]

19 Keenan, J.M., Hill, T., and Gumber, A. "Climate Gentrification: From Theory to Empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5) 054001 (2018). doi: 10.1088/1748-9326/aabb32

20 U.S. Census Bureau. "Total Population in Occupied Housing Units by Tenure by Units in Structure," *2013-2017 American Community Survey 5 Year Estimates* (2018), available at https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_14_5YR_B25033andprodType=table.

21 Prosperity Now. "The Facts about Manufactured Housing" (2017), available at https://familypromise.org/wp-content/uploads/2018/03/Manufactured-Housing-Fact-Sheet_2017.pdf.

22 Green, J. and Hanna, T. "Community Control of Land and Housing" (2018).

23 Eastside Community Network. "About," available at http://ecn-detroit.org/our-vision/.

24 Eastside Community Network. "Green Growth," available at http://ecn-detroit.org/green-growth-1/.

25 Eastside Community Network. "Lower Eastside Action Plan," available at http://ecn-detroit.org/leap.

Anchors in the Local Community: Universities and Hospitals

Anchors institutions are large public or nonprofit organizations rooted in their local communities, with some of the largest and most numerous being educational and health care institutions. These entities can have substantial economic power in their localities. For instance, hospitals and health systems represent $780 billion in total expenditures annually.[26] Moreover, they are often recipients of substantial sums of public money in the form of reimbursements for health care services (e.g., Medicare and Medicaid), tuition assistance, general operating support, research grants, and more. Instead of relying on "footloose," large corporations that often move (or threaten to move)[27] facilities in order to extract tremendous public subsidies to provide vital economic development, deploying anchor institution resources locally represents an alternative.

While not immediately obvious, many of these anchor institutions' missions relate directly to community resilience. For instance, extreme weather events and other climate-change-related effects can have serious ramifications for public health. Health inequities are estimated to generate an additional cost of $300 billion[28] in medical care, lost wages, family leave, and premature death—a figure that will only rise drastically as climate change further burdens low-income people and minorities. The World Health Organization expects that, between 2030 and 2050, climate change will cause a quarter million additional deaths per year.[29] Similarly, anchor educational institutions are deeply invested in the future of young people. Just over five years after Hurricane Katrina hit, one-third of Katrina's displaced chil-dren were at least a year behind in school.[30]

Montefiore in New York is one health system that has taken steps to address climate change as a determinant of health and social welfare by investing in energy efficiency and organizing affordable housing. Activated by the grassroots Northwest Bronx Community and Clergy Coalition (NWBCCC), in partnership with a local university and New York City's government, the Bronx Healthy Buildings Program tackles costly energy bills and poor housing conditions that often take away people's income from other basic necessities.[31] The program leverages participating anchors' power to promote "education, organizing, work-force development, and building upgrades," pinpointing specific buildings that are "drivers

26 Howard, T. and Norris, T. "Can Hospitals Heal America's Communities?" The Democracy Collaborative (2015), available at https://community-wealth.org/content/can-hospitals-heal-americas-communities.

27 See, for example: Bagli, C.V. "Opponents of City Subsidies Fret Over Deal With MetLife," *The New York Times* (November 14, 2006), available at https://www.nytimes.com/2006/11/14/nyregion/14metlife.html.

28 Wells, J. "White Wash: Biomedical Research Doesn't Reflect Diversity of American Public," University of California, San Francisco (December 5, 2016), available at https://www.ucsf.edu/news/2016/12/405091/white-wash.

29 World Health Organization (WHO). "Climate Change and Health: Key Facts" (February 1, 2018), available at http://www.who.int/en/news-room/fact-sheets/detail/climate-change-and-health.

30 Reckdahl, K. "The Lost Children of Katrina," *The Atlantic* (April 2, 2015), available at https://www.theatlantic.com/education/archive/2015/04/the-lost-children-of-katrina/389345/.

31 Hiser, J. "The Bronx Health Buildings Program: Tackling Asthma, Creating High-Road Jobs," *Climate Co-Lab Radio* (August 17, 2015), available at http://colabradio.mit.edu/the-bronx-healthy-buildings-program-tackling-asthma-creating-high-road-jobs/.

for high rates of emergency room visits."[32] By supporting tenant organizing and building inspections to determine how to best implement energy efficiency improvements, the health care system helps to enable housing stability.

As centers for innovation and large users of energy, universities have blazed the way in microgrid–small freestanding grids that can operate local generation, storage, and distribution in a coordinated way–development and deployment.[33] Microgrids can also disconnect from the larger grid in "island mode," and continue to operate, even if the rest of the parent grid fails. This makes them a key innovation for resiliency in the event of disaster.[34] The University of Central Florida's Solar Energy Center has coordinated with local government, schools, emergency management personnel, and utilities to install over 115 10-kW solar microgrid systems for local schools throughout Florida at a low cost.[35] During Hurricane Irma, 41 schools were able to open and operate as emergency shelters, providing electricity, heating and cooling, and other essentials while the larger grid was disrupted.[36] Not only do the microgrids provide shelters to communities during disasters, they operate as an educational and job training tool. The program has trained teachers in photovoltaics and renewable energy, who then teach their students. Still relatively nascent, as more microgrids come online wealthier institutions and communities could peel off the public grid in piecemeal privatization. Anchors, such as universities, could use their status as major economic and social actors to convene conversations about how to deploy microgrids so they benefit the whole community–from universal access during storms to the financial benefits of being able to manage energy storage.

Local Public/Municipal Ownership

Municipal or local public ownership describes businesses, services, and assets owned by local or regional governments. With residents and customers as their ultimate shareholders, publicly-owned enterprises do not have the same emphasis on growth and profitability like their for-profit counterparts. They ultimately are accountable to the will of the community and its objectives. Local publicly-owned enterprises are similar to anchor institutions and intrinsically tied to their locality, providing jobs, services, and investments. Being connected to the larger local governmental ecosystem that is making decisions on climate plans and

32 Ibid.

33 Chenoweth, H. "The Rise of University Microgrids," Higher Ed Facilities Forum (January 3, 2018), available at https://info.higheredfacilitiesforum.com/blog/the-rise-of-university-microgrids.

34 Roberts, D. and Chang, A. "Meet the Microgrid, the Technology Poised to Transform Electricity," *Vox* (May 24, 2018), available at https://www.vox.com/energy-and-environment/2017/12/15/16714146/greener-more-reliable-more-resilient-grid-microgrids.

35 Florida Solar Energy Center. "SunSmart E-Shelters Program" (2018), available at http://www.fsec.ucf.edu/en/education/sunsmart/index.html.

36 Energy Storage Technology Advancement Partners. "Webinar: SunSmart Emergency Shelter (E-Shelter) Program" (October 24, 2017), available at https://www.cesa.org/assets/2017-Files/ESTAP-webinar-slides-10.24.17.pdf; Solar United Neighbors. "Solar + Storage in Florida" (2018), available at https://www.solarunitedneighbors.org/florida/learn-the-issues-in-florida/solar-storage-in-florida/?nabe=4541329907646464:0andutm_referrer=https%3A%2F%2Fwww.google.com%2F.

investments means they have the potential to play a critical role in community wealth building and community resilience. With the urging of their communities, some municipal enterprises are taking up the community resilience mantle.

DC Water, the public water utility in Washington, DC is one such example. In recent years, the Washington Interfaith Network (WIN) and the local construction union affiliated with the Laborers' International Union of America (LiUNA), banded together to leverage the city's mandate to invest $2.6 billion in stormwater infrastructure to better serve the city's residents.[37] It did so by advocating for DC Water to incorporate green infrastructure tactics more amenable to workforce development. After a successful campaign, DC Water took up the mantle, working with a local university to build out a groundbreaking program for green infrastructure that prioritizes training residents with barriers to employment. DC Water also coordinated the end of the training program with the beginning of their contracting process. The new program has enabled contractors to better achieve the local hiring quotas already in place because there is more local technical capacity.

Across the country, in San Francisco, the local public water utility collaborated with People Organizing to Demand Environmental and Economic Rights (PODER)—a youth-led, Latinx environmental justice base-building organization working with the low-income, immigrant residents of San Francisco's Mission and Excelsior neighborhoods to increase the robustness of community resilience and adaptive capacity—to implement a six-acre, food-producing farm that now operates as a major community convening space.[38] The effort is part of the San Francisco Public Utilities Commission's (SFPUC) Environmental Justice program, the first of its kind in the U.S. The farm distributes around 1,000 pounds of fresh fruits and vegetables each season on what used to be underutilized land, creating healthier residents and climate resilience.[39] The consolidation and brittleness of industrial agriculture puts food systems at risk, especially as California experiences more droughts and higher temperatures.[40] Localized, diversified food gardens like the one SFPUC and PODER have collaborated on can provide for community members in times of food insecurity. SFPUC's financial and in-kind support of a grassroots organization deeply entrenched in the community provides an example of supporting bottom-up climate resiliency planning.

37 Sanchez, A., Marshall, C., and Bruno, A. "Invisible to Invaluable: Organizing Counties in Howard County, MD and Washington, DC, for Clean Water and Economic Opportunity," Industrial Areas Foundation (2014).

38 Gonzalez, R. "Community-Driven Climate Resilience Planning: A Framework 2.0," National Association of Climate Resilience Planners (2017), available at https://kresge.org/sites/default/files/library/community_drive_resilience_planning_from_movement_strategy_center.pdf; People Organizing to Demand Environmental and Economic Rights (PODER). "Programs," available at https://www.podersf.org/programs/.

39 San Francisco Public Utilities Commission. "Hummingbird Farm," available at https://sfwater.org/index.aspx?page=1202.

40 Morris, K.S. and Bucini, G. "California's Drought as Opportunity: Redesigning U.S. Agriculture for a Changing Climate," *Elementa Science of the Anthropocene*, 4 (2016), p. 142. doi: 10.12952/journal.elementa.000142

Conclusions

Preparing for and reducing the risk from climate change is an immense challenge for many communities, especially those that have traditionally suffered from disinvestment and disempowerment. However, it also represents an opportunity to begin to think differently about community development in such areas. As more resources, investment, and attention are directed towards climate change adaptation and community resilience, they could and should be focused on institutions and approaches that address entrenched systemic injustices and inequities and provide residents with opportunities to build wealth and power. As discussed, the seeds of such an approach are already being sown–from linking community energy efficiency and safe, affordable housing efforts to health care institutions; to communities organizing to gain collective ownership of land in order to make stormwater infrastructure improvements and improve standards of living; to worker-owned companies and social enterprises that provide good paying jobs, benefits, and training for local residents; to publicly-owned enterprises that are working with community-led initiatives to provide jobs and support grassroots climate planning. In short, community developers have the opportunity to leverage climate change efforts to create more equitable, just, sustainable, and democratic local communities.

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Building on Shared Values to Engage with Mainers on Climate Change

Elizabeth Rogers, Anna Brown, and Keith Bisson

In a politically divided era in Maine, where progress to address climate change had stalled, Coastal Enterprises, Inc. (CEI), a Community Development Financial Institution (CDFI) and community development corporation, sought to create a pathway for action with a mission for expanding good jobs, advancing environmentally sustainable enterprises, and growing shared prosperity. In collaboration with the Maine Climate Table (MCT), a group of concerned organizations and individuals, and the opinion research firm Goodwin Simon Strategic Research (GSSR), CEI undertook a deep analysis of climate change perceptions in order to meet Mainers where they are on the challenges ahead.

The initial orientation of the work focused on developing effective ways to talk about climate change to galvanize greenhouse gas reductions. While the research did provide clear insights to this end, it also yielded important findings relevant to climate change adaptation. CEI and its MCT partners learned that the attitudes, knowledge, and reactions of various audiences can help identify opportunities for shared understanding of, and community engagement around, climate change action. Moreover, the research process helped build trust among stakeholders, clarified promising policy solutions in politically challenging circumstances, and influenced CEI's ongoing programmatic, policy advocacy, and community investment decisions.

Climate Change and Maine

The state of Maine has an historically moderate and independent approach to politics and a legacy of leadership in progressive environmental policy. Maine has the third longest coastline (3,478 miles) and is the most heavily forested state in the country. For people "from away"—a term used to describe visitors and people who were not born and raised in the state—Maine may seem like the end of the line. But with forests, rivers, and beaches within reach, access to the Atlantic Ocean and North American shipping channels, European flight paths overhead, trade connections across the Canadian border, and busy New England neighbors to the south, Maine can feel like the center of everything to those who call it home.

Maine's rural communities share commonalities with other regions of the U.S. where pride and resourcefulness power entrepreneurship at the same time local economies dependent on legacy industries are experiencing tough economic transitions. Adjusting to change is not a new phenomenon for hardworking Mainers, yet community resilience is strained. Since 2000, Maine has lost a net of 37,000 middle-class jobs, many in

paper, forest products, and textile manufacturing.[1] With just 1.3 million people, Maine also has the oldest population in an aging nation. By 2020, the median age in Maine is predicted to be 46. The Greater Portland metropolitan area is showing economic growth but, overall, the state's economy has lagged in recovering from the Great Recession.[2] Maine ranked 33 nationally in personal income per capita in 2016, according to the U.S. Census Bureau.[3]

In recent years, individuals that make a living from the land and sea are adjusting to a shifting environment. Maine is experiencing record heat in the summer, and ice-out—the thawing of ice on lakes and ponds—is happening earlier, affecting ice fishing.[4] The Gulf of Maine surface temperatures are rising 99 percent faster than sea surface temperatures anywhere in the world.[5] Local fishermen and University of Maine scientists agree that warming waters are causing changes in our oceans and rivers that are bad for populations of fish and shellfish. While overall lobster catches are high, lobster landings are moving north. Northern shrimp numbers are at an historic low, and the fishery has been closed since 2013 and will be closed until at least 2021.[6]

Mainers are facing other impacts of climate change, including an upswing in pests and invasive species that are affecting farming, forestry, and recreation. Lyme disease, once found only in southern New England, is now endemic even in the northernmost parts of Maine, along with other serious tick-borne ailments.[7] Farmers are seeing changes to growing seasons along with severe storms that cause crop damage and are altering farming practices to account for temperature shifts. In the fall of 2017, Hurricanes Harvey, Irma, and Maria, and a powerful wind and rainstorm, left hundreds of thousands of homes without power, in some cases, for more than a week.[8]

1 Myall, J. "State of Working Main, 2017," Maine Center for Economic Policy (2017), available at https://www.mecep.org/wp-content/uploads/2017/09/MECEP-State-of-Working-Maine-2017.pdf.

2 Ibid.

3 Murphy, E.D. "Maine climbs 3 notches to No. 33 in median household income," *Portland Press Herald* (September 14, 2017), available at https://www.pressherald.com/2017/09/14/maine-ranks-no-33-in-median-income/.

4 Trotter, B. "Milder winters shaving weeks off ice fishing seasons in Maine," *Bangor Daily News* (April 4, 2018), available at https://bangordailynews.com/2018/04/16/environment/milder-winters-shaving-weeks-off-ice-fishing-seasons-in-maine/.

5 Pershing, A.J. et al. "Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery," *Science,* 350(6262) (2015), pp. 809–812, available at http://science.sciencemag.org/content/350/6262/809.

6 Sharp, B. "Regulators close Maine's shrimp fishery for next 3 years," *Associated Press* (November 17, 2018), available at https://www.apnews.com/aef9835a7a404bd2a66f33176dc48d50.

7 Robinson, S. "Lyme Disease in Maine: a Comparison of NEDSS Surveillance Data and Maine Health Data Organization Hospital Discharge data," *Online Journal of Public Health Informatics*, 5(3) (2014), p. 231, available at https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3959910/.

8 Graham, G. "Power companies expect recovery from historic storm to take Days," *Portland Press Herald* (October 30, 2017), available at https://www.pressherald.com/2017/10/30/more-than-74000-without-power-as-storm-roars-into-maine/.

In 2016, CEI was one of three CDFIs highlighted at a White House climate change forum on economic resilience, innovative partnerships and low-income communities.[9] Historically, climate change and environmental issues have not been priorities for most of the 1,135 federally certified CDFIs and Native CDFIs throughout the country. In recent years, CDFIs in areas affected by devastating storms, including Hurricane Katrina and Superstorm Sandy, have stepped up disaster preparedness and response efforts, particularly in relation to affordable housing and real estate development. CDFI practitioners work closely with communities and see up-front how climate-related shocks and less immediate stresses can disrupt both enterprises and people. They can play a role in supporting economic stability and community resilience.

Joining Forces as the Maine Climate Table

While CEI and others in Maine viewed climate change as a growing challenge, the political environment constrained action. In 2013, CEI and ten-plus organizations formed the MCT in an effort to address the ongoing and eventual impacts of climate on the economy. At the time, Mainers were in the first term of the administration of former Governor Paul LePage, who openly disputed the validity of climate science and ordered the removal of any reference to climate change from the website of Maine's Department of Environmental Protection.[10] The governor made it clear that he would not support the expansion of renewable energy in Maine due to his view that it would be too expensive for Mainers struggling to heat their homes.[11] From 2010 to 2012, climate-related planning stalled;[12] in 2013, the governor vetoed legislation authorizing a study of climate change risks for Maine.[13] Long a national leader in environmental protection and greenhouse gas reduction and a founding member of the Regional Greenhouse Gas Initiative (RGGI), Maine fell behind in promoting and adopting clean energy technologies. MCT members were determined to do something to get Maine back on course and started meeting regularly to determine how best to do that without legislative support. While every organization participating in MCT had a history of

9 Goldfuss, C. and Donovan, A. "Blog: Community Development Financial Institutions Finding Innovative Ways to Build Climate Resilience," The White House: President Barack Obama (May 26, 2016), available at https://obamawhitehouse.archives.gov/blog/2016/05/26/community-development-financial-institutions-finding-innovative-ways-build-climate.

10 Higgins, A.J. "Paul LePage Profile–Your Vote 2010," *The Maine Public Broadcasting Network* (2010), available at https://web.archive.org/web/20101231194146/http://www.mpbn.net/News/YourVote2010/YourVote2010TheRaceforGovernor/PaulLePage.aspx; Sharon, S. "Paul LePage Campaigns Against Climate Change Science but as Mayor He Supported It," *The Maine Public Broadcasting Network* (2010), available at https://web.archive.org/web/20120902004131/http://www.mpbn.net/Home/tabid/36/ctl/ViewItem/mid/3478/ItemId/13751/Default.aspx.

11 Marshall, C. "Maine and New England Stew Over Climate and Energy Projects. Climate Wire," *The New York Times* (November 1, 2010), available at https://archive.nytimes.com/www.nytimes.com/cwire/2010/11/01/01climatewire-maine-and-new-england-stew-over-climate-and-10325.html.

12 Woodard, C. "Is Maine ready for climate changes?" *Portland Press Herald* (March 16, 2013), available at https://www.centralmaine.com/2013/03/16/is-maine-ready-for-climate-changes__2013-03-17/.

13 Hoey, D. "LePage vetoes climate change study," *Portland Press Herald* (June 24, 2013), available at https://www.pressherald.com/2013/06/24/lepage-vetoes-climate-change-study_2013-06-25/.

protecting Maine's natural resources, most had been working in silos, focused on conservation, economic development, or environmental advocacy. As a first step, MCT invited over 80 statewide leaders to participate in a series of facilitated meetings to identify the top climate priorities for Maine. Consensus emerged on what constituted the most critical areas for policy action: renewable energy, energy efficiency, marine and coastal resources, agriculture/food systems, and supporting financing mechanisms, such as bond funding.

MCT was founded by Cathy Lee, a Maine-based attorney who advises and provides legal and advisory services to international and U.S. clients on climate change policy, projects, and practices. Recognizing the need for a new approach to building consensus and support (and inspired by the 2012 turnaround in Mainer's attitudes toward, and resulting victory for, marriage equality), Lee reached out to Oakland-based GSSR, a firm that helped reshape state marriage equality campaigns in Maine and Washington state. GSSR conducts research on emotionally complex, socially controversial issues. With a goal of enabling attitudinal change, GSSR attempts to understand underlying perceptions and emotional reactions that impact behavior and decision making. The complexity of climate science made it hard for organizations to speak with one voice and connect with audiences beyond their base. The highly charged political environment further aggravated bipartisan working relationships. MCT brought GSSR on board to help identify and analyze how Mainers from different regions of the state, life experiences, and political and social backgrounds thought and talked about issues related to climate change. Beginning in 2015, MCT members pooled resources and commissioned GSSR to conduct a series of focus groups to explore attitudes towards climate change generally, as well as reactions to draft policy proposals for the five issue areas chosen by climate supporters.

What members learned from the GSSR research was that the gap between passion and getting to collective action stemmed, in part, from communications challenges. The research findings helped clarify shared values and economic realities as a context for communicating with Mainers about their everyday lives. It highlighted the fact that Mainers' immediate and long-term economic concerns outweigh uncertainties caused by the warming climate. For them, proposed solutions and the messengers delivering them can seem elitist and out-of-touch. These findings echoed the response to the 2016 presidential campaigns, particularly how they played out in rural regions of the country.

Helping Farmers, Fishermen, and Food Businesses Adapt

Maine's coastal and marine resources are deeply connected to the state's economy and character. Many Mainers are familiar with, and can share personal stories about, climate change impacts they've experienced. In fact, changes–both man-made and environmental–have been occurring for decades. Historically, fishermen have fished a variety of species, so they were not dependent on one species for their livelihood. With the wintertime shrimp fishery closed, a limited wild scallop fishery and ground fishing closed to all but the largest operations due to the cost of federal permits and limited stock, the only income many fish-

ermen have today is from lobstering, an industry notorious for price fluctuations, unpredictable costs, and license restrictions.

Since 2010, recognizing ongoing economic challenges, CEI has worked with fishermen to diversify their income streams through ocean-based farming. In 2012, CEI, Maine Sea Grant, and the Maine Aquaculture Association launched a free class, Aquaculture in Shared Waters, to train commercial fishermen for successful careers in shellfish and seaweed aquaculture. With support from various federal funding sources, the program combines classroom training with hands-on workshops and field trips. Lessons cover the mindset shift from wild catch fishing as a hunter/gatherer to sea farmer, and the production of high-demand, native species that have a proven track record of thriving in a Maine coastal aquaculture environment. Program participants are also introduced to scallop farming, a nascent opportunity that CEI has researched extensively, leveraging Japanese technology and custom-built machinery to grow and harvest scallops in Maine waters.

Uncertainties about the short- and long-term changes and impacts, and the complexity of explaining factors such as ocean acidification, make it important to build on climate change knowledge based on people's lived experiences. However, as the GSSR research demonstrated, even when they can identify everyday examples, it is clear that the majority of Mainers do not understand the mechanisms of climate change that are leading to the impacts that they see. It is imperative to use a combination of credible messengers, including fishermen and scientists, who can connect the dots between environmental science and lived experience. In Maine, credible messengers include scientists from the University of Maine, an institution that Mainers hold with great pride.

Maine's farms have a long history as producers of iconic crops, including potatoes, blueberries, dairy products and maple syrup. While more young farmers are moving to Maine than any state in the country,[14] there is no shortage of farms that are in survival mode. Farmers, who tend to have low incomes, struggle to expand production, access processing, manufacturing facilities and markets. Smaller family farms may be more vulnerable to climate factors affecting the profitability of farming.[15] The GSSR research process highlighted that while the public values Maine-grown agriculture products and supports helping farmers adapt to climate change, more information is needed about crop diversification, healthy soils practices, and sustainable farming methods.

14 Hoey, D. "Maine's farm count defies national trend," *Portland Press Herald* (February 20, 2014), available at https://www.pressherald.com/2014/02/20/number_of_maine_farms_rises_slightly; Curtis, A. "USDA farming census: Maine has more young farmers, more land in farms," *Bangor Daily News* (February 23, 2014), available at https://bangordailynews.com/2014/02/23/business/usda-farming-census-maine-has-more-young-farmers-more-land-in-farms/.

15 Jacobson, G.L. et al. (eds.). *Maine's Climate Future: An Initial Assessment*, University of Maine (2009), available at http://www.climatechange.umaine.edu/mainesclimatefuture/.

Pathways to Community Resilience: Energy Efficiency and Renewable Energy

Energy efficiency and renewable energy earn strong support across partisan lines, especially when opportunities were described in ways that reflect traditional Maine values of responsibility, resourcefulness, independence, and common sense. In addition, highlighting collective impacts of both the problems and the solutions helped to counter a belief that strategies are likely to be elitist and costly–benefiting only those that can afford to weatherize their homes or put solar panels on their roofs. Solutions that engaged communities, such as community solar farms and community weatherization projects evoke Mainers' nostalgia for the past and hope for the future. These findings offer lessons for how to frame solutions–and pay for them. Further, the research confirmed that Mainers are particularly detail-oriented and want to know the nuts and bolts of benefits and costs.

Renewable energy and energy efficiency go hand in hand, especially since efficiency gains can support the cost effectiveness of renewable investments. Distributed renewable energy access that is designed to limit the cascading failures that can arise when centralized power gets knocked out can be an important way to build resilience to climate change impacts. Pride in the natural environment or concerns about climate change can take a back seat to economics in some small rural communities.[16] In practice, CEI is seeing growing support for community solar projects, which tend to be visible within a community, and represent shared community values in terms of "doing the right thing," saving money, and creating good jobs and energy independence. Community-based solar projects make up one of the fastest growing sectors of CEI's loan portfolio, with recent investments in solar arrays powering water treatment facilities in Waterville and Farmington.

Economic Development and Financing Change

Many Mainers are struggling financially and working hard to make ends meet. Research findings underscored that while people in Maine are generous by nature when it comes to helping each other, they feel like they do not have a lot left over to give back. Policies and programs that are perceived as costly create a lot of pushback. When actions are justified solely in order to address climate change, they can be seen as elitist. Many Mainers want to live a greener life, but the costs of entry can seem out of reach. Messaging that fails to acknowledge economic and political anxiety, job loss, and loss of community will make solutions seem disconnected for many audiences and provoke negative responses. In order to engage Mainers on climate change mitigation and adaptation strategies, it is important to remember that creating good jobs, dealing with drug addiction, and lowering taxes are the top three issues Mainers say that state officials should address.

Creating a dedicated funding source for climate actions is more likely to gain traction

16 Curtis, A. "Why Maine towns and cities are investing in solar projects," *Bangor Daily News* (July 7, 2018), available at https://bangordailynews.com/2018/07/28/homestead/why-maine-towns-and-cities-are-investing-in-solarprojects/.

if it is presented as needed to help create jobs, names specific programs and projects that benefit local communities across the state, and pays for itself. The details are important. Low-interest loans for individuals and businesses, including farmers, are viewed very positively in contrast to government grants, which are more likely to get push-back because they are seen as giveaways.

In addition to helping found and lead the MCT in its capacity as a steering committee member, CEI led the communications research process with GSSR for MCT. These efforts, and the partnerships developed among MCT member organizations are now informing CEI's communications strategy, financing activity, project implementation, and policy priorities. As a direct outcome, CEI partnered with the Maine chapter of The Nature Conservancy to build a pipeline of community solar projects and conduct a landscape analysis of financing opportunities to support communities and municipalities in expanding clean energy, including decentralized renewable power. It is working with Maine Farmland Trust and a MCT working group to explore soil health and other policies that can help farmers make the changes they need to adapt to new weather and growing patterns. As part of these efforts to engage a full spectrum of stakeholders, CEI joined the Natural Resources Council of Maine and 18 other partners in issuing five principles to advance an Energy Pathway for Maine.

"As Goes Maine, So Goes the Nation"

Maine has long prided itself on principles of resourcefulness and innovation. Mainers value the natural resources that support many livelihoods and cultural practices. While Mainers are known for their independence, they are also known for being good neighbors and good citizens, taking responsibility to protect their environment–even as they believe that they are not the cause of its degradation. Nationally, rural communities and post-industrial towns have been hit hard by factors mostly out of their control. A sustainable U.S. economy depends on innovation that prioritizes low-income, economically depressed, rural regions, helping to shift the narrative on the role that green enterprise can play in making the economy work for all.

From a commitment to collective action through the MCT, and the investment in social science research that has provided valuable insight into the hearts and minds of fellow Mainers, CEI is actively seeking ways to work with others to advance climate change action. The conditions for innovation in how to approach climate change mitigation and adaptation are ripe given a growing dynamism in the clean energy marketplace and shifts in state leadership as a result of the 2018 midterm elections.[17]

In addition to financing, CEI provides business advice, technical assistance, and training opportunities to help entrepreneurs and enterprises thrive, helping to create economic

17 Orvis, R. "America's Renewable Electricity Forecast Grows To 2050, Even Under Trump," *Forbes* (May 10, 2017), available at https://www.forbes.com/sites/energyinnovation/2017/05/10/americas-renewable-electricity-forecast-grows-to-2050-even-under-trump/#7fa436ed16e4.

resilience in a rural state. Cultivating the adaptive capacity to respond to changing conditions, including economic shocks and stresses, is central to adaptation. As CEI increases its knowledge and understanding of the economic and environmental implications of climate change, the organization is poised to better assist entrepreneurs in preparing for different climate conditions in their future. In addition to its 41-year focus on Maine's rural economy, CEI is already leading adaptation strategies for the fishing and aquaculture industries, providing technical assistance and loans to farmers and food businesses to address systems challenges. CEI is investing in companies like Pika Energy and Ocean Renewable Power Company, that are researching and designing independent energy systems, and financing redundant community solar energy systems in rural communities.

The GSSR research focused MCT members on climate change impacts that Mainers are experiencing in their everyday lives, common shared values and solutions that are perceived as creating community benefits. Throughout the research process, MCT member organizations across multiple sectors built a new level of trust and a common approach to communicating about climate change. This is already supporting collective efforts to develop legislation and engage target audiences. In the six years since the launch of MCT, recognition of climate change impacts has increased, as has the ability to talk about them and about solutions. As the research demonstrates, advocates and practitioners need to know their audience and understand the role of communications in making a compelling case for investment at the scale required to address climate adaptation and mitigation challenges.

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Embracing the Challenge of Climate Education and Engagement

Caroline Lewis

Founded in 2010, the CLEO Institute (CLEO) exists to build climate literacy and spur climate action. Nearly a decade ago, the data were alarming and there was a screaming need to build climate leadership by providing engagement opportunities. So CLEO was launched. Today, as the only nonprofit, nonpartisan organization based in Miami that is exclusively dedicated to climate change education and engagement, CLEO is viewed as the go-to regional source for credible, vetted climate science and expert insights into a variety of fields impacted by climate.

CLEO approaches climate literacy and advocacy in an interdisciplinary, holistic manner that addresses both adaptation (i.e., responding to the impacts of climate change) and mitigation (i.e., addressing root causes of climate change) with equal intensity. The shrinking timeframe predicted by recent reports to mitigate worst-case scenarios underscores the importance of this work.[1] Given their exposure to climate-related events, the Greater Miami and Southeast Florida regions serve as a climate laboratory for ingenuity and problem solving. Working with climate scientists and scores of governmental, business, academic, and community leaders, CLEO creates multiple access points to engage diverse audiences in understanding the climate crisis and to embrace scalable solutions.

During its first six years, CLEO's leaders changed the institute's tagline three times. These refinements trace the organization's education and engagement evolution. First, in 2010, "amplifying the climate conversation;" then, "bridging the divide between science and society on climate issues;" and now, "driving climate action through education and engagement." Despite its evolution as an organization, CLEO remains nimble in program and event design, partnering with many to offer a plethora of opportunities for intergenerational and interdisciplinary audiences to engage.

Engaging the Disengaged

Early on in this effort, it became clear that a significant majority of the 2.7 million people living in Miami-Dade County could not begin to articulate even a basic understanding of what climate change is, nor explain climate change's causes, effects, or solutions. Determined to change this, CLEO worked furiously with local scientists, partners, and educators to simplify the science, highlight a broad range of climate disruptions, identify solutions small and large, and engage a disengaged public. Informed by current reports and data put out

1 U.S. Global Change Research Program (USGCRP). *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* (Reidmiller, D.R. et al. [eds.]) (2018). doi:10.7930/NCA4.201

by the National Oceanic and Atmospheric Administration (NOAA), National Aeronautics and Space Administration (NASA), the U.S. Global Change Research Program (USGCRP), National Climate Assessment (NCA), and the Intergovernmental Panel on Climate Change (IPCC), CLEO began hosting forums and movie screenings with panel discussions; interactive solution summits and workshops; and presentations and classes simplifying climate science for a lay public. And it targeted every audience, top down and bottom up, simultaneously.

When young professionals were not showing up, CLEO created "Wine & Cheese–Ask the Experts Forums" to lure them. When the elected officials were too busy, they crafted intimate invitation-only Mayors' Roundtable Luncheons, and the mayors showed up. When teachers across disciplines wanted help, a CLEO Teachers Network was formed to host symposia and promote climate science across the pre-K-12 curriculum; and when young people wanted to engage, CLEO created the Generation CLEO (GenCLEO) Youth Movement. Then, to develop more speakers, it built a CLEO Speakers Network and partnered with climate scientists and communicators to help coach trainees. CLEO also successfully began partnering with businesses and municipalities to help integrate climate action in their sustainability planning. When CLEO leaders realized that Miami's underserved and frontline communities were not engaging, they aggressively sought funding to reach into the nooks and crannies of our vibrant but vulnerable communities.

A Pilot Project in Underserved Communities

Building community resilience and adaptive capacity requires an informed, engaged, and prepared public that is included as stakeholders during the planning phases. CLEO's Community Outreach Pilot Project recognized the importance of including communities of color in understanding climate causes, impacts, and solutions, and welcoming their contributions to planning efforts. In 2015, CLEO received support for this Outreach Project from the Miami Foundation, and targeted four communities with socioeconomically vulnerable residents. Two were low-lying Miami-Dade neighborhoods, Shore Crest and Sweetwater, and two were on higher ground, Liberty City and Little Haiti. More than 1,500 people were engaged during the seven-month pilot, primarily residents living in areas with high levels of social vulnerability and high exposure to the impacts of climate change.

In each community, the project had three phases and all events were either hosted or facilitated by local partners in conjunction with CLEO. The first phase consisted of informal listening sessions with the community, including residents, local leaders, and business owners, to gauge interest, understand concerns, and help shape a town hall agenda. CLEO included its academic and social justice partners in these listening sessions. Then, for phase two, CLEO co-convened a town hall with residents, city and county staff, scientists, local business, elected and community leaders, and partners to discuss concerns and solutions. Lastly, CLEO held interactive Climate 101 Workshops for the community, including climate scientists to answer additional questions.

Town halls revealed the following immediate climate concerns among underserved populations:

- Emergency and post-disaster preparedness;
- Climate gentrification by developers seeking high ground in Little Haiti and Liberty City;
- Tidal flooding or sunny day flooding in low-lying areas in Sweetwater and Shore Crest;
- Climate education and engagement for more information and a seat at the table for resilience planning; and
- Heat and health vulnerability and how best to minimize risk to under-resourced populations.

Conversations also highlighted the importance of understanding the roles of government, business, and community, as well as the role of individuals, in living more sustainably. CLEO advanced its intended goal of empowering future climate educators through the CLEO Speakers Network. Local residents interested in becoming climate speakers have already begun their training and some have given their own climate change outreach presentations–most notably, Valencia Gunder, whose powerful voice now also speaks to climate justice. Thus, the pilot has been expanded and reshaped over the years. Today, CLEO continues to provide participants unique opportunities to: (i) make connections between the many causes and effects of climate change; (ii) recognize multiple approaches to addressing solutions; and (iii) develop the ability to advocate for climate action.

The Reality at Ground Zero

It used to be sea level rise that spurred people to pay attention to climate change. Now, it's climate gentrification. Undeniably related, the two are the most commonly identified reasons researchers and reporters are visiting the region. Climate gentrification is now a more common term, as locals confront the reality that is the limestone ridge running a bit diagonally and roughly north/south through a chunk of Miami-Dade County. This ridge, with elevations higher than 18 feet above sea level in some parts, is akin to the Rocky Mountains in South Florida where the state is as flat as a pancake. The ocean and bay encroach to the east, the everglades to the west, and ground water, especially during king tides, creeps up through porous limestone bedrock in all lower-lying areas.

When Miami was first being developed, they carved the railroad tracks on that limestone ridge. This is where the socioeconomically vulnerable populations settled, forming communities like Overtown, Liberty City, and Little Haiti. Today, residents there are claiming an accelerated rate of gentrification and describe the, at times, predatory nature of prospective buyers and developers. Many locals still do not understand the implications of higher elevation and its link to sea level rise and now, more frequently, to property values. CLEO uses topography maps and Florida International University's Eyes-On-The-Rise App as tools to show Miami-Dade's elevation and inundation visuals at two, then four, then six feet of

sea rise. Many residents in these high elevation neighborhoods are still completely unaware of this risk. It is true that the area was already gentrifying, as the "artsy" Wynwood District expands northward, but the rate of gentrification in these higher ground areas seems to be increasing aggressively and is now supported by empirical scholarly evidence.[2]

Over the last five years, there have been major climate-related budget issues, publicly discussed at the City of Miami and at the Miami-Dade County level. Local residents are realizing that reality now includes living with sea level rise; funding million-dollar pumps to keep streets dry during high tides; elevating roads; experimenting with green infrastructure; and worrying about saltwater intrusion and freshwater vulnerability. Developers too must know, although some insist that elevation is not their driving force. Regardless of weighted priorities, communities are increasingly seeking better information about this shift in population. For instance, Florida International University professor, Hugh Gladwin, has been mapping land ownership patterns and GIS elevations in some of these vulnerable high ground areas. Professor Gladwin represents just one of many local subject matter experts whose research is advancing CLEO's climate communications mission.

But what does all of this mean for the people in Miami who live on the ridge? How do they cope? Will they have to move? Would they be inclined or are they able to relocate ninety minutes from where they work? Abandon a community, a neighborhood, a sense of place they helped build–a place they stuck with during the worst of times? At a Liberty City climate listening session several years ago, we asked city and county representatives how we could alleviate the crisis for vulnerable residents who fell behind on mortgage or tax payments. There were no easy answers, although some suggested a short-term, interest-free pool of funds to help the working poor when needed. Other ideas for short-term wage substitution include disaster-response training for temporary employment. After Hurricane Irma sideswiped Miami in 2017, thousands of people went without work and without paychecks for weeks. That is a game changer for the poor and the working poor. Disaster-driven unemployment causes a variety of ripple effects, including premature mortality. People must decide between paying the air conditioning bill and living through extreme heat made only worse by high humidity levels.

At a Climate Town Hall in Little Haiti a few years ago, a young woman agreed that our nights were warming. She relayed that when she opened her windows a little at night to let in some cool air, there was no cool air anymore. When asked: if she had no air-conditioning, then why were her windows closed? She explained she didn't feel safe leaving them open at night. In imagining thousands of hot homes and apartments closed-up in a warming world, CLEO has started pitching a public-private partnership possibility to design and install solar powered air-conditioning wall-units in at least one room of every home.

2 Keenan, J.M., Hill, T., and Gumber, A. "Climate Gentrification: From Theory to Empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5) (2018), 054001. doi: 10.1088/1748-9326/aabb32

Solutions beg for ingenuity that could well become job creators. Indeed, the disruptions we know of that are already here and those that are coming are threat multipliers for people without safety nets, the poor and the working poor (more than 58 percent of the 2.7 million people living in Miami-Dade County).[3] CLEO continues to expand its work in these under-resourced communities and insists that climate science and climate justice lenses are included when addressing solutions to climate disruptions. The science grounds the climate fight as urgent and long-term. The justice lens warns about the threat multiplier the climate crisis is becoming to millions of already vulnerable populations.

Partnerships and Expanding Audiences

CLEO has embraced partners that help connect the dots between climate change and vulnerability related to changes in heat, health, food, water, local economics, and extreme events. The success of CLEO's work includes harnessing the support of several partner institutions to inform, host, and promote events and initiatives. Locally, these include: University of Miami's Geology, Communication, Law, Architecture, Engineering, and Civic Engagement departments, as well as its Rosensthiel School of Marine and Atmospheric Sciences and Corporate Institute for Marine and Atmospheric Studies; Florida International University's Department of Biology, Journalism and Communication, and its Sea Level Solution Center; Miami Dade Colleges; Vizcaya Museum and Gardens and Pinecrest Gardens; and the Miami Climate Alliance, a group of climate justice-centered organizations, co-founded by CLEO and including New Florida Majority, Miami Workers Center, Catalyst Miami, and dozens more.

Miami now has many of the moving pieces needed to spur real action: informed leaders, climate scientists, entrepreneurial hubs, and a readiness level like no other, as climate impacts have quickly become real for its residents. Despite recent dire reports, locals say they want to stay in South Florida, as safely as possible, for as long as possible. Thankfully, many individuals, organizations, and foundations are seeing and seizing opportunities to innovate in the region, and they are welcomed. Over the years, CLEO and city, county, regional, and community climate leaders have worked with forward thinking climate-focused teams at the Urban Land Institute, Van Alen Institute, Harvard University Graduate School of Design, Association for Preservation Technology, Center For American Progress, Union of Concerned Scientists, World Resources Institute, Natural Resources Defense Council, The Nature Conservancy, and others, to educate and engage more audiences, assess large amounts of data, offer solutions, and promote innovative re-design. The collective effort is impressive.

Education is power, and in the case of climate change education, information allows people to engage, advocate, and contribute to solutions. There was a clear request by the

3 United Way. "Alice (Asset Limited, Income Constrained, Employed) Study of Financial Hardship" (2017), available at https://unitedwaymiami.org/wp-content/uploads/2014/11/17UW-ALICE-Report_FL-Update_2.14.17_Lowres.pdf.

region's most vulnerable residents to be "at the table" and included as stakeholders during resilience and adaptation planning. As CLEO staff and leadership expand, current efforts are broader and bolder. The Empowering Resilient Women and Girls initiative reaches into more under-resourced neighborhoods like Overtown and Allapattah, among others, convening workshops, under the banners of WE learn, WE Prepare, WE Act, and WE Lead. This is inspired by the research findings in the best-selling book, *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, where educating women is listed in the top ten solutions.[4] CLEO continues its work with all current audiences and is planning to further increase outreach to faith-based groups, health care professionals, elected leaders, media and meteorologists, school systems, homeowner associations, and young professionals.

Conclusions

CLEO has grown from a small staff of two to a solid staff of seven, plus interns, and it is scaling its work and reach year-by-year. Partners and volunteers grow each day and include a stellar expert advisory council who help inform the work and shape strategy. There are now calls for CLEO trainings, workshops, and forums throughout and beyond the state of Florida, and the formation of CLEO chapters around the country could become a reality. Ultimately, CLEO will expand its presence in other cities that are ready to engage diverse stakeholders in advancing community resilience, adaptive capacity, and climate leadership. Mentoring them will become part of the institute's work as it shares best practices and lessons learned.

What we have learned already is that at least some underserved communities are now at the table and able to advocate in their own interests; that Chambers of Commerce are re-defining resilience and adaptation in advancement of a stable and prosperous economy and work force; that K-12 educators are now weaving climate across the curriculum; that artists are provoking audiences and conversation; that governments are mapping vulnerability and raising funds for adaptation efforts; that cities, counties, schools, and businesses are measuring and lowering carbon footprints; that young people are mobilizing, finding and sharing their voices and their outrage at inaction; and most importantly, that dismissing or denying the science of climate change is much less acceptable, as climate voters become more numerous, more informed, and more vocal.

These successes will only accelerate if we remain committed to inviting, including, and making room at the table for all segments of society to engage in understanding climate science and to embrace solutions that allow for the adaptation to changes we cannot stop and the mitigation of the causes of a warming world.

Caroline Lewis is founder and senior climate advisor at the CLEO Institute.

4 Hawken, P. *Drawdown: The Most Comprehensive Plan Ever Proposed to Reverse Global Warming*, Penguin Press (2017).

America Adapts: The Value of Podcasting in Climate Communications

Doug Parsons and Dan Ackerstein

As the realities of a changing global climate begin to reveal themselves, a shift in the climate conversation has begun to take shape. While climate change mitigation–efforts to reduce the human-induced changes to the climate due to fossil fuel emissions–dominated the discussion for much of the past three decades, climate change adaptation is now receiving newfound, and essential, attention in policy and planning circles. Climate change adaptation is defined by the U.S. government as "[a]djustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects."[1] While this definition is appropriately clinical, the attention being placed on adaptation reflects a harsh, but inescapable reality: the warming of the planet has already begun in earnest, and the consequences of our past actions will now be felt. Active, thoughtful adaptation to those consequences is essential if we are to minimize the social, political, and financial disruptions that loom ahead.

However, discussion of climate adaptation needs to transcend the technical if it is going to move public opinion and create the sense of urgency in the general public that exists in the scientific community. The environmental movement has suffered from a perception of being excessively moralistic and preachy in the past, but in the case of climate change adaptation it may very well be time to alert the world to the immediate impacts that transcend the moral imperative. At a minimum, the adaptation community needs to assert its own leadership role in climate conversations and speak with both authority and the energy that this subject merits.

The community of adaptation professionals can struggle to speak with a clear and consistent voice around not only the adaptation steps prescribed, but the term itself. While technical definitions are essential to the scholarly literature on the topic, descriptions of adaptation that resonate with policy- and decision-makers are vastly more important. Creativity, emotion, and narrative will be essential to those descriptions.[2] It is critical to balance scientific precision with inescapable human experiences; to wit, while wildfires have existed in the American West for millennia, there is little doubt that climate change has made those fires more common, more intense, and more dangerous than almost any time human history. Wildfires aren't a result of climate change, but the intensity of damage

1 U.S. Global Change Research Program (USGCRP). "Glossary" (2018), available at https://www.globalchange.gov/climate-change/glossary.

2 Morton, T.A. et al. "The future that may (or may not) come: How framing changes responses to uncertainty in climate change communications," *Global Environmental Change*, 21 (2011), pp. 103-109. doi: 10.1016/j.gloenvcha.2010.09.013

and danger absolutely is.[3] By highlighting firefighters' wisdom about how they adapt their firefighting techniques or how victims seeks to rebuild with greater engineering resilience, audiences benefit from a much deeper understanding of the connection between science and human capacity.

The foundational challenge faced by the adaptation community today is extending the scope of their project beyond narrow scientific, technical, and scholarly boundaries. Adaptation is an undertaking at a societal level that requires rethinking fundamental assumptions about geography, infrastructure, finance, risk, environmental stewardship, and social equity, while profoundly impacting the daily lives of many, if not all, Americans.

To meet this challenge will require building a sense of shared interest. While the concept of national unity and shared risk/interest is increasingly at odds with the current political environment, it is ever more critical to the challenge posed by a changing climate. The collective nature of the need for adaptation is at the core of the shift in worldview necessary to address the problem. For adaptation to happen, leaders in the field will need to build a shared awareness of adaptation itself, a shared body of knowledge from which decisions can result and strategies can be drawn, as well as a shared commitment to the long-term, distributed nature of this challenge.

Adaptation will not happen by accident. The rate at which the climate is changing will preclude "natural" or "market-driven" changes to human geography and lifeways. To be optimally effective and equitable, it must be intentional and proactive and, as such, it must be based in a shared awareness of the urgent need for adaptation. Although different geographic regions and demographic groups will experience climate change very differently, all will feel its effects profoundly, and some will experience first, second, and even third tier impacts as populations are displaced, economies are disrupted, and systems fail to endure these cascading shocks and stresses. It is essential that the public not only deepens its understanding of the climate crisis, but also engages with the certainty of adaptation as a necessary response. Government publications like the *National Climate Assessment* are useful as foundational documents, but insufficient for communicating to the public about these issues. Similarly, the adaptation community remains largely a practitioner and scholarly community with public messaging around the need for, and value of, adaptation being largely absent from popular discourse.

Adaptation remains a field in its infancy. Adaptation professionals are like small-town sheriffs in the old west attempting to bring some semblance of order to a chaotic, turbulent place in a time of change without more than a tenuous link to a central authority or policy-making base. While much good policy and decision-making is taking place, too often these processes are frustrated by a lack of reliable information, centralized resources, and access to peers. Whereas tools like vulnerability assessments and scenario planning documents

3 Abatzoglou, J.T. and Williams, A.P. "Impact of anthropogenic climate change on wildfire across western US forests," *Proceedings of the National Academy of Sciences*, 113(42) (2016), pp. 11770-11775.

were the first to reach practitioners widely, in the absence of more sophisticated tools, these have become de facto approaches to adaptation planning and their shortcomings for this purpose are emerging more clearly. The private sector has begun to fill this void. Companies investing in Big Data are identifying ways to develop predictive models for risk assessment. These may not be the most thrilling applications of computing power, but they are critically important to planning exercises looking 30, 50, or 70 years in to the future.

Adaptation is, by any measure, a generational challenge. It is essential that the scope of that challenge not overshadow the equally enormous generational opportunity. Changes will undoubtedly put massive strain on social bonds and institutions, and the potential for instability is enormous. The challenge for society is to infuse more urgency into this cause. And that will require new and innovative ways to communicate this issue. That's where a climate change podcast can be a meaningful first step.

Climate Change and Podcasting

The field of climate communications is littered with unsuccessful efforts that attempt to make climate change relevant to the general public. Unfortunately, climate change is an incredibly complex subject, laden with uncertainty and nuance. Worst of all, it is often framed by dire predictions. All of these qualities make it increasingly hard to reach audiences with compelling messages and actionable knowledge. Some of the most seemingly successful efforts at climate communication often repeat the habit of just "preaching to the choir." By failing to reach a broader audience–often incidental to the doom and gloom–climate change communicators miss the chance to engage the full range of stakeholders necessary for informed climate action.

People are desperate to learn about the world around them. The central challenge for technical subjects like climate change is that much of that learning must happen in non-technical ways. Even adaptation professionals are looking for avenues to understand adaptation outside of formal webinars and scientific reports. Podcasts offer a potentially impactful mechanism to disseminate substantive information to a broad array of audiences.

Podcasts represent an entirely new platform for sharing information in accessible, yet substantive ways. Functionally, podcasts are "a digital audio file made available on the Internet for downloading to a computer or mobile device, typically available as a series, new installments of which can be received by subscribers automatically."[4] More practically, podcasts are the equivalent of always-available, downloadable radio talk-show broadcasts. In much the same way that companies like Netflix have taken television shows from time-specific broadcasts to on-demand streaming, podcasts do the same for audio recordings and broadcast radio. Moreover, they allow listeners to carefully select subject matter, content, and host, as well as the time and place they consume that content.

4 Podcast Insights. "Podcast Statistics" (2018), available at https://www.podcastinsights.com/podcast-statistics/.

The unique appeal of the podcast as a platform lies in its availability, specificity, and accessibility:

- ***Availability:*** Conventional radio broadcasts exist in real-time–miss them and they are gone. Podcasts remain permanently archived, available, and referenceable.
- ***Specificity:*** The pleasures of generalist listening are enormous, but pursuing a depth of interest in a subject is similarly satisfying. Podcasts can cater to small audiences with very specific interests. There are podcasts on paleobotany, the art of negotiation, and even Australian lifeguard competitions. By catering to specific audiences and subpopulations, podcasts can message most effectively to the groups most interested in their content.
- ***Accessibility:*** Podcasts present information in the form of a conversation. In fact, listeners often describe themselves as feeling that they are part of the conversation that they are listening to. Podcasts are rarely formatted as lectures, and the audio nature of the medium means that they do not require exclusive attention.

Podcasting emerged in 2004, led into the public eye largely by avatars of pop culture and comedy cultural critics like Marc Maron and Ricky Gervais. Podcast appeal broadened rapidly with creative applications of the technology, with the Harry Potter-centered *Muggle-cast* and true-crime *Serial* being prominent examples. By 2012, 29 percent of Americans had listened to a podcast. Today, that figure is 44 percent and over 500,000 podcasts are actively broadcast in over one-hundred languages. While most of those podcasts have a small listener-ship, those listeners are dedicated–73 million Americans are estimated to listen to a podcast at least every month; 48 million listen weekly.[5] Both numbers have grown consistently and steadily.

Podcasting represents a unique opportunity for messaging and engagement because the barriers to entry and exposure are so low. Production challenges and costs are marginal. There are few barriers to access and marketing often happens organically within communi-ties. The technology for podcast recording is quite simple; inexpensive software tools allow for audio recording, editing, and production. In-person interviews can be conducted with a basic smartphone. Off-site interviews simply require a service like Skype or Zoom to ensure audio quality. There is, of course, a learning curve both around the technical aspects and the challenges of delivering good content, but neither are so difficult as to be problematic for an engaged learner. Distributing a podcast is similarly straightforward with services like Apple Podcasts, Spotify, Pandora, and I Heart Radio all providing users access to podcasts, with Apple being the largest (65 percent).[6]

Promoting a podcast happens largely through social media and organic channels within an industry sphere. Word-of-mouth remains the most compelling means by which news of a

5 Ibid.
6 Ibid.

quality resource is shared, but active promotion by trusted partners, colleagues, and network associates is essential to publicizing a podcast. Fortunately, once the word is shared, podcast distributors make it easy for listeners to find what they are looking for. The search functions in each service are optimized for keywords and very effective at connecting audiences to their sought-after content.

While recording and publishing a podcast is a relatively inexpensive undertaking, only the most successful podcasts are financially lucrative. Podcasts reaching truly wide audiences or key demographics are largely supported by advertising and corporate sponsorships. Podcasts that are more narrowly focused, or educational in nature, are most often funded by grants, voluntary listener contributions, or online funding campaigns. Some podcasts hosted by non-governmental organizations (NGOs) are nonprofit entities funded by traditional charitable giving channels. In some instances, where the podcast and an organization have shared interests, single episodes can be sponsored in return for a focus on a specific subject or event.

The America Adapts Podcast

As the world's most popular climate change podcast, *America Adapts* is one of the first efforts to use podcasting to educate professionals and the public about climate change adaptation. The *America Adapts* podcast is a platform for sharing knowledge, information, and opinion across the field of climate adaptation. The show's mission is to catalyze global-scale connections between experts and information on climate adaptation practice and research. *America Adapts* seeks to enhance the visibility of adaptation research and current interventions to impacts of climate change, connect professionals and their efforts to maximize the resource base, and to increase the efficiency, efficacy and equity by which we can prepare and respond. *America Adapts* communicates critical issues on a real-time platform through interviews with scientists, activists, policy makers and journalists seeking to reach the public with their work and findings. Finally, it seeks to inspire the public with a message of hope and possibilities balanced with an emphasis on the critical need to make changes.

The *America Adapts* podcast includes more than 95 episodes, featuring experts from public health, planning, national security, agriculture, conservation, to landscape architecture. Adaptation is an issue relevant to almost every economic sector. That interdisciplinary nature is a key part of the podcast's value: it highlights areas of adaptation that many, even those working in the field, did not know existed. Recent examples include:

- A conversation with *Vox*'s David Roberts dug into the philosophical considerations of adaptation.
- An interview with adaptation expert Dr. Susie Moser discussed how adaptation will drive transformational changes in our society.

- Jeff Goodell, an environmental writer with *Rolling Stone* magazine, discussed his recent book that looks at the ramifications of coastal inundation in major cities around the world.

Alongside the need for a more sophisticated national conversation around adaptation is an emerging need for America to engage with the world on this topic. With the announcement of the new International Commission on Adaptation there is a growing sense to create some unity in the field. In the U.S., we often go our own way on consequential environmental policy issues. But, there is value in integrating domestic efforts with overseas adaptation efforts. *America Adapts* has developed a listener base in over 75 countries where the interest in understanding what the U.S. is doing on adaptation is substantial.

Here in America, we also have much to learn from our international partners. Many countries are quite advanced–the Netherlands has been the focus of several episodes of the podcast. That said, much of the policy and funding emphasis for adaptation has been focused on developing countries, and rightly so, since many of them will bear the brunt of climate impacts for decades to come. There are very few national platforms to talk about adaptation. The biannual National Adaptation Forum has emerged as an essential gathering of adaptation professionals. Likewise, a number of trade associations are in early stages of formation, but no platforms exist that provide a recurring conversation about this issue that is both substantive and accessible. *America Adapts* seeks to fill the void.[7]

America Adapts listeners include academics, nonprofit organizations, students (middle school to university level), the general public, and leading experts in adaptation in state and federal government agencies. One of the most interesting developments since the podcast was launched is the community of adaptation professionals that has arisen around the podcast and its various social media platforms. The podcast has become a shared space of information exchange for students and professionals alike. The field of adaptation is so diverse, touching up on so many sectors, that no single platform can accommodate them all. The podcast, and the conversations that unfold there, begin to fill that void. Social media, such as Facebook, Twitter, and Instagram create a space where listeners can both provide feedback to the show, but also amongst themselves, independent of the show itself. The podcast becomes a prompt for critical conversations, and inspiration for debate and networking amongst key stakeholders. Generally, you think of a podcast as a one-way conversation, but social media allows people to share feedback on the content covered, talk about what they agreed or disagreed with and, most importantly, share ideas for future content. The community around *America Adapts* is diverse, international and growing; it provides a real-time illustration of how adaptation is evolving around the world.

7 Balasubramanian, M. "Climate change, famine, and low-income communities challenge Sustainable Development Goals," *The Lancet Planetary Health*, 2(10) (2018), e421-e422.

For nonprofits who seek to engage in their own podcast productions, they may not necessarily feel the obligation to bind themselves to the rules of journalism. For some, podcasts are simply a means of informative entertainment. Yet, for others, podcasts are becoming a valuable tool for educating their constituents. For instance, university academics have begun to incorporate *America Adapts* episodes into their curriculum in a variety of fields. An initiative called Podcasts in the Classroom is being led by a faculty member at the University of Waterloo in Ontario, Canada. The Waterloo team is developing templates that people can use when they listen to the *America Adapts* podcast. Soon, similar templates will be available to nonprofits and community development organizations who will then have a model for optimizing engagement in both the digital and physical worlds. Bridging a digital listener together with an active real-world stakeholder is the next challenge ahead for the diffusion of various innovations arising from podcasts.

Conclusions

Unique problems often demand, and generate, unique solutions. A societal-level response to the challenge posed by climate change demands creative, multi-modal thinking about education, conversation, knowledge-sharing, and consensus-building. For a civilization-scale project like adaptation to climate change, making use of every available resource to move public awareness and understanding is essential. In that regard, podcasting represents a low-cost, readily accessible channel for reaching policy makers, leaders, professionals, and the general public with information that is accessible, digestible, and meaningful. Moreover, podcasting can engage audiences in times, places, and contexts where learning is a pleasure rather than a chore. Climate change professionals, as well as science educators and leaders more broadly, would be wise to explore podcasting as a means to share their messages more broadly and to build public understanding of the challenges facing our collective communities. Moreover, they may be missing out on some key conversations about real life experiences that are fundamentally defining the nature of vulnerability, adaptive capacity, and transformative adaptation.

Doug Parsons is host of the America Adapts podcast and Dan Ackerstein is principal of Ackerstein Sustainability.

Healthy Aging: A Conceptual Model of Community-based Solutions in the Face of Climate Change and Global Demographic Changes

Seciah Aquino, Josefina Flores Morales, Max Aung, Mary Keovisai, and Jennifer K. McGee-Avila

Many regions around the world are at increased risk of changing environmental conditions, such as water shortages, extreme temperatures, natural disasters, floods, droughts, and rising sea-levels.[1] These events are increasing in severity and frequency. As these global trends unfold, countries must also grapple with an aging populace. People are living longer than ever before and societies are increasingly dealing with the novel challenge of supporting remarkably large numbers of older citizens and denizens.[2] Climate change and shifting demographic patterns require innovative ideas about how to build and adapt community infrastructure that helps older individuals thrive. Urban planners, and community investors will need to consider aging populations as they think about how the built environment can promote healthy local communities in the face of a changing climate that has acute and unique consequences for individuals aged 65 and over.

In this article, we briefly review: (i) global aging patterns; (ii) the connection between climate change and the health of older-age people; and (iii) a conceptual model that planners and community leaders may use to move forward. Ensuring global healthy aging requires community development solutions that address the direct health risks and the social costs of being older-aged during a time of climate change.

An Aging Population

The increase in older individuals across the world is a direct result of demographic changes such as the transition from high to low birth and death rates. The average decrease in global fertility rates means that recent birth cohorts are smaller in size than before. Increases in life expectancy translate into larger populations of older individuals. Taken together, these trends

1 Kousky, C. "Informing climate adaptation: A review of the economic costs of natural disasters," *Energy Economics*, 46 (2014), pp. 576-592; Trenberth, K.E. et al. "Hurricane Harvey links to Ocean Heat Content and Climate Change Adaptation," *Earth's Future* (2018).

2 Riley, J.C. "Estimates of regional and global life expectancy, 1800–2001," *Population and Development Review*, 31(3) (2005), pp. 537-543.

result in a higher proportion of middle and older individuals in a given country's population.[3] In the U.S., for instance, one in five people will be 65 or older by the 2030.[4] This aging trend is common in high-income countries such as Japan, the U.S., and Australia.[5] For some low- and middle-income countries, however, the drastic shift in population age structure has yet to come.

Societies cannot ignore how aging warrants the attention of many concerned with the link between the built environment and the wellbeing of communities. People are living longer than before, and the years of life gained over the past decades in life expectancy are often lived in unhealthy and physically limited conditions.[6] The Centers for Disease Control and Prevention estimates that 80 percent of older adults (aged 60 and over) are experiencing at least one chronic disease such as cardiovascular disease, cancer, cognitive decline, and/or diabetes.[7] These are current issues that aging populations face. Now, when climate change and extreme weathers events are included in the discussion of older-age wellbeing, community-level solutions are required.

Climate Change and Health Risks

Global climate change increases individuals' susceptibility to adverse health conditions. Temperature extremes and increased natural disasters such as hurricanes, wildfires, and droughts all contribute to the health of people and communities.[8] Climate change places disproportionate stress on individuals with already vulnerable health status, notably aging adults. Older adults struggle with physical mobility and often live with one or more chronic health condition.[9] Extreme temperature events can exacerbate chronic health conditions and places older adults at risk for increased health care and social services utilization.[10] Furthermore, the evacuation of older adults prior to, during, and after natural disasters poses extreme

3 Pantazis, A. and Clark, S.J. "A parsimonious characterization of change in global age-specific and total fertility rates," *PLoS ONE*, 13(1), e0190574 (2018); Stolnitz, G.J. "The demographic transition: from high to low birth rates and death rates," *Population Growth* (2017), pp. 30-46.

4 United States Census Bureau. "Older People Projected to Outnumber Children for First Time in U.S. History" (2018), available at https://www.census.gov/newsroom/press-releases/2018/cb18-41-population-projections.html.

5 Lee, R.D. "Demographic change, welfare, and intergenerational transfers: a global overview," *Ages, Generations and the Social Contract* (2007).

6 Crimmins, E.M. and Beltrán-Sánchez, H. "Mortality and morbidity trends: is there compression of morbidity?" *The Journals of Gerontology: Series B*, 66(1) (2011), pp. 75-86.

7 Centers for Disease Control Prevention and Merck Company Foundation. "The State of Aging and Health in America 2007" (2007), available at www.cdc.gov/aging.

8 Gamble, J.L. et al. "Climate change and older Americans: state of the science," *Environmental Health Perspectives*, 121(1) (2012), pp. 15-22; Geller, A.M. and Zenick, H. "Aging and the environment: a research framework," *Environmental Health Perspectives*, 113(9) (2005), p. 1257.

9 Kriegsman, D.M., Deeg, D.J., and Stalman, W.A. "Comorbidity of somatic chronic diseases and decline in physical functioning: the Longitudinal Aging Study Amsterdam," *Journal of Clinical Epidemiology*, 57(1) (2004), pp. 55-65.

10 Geller, A.M. and Zenick, H. "Aging and the environment" (2005); Gronlund, C.J. et al. "Heat, heat waves, and hospital admissions among the elderly in the United States, 1992–2006," *Environmental Health Perspectives*, 122(11) (2014), p. 1187.

logistical issues, particularly if they are living alone, or in long-term care facilities.[11] This can further reduce their access to services and can worsen stress-related health conditions.[12]

Physical and social environments have a direct impact on health. Climate change directly influences human health and disease by destabilizing core infrastructure necessary for community health. Using severe droughts as one example, vulnerable communities may lack core natural food and water resources. In the global context, developing countries struggle in situations of drought. Migration is often one short-term solution for afflicted communities. However, migration is difficult for older adults. Thus, droughts and extreme temperatures require adequate shelter and transportation. The absence of infrastructure that considers the needs of older adults in climate-driven crisis threatens more than a comfortable lifestyle–it undermines basic access to health care, food, and other living necessities.[13]

Climate-change-induced conditions influence the health of older-aged communities in a dynamic way because it not only directly increases their health risk, but also affects their social lives. One third of the older non-institutionalized population lives alone. People who are older and who live alone may be at increased risk during climate change events because of their potential for being physically limited, having multi-morbidities, and being at increased risk of hospitalization.[14] People who are poor and do not have the resources to move post-natural disaster will also be critically and disproportionately impacted.

Why Community Development Matters for Aging and Climate Change

Community-based interventions that consider aging and climate change issues can improve quality of life and prevent unnecessary costs for communities. One promising intervention avenue is to build or adapt community infrastructure in ways that support healthy lifestyles among older adults. For instance, increasing the number of parks, grocery stores, and health clinics in neighborhoods where older adults live relaxes the burden of physical mobility constraints. Improvement of transportation systems ensures adequate space for older adults and people with disabilities. These kinds of investments are necessary not only to promote the general health of aging individuals, but also to address some of the risks associated (in response to increased heat-waves, for instance) with climate change, which hurt the aging population the most. These interventions have the potential for high returns.

11 Gamble, J.L. et al. "Climate change and older Americans" (2012).

12 Rosenkoetter, M.M. et al. "Perceptions of older adults regarding evacuation in the event of a natural disaster," *Public Health Nursing*, 24(2) (2007), pp. 160-168.

13 Martin, S.A. "A framework to understand the relationship between social factors that reduce resilience in cities: application to the City of Boston," *International Journal of Disaster Risk Reduction*, 12 (2015), pp. 53-80; Kiyota, E. "Co-creating Environments: Empowering Elders and Strengthening Communities through Design. What Makes a Good Life in Late Life? Citizenship and Justice in Aging Societies," *Hastings Center Report*, 48(5) (2018), S46-S49; Greenfield, E.A. "Age-Friendly Initiatives, Social Inequalities, and Spatial Justice," *Hastings Center Report*, 48(5) (2018), S41-S45.

14 Legrand, D. et al. "Muscle strength and physical performance as predictors of mortality, hospitalization, and disability in the oldest old," *Journal of the American Geriatrics Society*, 62(6) (2014), pp. 1030-1038.

In examining the relationship between living in a walkable neighborhood and mortality risk among older adults, researchers found that those who lived in more walkable spaces had higher chances of survival in older age.[15]

The ability to relocate in response to climate change is driven by many factors, including financial security, social networks, and physical mobility. Low-income older-aged individuals face a double jeopardy of disadvantage that hinders their capacity to survive the effects of climate change. Second, the community infrastructure of neighborhoods with evidently less investment may experience more damage. This means that local community developers who care about aging and climate change infrastructure need to consider additional factors. Different contexts (e.g., rural vs. urban, low vs. high-income countries) require different strategies.[16]

Adaptation strategies include the diversification of assets, such that households do not only rely on one kind of crop or business for economic survival.[17] For instance, farmers in rural places and in unstable places can diversify the technologies of their crops, and/or learn new trades to supplement their livelihoods. However, even the extent of participation in adaptation strategies to climate change varies by age. For example, a study of farmers in Eastern Kenya found that older farmers are less likely to uptake new technologies and grains that would mitigate the impact of droughts on their product.[18] This is a perfect example of how development interventions about climate change need to consider aging populations and how to help support them as they cope with climate-induced changes and disasters.

One potent solution is inter-sectoral collaborations. Public health departments should collaborate with urban planners to create accessible apartments for older people. Updated building codes could require backup generators to support possible power outages during extreme weather events. Urban planners should find ways to promote the social lives of older people because social connectedness can uplift the mental health of older people and serve a practical purpose. Public-private partnerships are especially important to consider because they combine funding mechanisms to promote both healthy investments and social infrastructure in local communities. One example of a possible public-private partnership would be a housing development funded by private investors but supported by public subsidies for older people who cannot otherwise afford to live there.

Our team developed a Model for Healthy Aging for practitioners that guides an understanding of the climate-change-induced health risks of the elderly population. The model shows how developers, health experts, planners, and community leaders can address this issue. The model assigns a climate change event to the risk it poses for the elderly and

15 Takano, T., Nakamura, K., and Watanabe, M. "Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces," *Journal of Epidemiology & Community Health*, 56(12) (2002), pp. 913-918.

16 Agrawal, A. "The role of local institutions in adaptation to climate change," World Bank (2008).

17 Lin, B.B. "Resilience in agriculture through crop diversification: adaptive management for environmental change," *BioScience*, 61(3) (2011), pp. 183-193.

18 Mugi-Ngenga, E. et al. "Household's socio-economic factors influencing the level of adaptation to climate variability in the dry zones of Eastern Kenya," *Journal of Rural Studies*, 43 (2016), pp. 49-60.

provides a potential area of investment to address that risk. Below, we review the main tenets of the model and supplement these key points with relevant empirical literature:

Improve mobility/ transportation systems that increase accessibility for older individuals.
Urban planning and design can strengthen cities and communities with public spaces that are accessible and that carry potential to promote social connectedness.[19] Mobility also means migration. In regions with rising waters and flooding, one of the strategies of adaptation is retreating from the space, encouraged by buyouts. These buyouts need to be financed and they often are funded by the state or entities like the U.S. Federal Emergency Management Agency (FEMA). More people need them than receive them, which "condemns some to live through multiple disasters."[20]

Promote affordable community living and community-supported solutions to social isolation.
Older people rely on several forms and sources of housing. Housing options include subsidized housing with associated programs that ease health care access. However, these housing projects are limited in number and should be expanded.[21] Older people who live with others adapt better after natural disasters.[22]

Support access to creative health care provision, such as mobile clinics/teams.
Tackling health issues in underserved communities can lead to not only community-wide health improvements but also significant cost savings. Mobile health clinics, for example, improve access to health care while also overcoming negative social determinants of health.[23] This cost-effective care delivery model should be more readily considered as a solution to address the needs of the elderly population and should be integrated into health care systems more frequently.

Improve housing infrastructure, including access to air conditioning and power back-up options.
There are promising technological advancements to improve how we think about places and aging. For instance, gaming technology has been used to plan infrastructure and housing projects to facilitate designer and client housing prototypes using digital design.[24] These designs can be used to produce prototypes of living spaces that are responsive to both climate change and aging needs.

19 Schuur, S. "Designing for Future Uncertainties: Comparative Studies of Two Adaptive Strategies in Urban Design in New York and Sweden," *Climate Change Adaptation in North America* (Leal, W. and Keenan, J.M. [eds.]) (2017), pp. 177-191.
20 Wiseman, R.F. "Why older people move" (1980).
21 Gibler, K. "Aging subsidized housing residents: A growing problem in US cities," *Journal of Real Estate Research*, 25(4) (2003), pp. 395-420.
22 Kwan, C. and Walsh, C.A. "Seniors' disaster resilience: a scoping review of the literature," *International Journal of Disaster Risk Reduction*, 25 (2017), pp. 259-273.
23 Stephanie, W. et al. "The scope and impact of mobile health clinics in the United States: a literature review," *International Journal for Equity in Health*, 16(1) (2017), p. 178.
24 Wu, W. and Kaushik, I. "Design for sustainable aging: improving design communication through building information modeling and game engine integration, *Procedia Engineering*, (118) (2015), pp. 926-933.

Create access to green spaces.

In Taiwan, increasing access to green spaces has improved the health of the elderly.[25] Community environments support physical activity and social connections for the elderly. This intervention revealed that when available, older adults not only accessed the spaces but also asked for a combination of structured activities and age appropriate physical exercises. Thus, evidence reveals that green spaces are a viable intervention to improve the health of older adults.

Figure 1. The Model for Healthy Aging that bridges climate, change, health, and community development needs

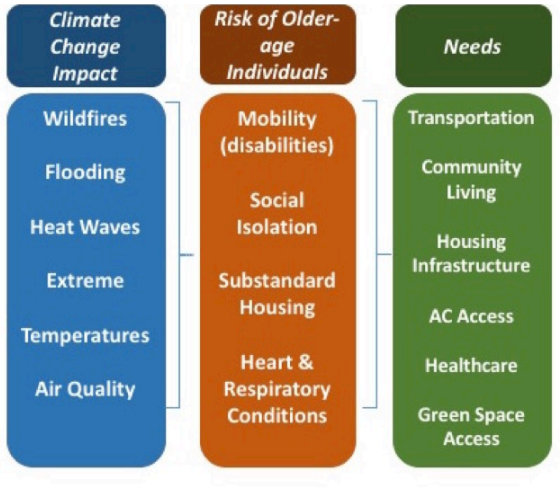

Figure 1 is the conceptual Model for Healthy Aging, which ties together the health-climate change link and the global aging phenomenon. The model shows that increasing the resources in the physical and social environment are important building blocks that can help mitigate the adverse community health effects of the aforementioned climate change events. Efforts to increase infrastructure for climate change adaptation for the aging community need to work across more than one of these community resources.

Our model builds on the four action areas of the Robert Wood Johnson Foundation's Culture of Health Framework.[26] The framework is a movement that promotes cross-sector collaboration to strengthen systems that would, in turn, create healthy and equitable

25 Pleson, E. et al. "Understanding older adults' usage of community green spaces in Taipei, Taiwan," *International Journal of Environmental Research and Public Health*, 11(2) (2014), pp. 1444-1464.

26 Robert Wood Johnson Foundation. "Building a Culture of Health: An Action Framework," Vision to Action: Measures to Mobilize a Culture of Health Report (2016), available at from https://www.rwjf.org/content/dam/COH/RWJ000_COH-Update_CoH_Report_1b.pdf.

communities.[27] It depicts a movement in thought and practice that allows stakeholders from all fields to join forces to improve people's health. The built environment is directly associated with health outcomes.[28] In the face of changing climate conditions and increased prevalence of extreme weather events, the built environment needs to transform in order to meet the health needs of the most vulnerable populations.

Community development practitioners should consider investing in projects that address the wellbeing of the community as a whole. Investment in infrastructure will have ripple effects not just for the health of the elderly but those with disabilities and other vulnerable populations. Improved infrastructure and healthier elderly populations will decrease costs to health care systems, which can lead to a reinvestment of savings in other public goods. An investment in health is an investment in all of society.

Practical Recommendations and Implications

In addition to a conceptual framework, there are practical recommendations for current and long-term projects. First, the language of contracts in development projects that aim to increase equity need to include a memorandum of understanding for vulnerable populations. Specific language in the contract will assure access for those living in poverty. Investors and planners who seek to create affordable solutions should ensure that new projects do not increase inequities in the aging community. Second, developers and planners can use our Model for Healthy Aging to account for the top three needs for the community of interest: transportation, housing, and health care. Third, development projects that promote healthy aging in the face of climate change need to be sustainable. To ensure the success of community development projects after their creation, they need to have a responsible and prepared leadership team at the helm. Teams should be equipped with the financial knowledge that will ensure stability and sustainability.

Looking forward, we need to examine the models of sustainable aging pioneered by other countries. The following are structural changes that would ensure a safer future for elderly populations:

- ***Policy development:*** ensure sustainable public finances to guarantee adequate pensions, health care, and long-term care.
- ***Reform current health care systems:*** ensure adequate systems of long-term care exist to ensure wellness.
- ***Human capital development and inclusive growth:*** support economic and social integration by setting up systems that allows volunteer and job opportunities.

27 Mockenhaupt, R. and Woodrum, A. "Developing evidence for structural approaches to build a culture of health: A perspective from the Robert Wood Johnson Foundation," *Health Education & Behavior,* 42(1_suppl) (2015), 15S-19S.

28 Berrigan, D. and McKinno, R.A. "Built environment and health," *Preventive Medicine*, 47(3) (2008), p. 239.

- ***Intergenerational perspective:*** create social awareness that we are all aging individuals, to help those who are currently in the latter stage of life, ensuring a safer future for us all.

This last point is critical because public engagement and awareness is one of the most important aspects of social and community change. Average individuals who may not think or perceive that climate change threatens their livelihoods need to be included in conversations in order to have a wider net of allies and supporters for healthy aging infrastructure.[29] Collective action will increase intentional dialogue about the issues and solutions that these conversations need.

Conclusion

The changing demographic landscape prompts developers and planners to consider the needs of aging individuals. The built environment is an opportunity for meaningful intervention. Aging populations not only require novel and health-promoting built environments, but also a shift in the priorities of developers and investors. Currently, aging is at the margins of conversations about both climate change and community development. In order to age with dignity, we should insist on an integration of community development, environmental science, and health.

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29 Myers, C.D., Ritter, T., and Rockway, A. "Community Deliberation to Build Local Capacity for Climate Change Adaptation: The Rural Climate Dialogues Program," *Climate Change Adaptation in North America* (Leal, W. and Keenan, J.M. [eds.]) (2017), pp. 9-26.

The Critical Role for Young People and Schools in Resiliency Planning

Deborah McKoy, Amanda Eppley, and Shirl Buss

Demographers predict that people under the age of 18 will comprise 60 percent of the population of U.S. cities by 2030.[1] Despite this trend, recognizing the critical role that young people and schools can play as stakeholders in community planning–especially with respect to climate resilience and adaptation–continues to be a major blind spot for policy makers. The Center for Cities + Schools at the University of California, Berkeley (CC+S) has attempted to address this void through the Youth-Plan, Learn, Act, Now! action research initiative (Y-PLAN). For nearly 20 years, Y-PLAN has empowered thousands of low-income young people of color–ages 5 to 25–to tackle authentic development challenges in their communities and to interact with city planning policy makers about their concerns. Issues they have investigated have ranged from housing displacement to transportation access to climate change–through civic learning experiences largely in public school classrooms around the Bay Area, across the U.S., and around the world.

Demonstrating an innate understanding of resilience, Y-PLAN participants explore the critical role of home, of connection to place, and of social ties in developing an adaptive capacity to natural, social, and political factors. Young people frame community resilience broadly–as a community often thriving in the face of adversity. When invited to collaborate with professional planners and policy makers, students offer a depth of analysis on issues ranging from housing to healthy food access, waterfront accessibility to carbon emissions, poverty to urban violence to gentrification, and they situate us all as partners in a larger community of practice. By embedding schools and young people into the fabric of community resilience work, we not only benefit our children but also allow them to help us solve the most vexing challenges of our time.

Pieces in the Resilience Research Puzzle

The contemporary resilience field is largely focused on two main concepts: urban resilience and community resilience. Both of these categorical definitions build on earlier conceptual frames that describe resilience as a speedy return to a single "equilibrium" or the status quo. However, in the majority of low-income communities of color, such as those engaged in Y-PLAN, the status quo is not an acceptable condition for children and youth to

1 Wright, H. et al. "Cities Alive: Designing for Urban Childhoods," ARUP (2017), p. 7, available at https://www.arup.com/-/media/arup/files/publications/u/cities_alivedesigning_for_urban_childhoods.pdf.

grow up in. Many researchers and practitioners recognized this reality and developed other theories of resilience and adaptive capacity that took this concern into consideration, ultimately recognizing the value of transformative adaptation over single equilibrium resilience.

Urban Resilience

In 2016, social-ecological researchers conducted an extensive review of the resilience literature, covering 172 studies with 25 distinct definitions of urban resilience.[2] They found that these definitions differed significantly across critically important categories, from the definition of the term "urban" itself, to the conception of "equilibrium," to the timescale needed for action. After identifying six such conceptual tensions that a complete definition should address, they defined urban resilience as "the ability of an urban system—and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales—to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity."[3]

This definition is notably similar to late stage definitions of urban resilience as "the ability of an urban system or city to respond to the new requirements imposed by internal and external shocks or change processes by learning, adapting, reorganizing, and transforming its subsystems to take advantage of new opportunities."[4] Both definitions consider the city as an ecosystem and allow for resilience to be demonstrated as an informed return, change, or transformation to an improved state. As future transformative states are highly contested, urban resilience has fallen by the wayside in favor of a body of knowledge framing transformative adaptation and adaptive capacity.[5]

Community Resilience

While urban resilience has become a minor concept, community resilience has developed a mature body of scholarship in both theoretical and empirical terms. However, the diversity of community resilience concepts can be overwhelming to casual practitioners. To wit, community resilience draws from both "psychological resilience," which considers an individual's capacity to deal with adversity or change, and "disaster resilience," examining how systems respond to disasters. Community resilience, therefore, is the "capacity of the social system to work toward a common objective … consider[ing] both system characteristics that support change and the processes through which agency can be created and enacted so as to retain a community's core structures and processes." Essentially, what distinguishes community resilience from urban resilience in these definitions is community resilience's

2 Meerow, S., Newell, J.P., and Stults, M. "Defining urban resilience: A review," *Landscape and Urban Planning*, 147 (2016), pp. 38–49. doi:10.1016/j.landurbplan.2015.11.011

3 Ibid, p. 29.

4 Davidson, J.L. et al. "Interrogating resilience: toward a typology to improve its operationalization," *Ecology and Society*, 21(2) (2016), table 1. doi: 10.5751/ES-08450-210227

5 Ibid, p. 3.

consideration of the people involved, their agency to effect change, and the value of the elements of their culture that must be preserved for a system to demonstrate resilience functionality. This is a crucial distinction for the concept of community resilience.

Community Resilience and Urban Youth

Y-PLAN recognizes the need for a shift in the relationships between young people and those with the power to affect community resilience and climate adaptation. This is especially true when considering that urban youth tend to differ from their civic leaders not only in age, but also in race and socioeconomic status. While Y-PLAN works primarily with low-income students of color across the U.S. and abroad, the professionals and practitioners it partners with are majority white, middle-income men and women, who often hold advanced degrees in their fields.

The challenge is how to forge understanding between these youth and the adults in positions power despite the lack of shared experiences and aligned socio-economic backgrounds. This gap in understanding, perspectives, and priorities then contributes to the far too frequent disconnect between policies and young people's everyday lives. For example, bike share programs are launched that require credit cards to use, and rapid transit agencies charge full fare for anyone over the age of twelve. What is the result? Teenagers are excluded from participation. When students have been tasked with mitigating the impacts of sea level rise, the gap in priorities is highlighted, and Maslow's hierarchy of needs comes into play. One Y-PLAN teacher put it succinctly, "[g]entrification is a really big issue, racism is a really big one too ... If they're worried about getting shot at today, they're probably not worrying about [sea level rising] tomorrow."[6]

Bridging the Gaps

Through Y-PLAN, we have seen how this gap can be bridged by forging communities of practice that leverage civic learning experiences for young people and critically examine the equity concerns embedded in the existing understanding of what we mean by resilience. What distinguishes Y-PLAN action research initiatives from many other youth engagement programs is a set of essential conditions shared by all Y-PLAN work, in the classroom, in the boardroom, and in city hall:

- An authentic civic client who seeks recommendations for addressing current, implementable questions/challenges in their community;
- A curriculum designed to optimally engage classrooms in critical inquiry within a public school setting;
- Adherence to Y-PLAN's rigorous five-step methodology; and
- A social justice and equity focus.

6 Y-PLAN teacher interview.

Y-PLAN is grounded in critical social theory that bridges the fields of education and city planning.[7] Communities of practice recognize that "building complex social relationships around meaningful activities requires genuine practices in which taking charge of learning becomes the enterprise of a community."[8] By building those "complex social relationships" between civic leaders and young people around "meaningful activities" like creating a more resilient city, with "genuine practices" such as learning from lived experiences, primary source data collection, and best practices scans, that work can begin to be recognized by all members of the community of practice as a shared directive–"the enterprise of a community" that will bring out the best abilities of each member to develop a better product together, to the benefit of everyone.[9]

A prime illustration of how to engage students and bring them to the table is at Richmond High School, in California. Through Y-PLAN over 250 students worked as consultants for the Richmond city manager to inform the Climate Action Plan (CAP). Working over the whole semester, teams of students made recommendations to address climate change impacts on their home, local business, school, and the city overall. What attracted statewide attention to their work was how vividly the students were able to express how invisible they and their everyday lives felt within the broader CAP process. Students expressed concerns around housing displacement, lack of access to safe transportation, healthy food and safe drinking water. A summary of students' recommendations was included in the final Richmond CAP. Short-term actions were also implemented, ranging from shifting from the use of plastic water bottles to hydration stations, to new bike racks to solar bus stops. As former city manager Bill Lindsay said at the final event, "we have learned so much from the students –most especially how much we overlook when not engaging them in planning for our future."

Equity and Civic Learning about Resilience

While a community of practice, buoyed by civic learning, can contribute to community resilience, another central tenet in the Y-PLAN initiative has been a focus on equity. While communities of practice, civic learning, and resilience all have the potential to address the current inequities in our society, they do not necessitate equity. A community of practice, in itself, does not require a power differential amongst its members, and certainly not one as vast as that between low-income young people of color and the leaders of their cities. Similarly, civic learning is essential for all students, regardless of their socio-economic status or race. Meanwhile, equity often remains a sidebar or removable section in the aforementioned conversations around community resilience.

7 McKoy, D.L. and Vincent, J.M. "Engaging Schools in Urban Revitalization: The Y-PLAN (Youth–Plan, Learn, Act, Now!)," *Journal of Planning Education and Research*, 26(4) (2007), pp. 389–403. doi: 10.1177/0739456X06298817

8 Wenger, E. *Communities of Practice: Learning, Meaning, and Identity*, Cambridge University Press (1998), p. 272.

9 Ibid.

Perhaps most saliently, this omission is evident in the definition of resilience itself. The conception of resilience as necessarily positive is held to be generally true across social, physical, and biological disciplines, as they start from the assumption that either the original state was desirable, or that a resilient system will adapt or transform into a more desirable state. This is a deeply flawed assumption. Questions of "resilience for whom" must be considered before proceeding under the assumption that resilience is by definition, positive.[10] In fact, "efforts to build resilience should focus on transforming systems that are inequitable (e.g., poverty traps) or hinder individuals or communities from developing adaptive capacity," recognizing that "urban resilience is inevitably a contested process in which diverse stakeholders are involved and their motivations, power dynamics, and trade-offs play out … [and] shaped by who defines the agenda, whose resilience is being prioritized, and who benefits or loses as a result."[11]

The consideration of equity in transformative adaptation should be considered not only in terms of outcomes, but also in terms of the impact of power distributions on decisions of desirability.[12] In other words, who decides what adaptations should be taken? Any transformations that occur may be hardest on those with the fewest resources as those with the most capital are best able to adjust to societal transformation.[13]

An assumption of resilience as a necessarily positive construct ignores the very real questions and concerns of the thousands of low-income Y-PLAN students of color. They acutely know through their own lived experiences, and framed through civic learning opportunities, what to ask within their trusted communities of practice:

- If we improve our community, will we still be able to afford to live in it?
- Why is our neighborhood at the greatest risk to natural disasters like earthquakes, sea level rise, and flooding? And what can we do about it?
- Why are we focused on planning for the future when we don't have healthy food or stable shelter or safety from gun violence today?
- We may not be able to define resilience for you, but we can tell you that we are resilient.

The Rigorous Five-Step Y-PLAN Methodology

Y-PLAN action research projects engage students of all ages in a rigorous five-step methodology. Educators guide students through this process with the help of the Y-PLAN Instructor Guide and accompanying Student Field Guide. Y-PLAN focuses on the community as a text for core learning, producing positive outcomes for both students and the neighborhoods in

10 Meerow, S. et al. "Defining urban resilience" (2016); Davidson, J.L. et al. "Interrogating resilience" (2016).
11 Meerow, S. et al. "Defining urban resilience" (2016), p. 46.
12 Adger, N.W. et al. "Successful adaptation to climate change across scales," *Global Environmental Change*, 15(2) (July 2005), pp. 77-86, available at https://www.sciencedirect.com/science/article/abs/pii/S0959378004000901. doi: 10.1016/j.gloenvcha.2004.12.005
13 Y-PLAN teacher interview.

which they live. The students are building college, career, and community readiness, while helping contribute to healthy, equitable, and joyful cities, and all stakeholders are learning to understand each other's perspective.

In phase one, Start Up, students uncover their own strengths and those of their team. They learn about their Y-PLAN challenge directly from their civic clients: city and regional leaders who pose an authentic question for the young people to help solve. In recent Y-PLAN work in New York City, for example, students partnered with the Brooklyn borough president's office to improve access to healthy food while reducing waste. Japanese Y-PLAN students, likewise, informed the programming of public space in post-tsunami Kamaisha where they've committed to build no housing on the water's edge, while Green Academy sophomores from Skyline High School engaged with the Oakland Planning Department to design a more sustainable and vibrant city center.

In phase two of the Y-PLAN methodology, Making Sense of the City, students take to the streets to map their community, collect relevant data, and conduct interviews and surveys with residents and stakeholders. They consider the strengths, weaknesses, opportunities, and threats they find, and gather inspiration from local, regional, national, and global best practices before moving into phase three, Into Action. During this phase, students review their primary and secondary source research as they engage in a design charrette process to guide their brainstorms and help them create plans for change, weighing the costs and benefits of short- and long-term recommendations.

Students then prepare and present their policy recommendations to their civic clients as part of phase four, Going Public. Panels comprised of city and education leaders offer students verbal and written feedback based on the academic skills demonstrated by their presentations, as well as the potential impact of their proposal on participants, processes, policies, and places, ultimately considering the promise of their recommendations to help build a healthier, more equitable, and joyful community. Students' work does not end with the final presentations, but rather, phase five, Looking Forward and Back, allows students the space for reflection that is essential both for cementing the skills and knowledge they learned from the project and also for structuring the shared accountability for next steps of implementation.

Case Study

In one recent project, during the spring of 2018, a science classroom of high school students from East Palo Alto Phoenix Academy (EPAPA) were tasked with developing proposals for a more resilient East Palo Alto. As in all Y-PLAN projects, students started phase one by connecting with their lived experience through writing "Where I'm From" poems and conducting an activity situating themselves in the city. During phase two, they mapped their community, analyzed its strengths, weaknesses, opportunities, and threats, designed and conducted resident surveys and stakeholder interviews, and researched global

best practices for sea level rise, housing, transportation, and education.

As the EPAPA students began to develop recommendations as part of phase three, a team of professional planners, designers, and environmentalists visited their classroom on a rainy March afternoon to learn from and with them. After a working session in the classroom, several students stayed after school to lead the adults two blocks from their campus to show the place that they considered the heart of their community. When they reached the road's end, a flooded trail greeted the group, and the adults, wearing dress shoes, stopped walking. Unwilling to end their tour without reaching its highlight, one student, Santiago (Santi), turned abruptly to the right and gestured for everyone to follow.

"I know another way. I live right over there," he pointed, and without looking back to allow for dissent, he led the group through a break in the fence, along a makeshift muddy path, skirting the bulk of the flooding, toward a steeper route to the berm. Along the way, students described the dire need for affordable housing in the face of displacement from both gentrification and sea level rise, each telling his or her own story of overcrowding: of fourteen people in a one-bedroom apartment, of families living in unfinished garages, of living arrangements with no access to a kitchen, of paychecks where more than 70 percent was spent on rent.

Once the teenagers had helped the adults scramble up the slippery embankment, they stood together, perched atop the East Palo Alto Baylands Trail, overlooking the expansive tidal flats. Santi and his classmates pointed out their soccer fields, the shore birds that no longer flee when they jog by, the tidal flats, and ultimately the bridge where the trail crosses the water and passes out of sight. One of the professional planners in the group offered the possibility of a water's edge, environmentally friendly development as a solution to alleviate the housing burdens the students had just described. With a pause, the young people slowly, emphatically shook their heads. Santi explained that "so much already lives here. The egrets, the squirrels, all of them. They've lived here longer than any of us. We can't steal that."

Over the following weeks, phase three continued, and students held brainstorming charrettes to develop proposals with recommendations including elevated housing structures, unifying mixed-income apartments, and low-income condos affording local residents home ownership benefits. They recommended a transportation corridor redesign to ease congestion, reduce emissions, and build community, and they designed a Mexican style *Plazita* to spark the local economy and highlight its culture. Additional professionals visited their classrooms to listen to their ideas and help push them further, asking for their analysis of costs and benefits and consideration of outside constraints, from zoning to land ownership.

As students moved into phase four, they created slides, models, posters, and policy briefs, and presented their proposals to regional leaders at University of California, Berkeley alongside their Bay Area peers, to their own city council and city manager a few blocks from their school in East Palo Alto, and in a boardroom at the nearby Facebook headquarters. At the city council meeting, one council member pressed the students further still, asking if they were given the opportunity to push one, and only one, recommendation through, which

it would be. Santi once again stepped forward for his peers, explaining eloquently to the council that despite their affinity for the *Plazita*, with its ability to drive economic development while maintaining a cultural identity, housing must be prioritized above all else. Finally, during phase five, students not only completed written reflections and discussions, but fourteen students were hired as summer interns to research housing conditions in their community.

Conclusions

As resilience and community resilience become more resolute in their analysis and in practice, consideration should be given to the proposition that young people innately understand the concepts of resilience with a great deal of clarity. Resilience, whether for an individual or across a system, requires stability, it requires understanding, relationships and trust, it requires inclusion and responsibility, and it requires connection.

We simply won't create needed change in our cities–or be able to truly address everyone's concerns–without the insight and contribution of young people. This is critical for two reasons. First, as a society we must invest in cultivating a sense of agency in young people through their community and civic engagement on topics of interest to them, such as the effects of climate change. Second, city planners in the community development field must integrate young people's insights to make better decisions for everyone–not just the wealthier classes who can afford to remain in cities as part of climate gentrification.[14] Moreover, our public schools offer a unique opportunity for community development to reach our nation's young people, equitably.[15]

Just like the EPAPA students, the more than 10,000 students who have engaged in Y-PLAN action research initiatives throughout the last two decades share both a first-hand understanding of the implications of displacement from environmental hazards and gentrification through their lived experiences, and an innate understanding of resilience through their own embodiment of it. Throughout their work, students share intimate stories of the displacement of friends, of families, of themselves, stories of food insecurity and homelessness, of inequitable educational opportunities.

By building on their lived experiences, by collecting primary source data only they can generate, and by working as part of a community of practice with city leaders in initiatives such as Y-PLAN, they allow us to improve our cities together. The heart of their proposals comes not in spite of the current conditions in our cities, but because of them. As our field searches for ways to advance community resilience, the visions of our young people,

14 Keenan, J.M., Hill, T., and Gumber, A. "Climate gentrification: from theory to empiricism in Miami-Dade County, Florida," *Environmental Research Letters*, 13(5) (April 23, 2018), available at https://iopscience.iop.org/article/10.1088/1748-9326/aabb32.

15 McKoy, D.L. "The Community Development and Education Connection: Reviving Cities, Transforming Schools and Engaging Young People in the Process," *Community Investments*, Federal Reserve Bank of San Francisco, 19(2) (2007), pp. 20-23.

informed by lived experience and unbounded in their creativity, can provide the bridges we need between sectors, between communities, between the natural world and the built environment, and between the realities of today and our visions for the future. The essence of community resilience is found in young people. They hold the missing piece of the puzzle we struggle to complete. They are our present and our future.

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Drawing a New Roadmap: The Resilient by Design Bay Area Challenge

Allison Brooks

This article discusses how the 2017-18 Resilient by Design Bay Area Challenge (RBD Challenge) galvanized creative, silo-crossing, multi-benefit thinking concerning how best to prepare for sea level rise along California's low-lying San Francisco Bay shoreline. In the process, this international, Rockefeller-funded design challenge confronted key questions in the community development field, ranging from how to engage at-risk populations in critical decisions concerning their future safety to why municipalities should consider resilience and adaptation when planning infrastructure upgrades and where to get the money to be proactive, rather than reactive, about climate change.

These kinds of challenges and questions rose dramatically to the surface with the Camp Fire of 2018 in Paradise, CA as they did after Hurricanes Michael, Harvey, Sandy and Katrina. Our increasing experiences with extreme weather events–more wind, water, heat, and fire than ever before–call on us to accelerate our response and to plan ahead with agility and flexibility in mind. This is exactly what the RBD Challenge provided–an opportunity to accelerate the development of a platform and process for the San Francisco Bay Area to proactively manage climate change impacts now and into the future.

Extreme Danger

While climate change is often relegated to the category of "future threat," it is worth noting that much of the writing of this article occurred during a very present-day cloud of wildfire-fueled smoke that was impossible to ignore. Over two weeks in November 2018, toxic smoke and particulate matter darkened the skies of the Bay Area. The dark cloud drifted 190 miles southwest from the deadliest and costliest fire in the state of California's history – the Camp Fire in the town of Paradise in the Sierra foothills. With 85 lives lost, 13,972 residences destroyed, and 52,000 people evacuated, the Camp Fire was an alarming and now seemingly annual reminder of the vulnerability of California communities to multiple hazards exacerbated by climate change. These are immediate hazards to human safety and public assets created by fires, flooding, sea level rise, drought or extreme heat[1]– on top of the ever-present danger posed by living in earthquake country.

Devastating events like the Camp Fire illustrate how unprepared our governance and financial systems are to tackle the extreme climate challenges of the 21st century, let alone deal with near-term challenges such as access to affordable housing and limited mobility.

1 California Department of Forestry and Fire. "Camp Fire Incident Information" (2018).

Coined "the new abnormal" by former California Governor Jerry Brown, extreme events like the Camp Fire call for new approaches to community development that proactively prepare communities, particularly the most vulnerable low- and moderate-income communities at the frontlines of risk, for an uncertain future.[2]

To that end, the RBD Challenge focused on fostering a new model of collaborative, multi-disciplinary problem solving before, not after, the disaster strikes. The challenge tapped into the creative power of design thinking to help Bay Area residents visualize and realize a region more resilient to climate-related flood issues. In the process, the project shed light on how traditional models of infrastructure and community development financing are insufficient to the task ahead and offers up some ways in which that deficit can be overcome.

Connecting People to Climate Risks

As a diverse metropolitan region with low-lying shorelines susceptible to flooding, rising sea levels, and active earthquake faults, the San Francisco Bay Area is a prime candidate for proactive action to reduce local- and regional-scale risks from climate change impacts. Much of the Bay Area's urban development, including housing, job centers, roads, bridges, airports, rail lines, and wastewater treatment plants, have been built along the shoreline of the bay. This shoreline is more vulnerable to sea level rise than previously thought according to a recent evaluation identifying severe land subsidence issues in areas sitting on top of artificial landfill.[3]

Addressing some of this vulnerability through a year-long design challenge was a primary focus of the RBD Challenge, which was funded largely through a significant Rockefeller Foundation grant. The challenge brought together teams of designers, architects, landscape architects, engineers, economists, educators and planners, and asked them to work with community organizations, local governments, and residents of all ages to develop innovative, community-based solutions to strengthen the region's resilience.

The RBD Challenge was modeled after a project called Rebuild by Design, started by the U.S. Department of Housing (HUD) in response to the devastation experienced in New York, New Jersey, and Connecticut from Superstorm Sandy. In contrast, the RBD Challenge was pre-emptive, offering an opportunity to accelerate the regional conversation about climate adaptation, identify the types of multi-benefit strategies that could be implemented to address flood and sea level rise vulnerabilities, and explore new models of finance and governance better matched with the scale of potential impacts.

While HUD made one billion dollars available post-Sandy to help fund the conceptual designs that emerged out of the East Coast's Rebuild by Design, the West Coast did not

2 Birnbaum, E. "California Governor on Wildfires: 'this is the new abnormal,'" *The Hill* (November 11, 2018), available at https://thehill.com/homenews/state-watch/416167-california-governor-on-wildfires-this-is-the-new-abnormal.

3 Shirzaei, M. and Burgmann, R. "Global climate change and local land subsidence exacerbate inundation risk to the San Francisco Bay Area," *Science Advances*, 4(3) (2018). doi: 10.1126/sciadv.aap9234

have the benefit of a similar pot of gold at the end of the process. What intrigued the Rockefeller Foundation, however, and what ultimately inspired them to invest significantly in the RBD Challenge, was the region's prior approval of a groundbreaking ballot initiative in June 2016. The Clean Water, Pollution Prevention and Habitat Restoration Measure (Measure AA) will generate hundreds of millions of dollars over the next 20 years for wetland and habitat restoration, flood control, and public access along the shoreline. One might argue that Measure AA is the first regional-scale climate change ballot measure in the U.S. It signaled to the Rockefeller Foundation that the Bay Area is willing to put our money where our risk is.

Drawing a New Roadmap

Over the last 30 years, the climate change field has largely been the domain of scientists, academic institutions, and environmental groups raising the alarm about the contribution of fossil fuels to greenhouse gas emissions and climate change. However, as the frequency of extreme storms and hazardous events across the U.S. has increased in the last five years–devastating cities, displacing communities, and costing billions of dollars in recovery–there has been a discernible shift in those making the case about climate change. Scientists, academics, and environmentalists are now joined by a much broader set of constituents, such as those that came together during the RBD Challenge effort. Indeed, there is now growing recognition of the need for multi-disciplinary networks of partners to work together to adapt to the changing climate. This shift has expanded the scope of climate adaptation into other sectors such as community development and transportation planning, sectors not yet oriented towards the scale of the challenge.

What is becoming increasingly evident, as we work to adapt to the latest floods or fires, is that government systems, from local to regional to state and federal, are set up to respond to the immediate impacts of disasters but not to the long-term land use and public investment questions raised by them. Government systems are not set up to work proactively and collaboratively across disciplines to make the large-scale investments necessary to adapt to climate instability, to mitigate risk, and to thereby reduce the cost and impact of extreme storms, sea level rise and other shocks and stressors.

That said, the severity of the risk has not gone unnoticed by bonding agencies such as Moody's Investors Services. In November 2017, Moody's announced that states and local governments that fail to implement sufficient adaptation and resilience strategies to address longer-term shifts in the climate will face negative credit ratings. In their announcement, Moody's informed municipal governments that not taking the appropriate measures now to reduce their climate-related risk will impact their ability to generate the resources needed for recovery or to meet demands for other infrastructure needs.[4]

4 Kurtz, K. and Wetz, M. "Climate change is forecast to heighten US exposure loss placing short and long-term credit pressure on US states and local governments," Moody's Investors Service (November 28, 2017), available at https://www.moodys.com/research/Moodys-Climate-change-is-forecast-to-heighten-US-exposure-to--PR_376056.

Though bond rating agencies and insurance companies are paying close attention to the cost of doing nothing in the face of climate instability, the banks and lending institutions that make up the community development landscape have not yet stepped up to the plate in terms of helping the public sector respond to complex climate risks. Municipalities need funding partners to provide resources necessary to conduct the early assessments, planning, and design required to make sound decisions about investments in more resilient housing, infrastructure, and natural systems. The silo-busting nature of extreme climate events requires a systems-based approach to climate adaptation that moves far beyond those currently exercised by the community development field, which has largely narrowly focused on affordable housing.

Devastating events like the Camp Fire or Hurricane Michael in Florida that wipe out entire communities raise major questions that should be of concern to the banks and lending institutions brought in to help with recovery:

- How should we go about rebuilding a community in a way that makes it more adaptive to the scale of risks caused by the changing climate?
- Should we be rebuilding at all in a location highly vulnerable to climate risks?
- Who decides how, where, and if the rebuilding happens? Local government, state agencies, financial institutions?
- Isn't there more that can be done to adapt our communities, infrastructure, and natural systems to the impacts of climate change we know are coming?

The new abnormal caused by climate change calls for an agility in financing that doesn't currently exist, tapping into ways in which investors can capture returns on investment by calculating the costs that result from doing nothing.

A Collaborative, Systems Approach

Philanthropic and public sector grants are typically the sources of funding available for predevelopment costs associated with getting a project off the ground. The conceptual designs that emerged out of the RBD Challenge in nine diverse locations around the San Francisco Bay shoreline, however, indicate that climate change offers a new set of opportunities for banks and lending institutions to invest in more resilient housing, infrastructure, schools, and commercial development. These investments, in turn, can be and were designed to produce multiple benefits at a community and neighborhood scale. Banks and lending institutions have an important role to play in supporting the types of organizations able to shepherd multi-benefit projects through each stage of development. These organizations require expertise in managing complex streams of funding and financing to support different aspects of projects at different phases, as well as in supporting the network of partners essential to sustained success.

An agile and creative mindset is required for multi-benefit, adaptive infrastructure investments. Whereas traditional infrastructure projects are planned and implemented based on singular goals such as moving people and goods through a region, managing stormwater or wastewater, or providing recreational opportunities, adaptive infrastructure projects are aimed at squeezing the most benefits as possible out of a pool of different funding and financing sources. One example of a multi-benefit project that emerged from the RBD Challenge, as profiled in *Estuary News*, was the Colma Creek "Collect and Connect" project in South San Francisco led by the Hassell+ team:

> In places like South San Francisco, seawater will push inland and exacerbate flooding during rainstorms. To allow the earth to sponge up surplus water, Hassell+ has proposed replacing paved surfaces with more permeable ones–think soccer fields, baseball diamonds and playgrounds–in the floodplain of the creek. They also hope to line the creek–currently contained in concrete bed like a canal–with native vegetation and a cycling-walking path, all the way from Orange Memorial Park to the Bay.
>
> To complement this linear park system and corridor, Hassell+ envisions connecting local schools to the streamside parkway via direct bike-friendly travel routes. By this arrangement … the schools would serve as "resilience hubs" or gathering points during disaster events. On a day to day basis, too, the project could make South San Francisco–already a compact place where distances are small, but vehicle traffic is thick–into a much more bikeable, walkable place.[5]

To accomplish the ambitious degree of adaptation to climate change described above, government agencies, community development professionals, and lending institutions would clearly be required to think in much broader and more integrated terms than ever before.

Starting with Community Knowledge First

The RBD Challenge also highlighted how resiliency strategies must be borne out of local expertise and knowledge, with community residents helping to lead efforts around collaborative problem-solving. Marin City's "The People's Plan" that emerged out of a partnership between the Permaculture and Social Equity Team (P-SET) and the community-based organization Shore-Up Marin is an important model of community-based planning focused on capacity building and collaborative problem-solving.

A predominantly African-American shoreline community that sprung up as a result of World War II shipbuilding efforts, Marin City faces current flooding challenges due to its bowl-like setting with water running down steep mountain slopes on three sides. A history of

5 San Francisco Estuary Partnership. "Nine Teams Design for Rising Sea Levels in Nine Places; A Special Section Reveals Resilient Design in Action," *Estuary News* (June 2018), available at http://www.sfestuary.org/wp-content/uploads/2018/06/EstuaryNewsJune2018-v7pages-web.pdf.

redlining, systemic racism, and subsequent disinvestment has also led to poor health and socio-economic outcomes for local residents, a community located in an otherwise predominantly white, affluent county. Working with Shore-Up Marin, the P+SET team set out to model a community-led design process for resiliency planning that got people to "just get up out of their comfort zone, do something different, embrace the communities like ours in Marin City" as stated by Terrie Green, the co-director of Shore-Up Main, again in *Estuary News*:

> P+SET held a community course that covered permaculture design and advocacy literacy. The permaculture course taught locals to assess flood risks and then apply natural strategies to prevent floods…certain natural strategies, if applied and kept up by the community, could help with flooding problems. Class participants considered everything spanning brush plugs, rain gardens, rain cisterns, curb cuts, and more. All of the strategies help to slow, store and sink water, which diverts it from flooding.
>
> [The People's Plan for Marin City] is a living document that outlines community-designed solutions to local issues. Currently, it includes six intervention sites, but it will evolve as the city changes and solutions get implemented. Marin City aims to get the People's Plan officially incorporated into standard planning process, which would give local residents a voice in any major project from the beginning.[6]

As evidenced by The People's Plan and the other collaborative problem solving that emerged out of the RBD Challenge, achieving greater resiliency involves a multi-dimensional approach. However, an essential element to any approach requires building meaningful relationships and trust with local resident experts, the people living at the frontlines of risk and who are essential to carrying out resilience strategies long into the future.

The Realities of Financing Resilient Infrastructure

The first instinct of communities devastated by floods or fires is to replace what was lost, or rebuild in place, but climate change requires communities and those engaged in helping them to think about larger safety and infrastructure investments. Finding the resources for any large infrastructure project is challenging, and that challenge has only increased in this era of declining public budgets. Historically, major infrastructure projects, ranging from coastal protection projects to large economic redevelopment plans, were revenue producing or exclusively publicly funded. As public funds have grown scarcer, however, so have project implementation options. At the same time, as our understanding of the climate related threats to our communities grows, we need to not only address our current crumbling infrastructure, but also build to higher safety standards. That means we no longer have the luxury of staying in our silos. While big public infrastructure was once the role of utilities, water districts, and transportation agencies, with housing and commercial development left to the

6 San Francisco Estuary Partnership. "Nine Teams Design for Rising Sea Levels in Nine Places" (June 2018).

private sector and community development field, we must now come together to ensure that every scarce dollar invested in our built environment plays dual or triple roles.

Climate resilient projects are even more complicated than traditional development or infrastructure projects for a few key reasons:

- ***Systems not projects:*** Most resilience projects are large collections of interventions, such as green storm water infrastructure systems, rather than individual assets, like a water treatment plant. As a result, these projects can take longer to design, pose unique technical challenges, and have higher predevelopment costs.
- ***Diffuse benefits:*** A successful resilience solution will often generate benefits across broad areas and populations, such as improvements to ecosystem services and public health. However, diffuse benefits can be difficult to monetize relative to conventional single-function projects, such as a wastewater treatment plant or toll road. The key funding take-away here is that diffuse benefits mean potential access to multiple revenue sources.
- ***Immediate success isn't the usual result:*** Traditional infrastructure projects like roadways address immediate problems such as traffic congestion. In contrast, the benefits of most resilience projects are avoided costs or reduced losses that can be hard to capture and convert into revenues.[7]

Despite these challenges, as highlighted in the earlier South San Francisco example, well-designed resilient infrastructure systems have an advantage over traditional projects because they often generate multiple, cross-sector benefits. Each type of benefit may have its own funding source, allowing projects to tap a greater variety of transportation, water, or community development grants. Investment in infrastructure along with community development can leverage and enhance both efforts.

Strategically aligning different funding requirements and application cycles can involve significant effort. While this level of coordination can add challenges to an already complex effort, it can also make the difference between effective, large-scale, long-term mitigation of risks to a vulnerable community, and incremental quick fixes.

Conclusions

The RBD Challenge brought together hundreds of organizations, thousands of individuals, and some of the leading designers in the world to tackle flooding, sea level rise and seismic risks in the Bay Area region. The exchange of knowledge, relationships built, and ideas generated have inspired individuals and institutions throughout the region to take the threat of climate change seriously and to plan concrete steps to address risks and prepare communities.

7 Northcross, M. et al. "Finance Guide for Resilient by Design Bay Area Challenge Design Teams Final Version 2.0," NHA Advisors and Resilient by Design Challenge (August 1, 2018), available at https://static1.squarespace.com/static/579d1c16b3db2bfbd646bb4a/t/5b5f4da288251b0f228a990e/1532972477684/RBD+Financing+Guide+%28NHA+Advisors%29+Final+Version+2a.pdf.

As the RBD Challenge partners work together to advance the best of the multi-benefit projects that emerged from the effort, we look to funding and financing partners to join us in charting a path forward that serves Bay Area residents and also reduces the financial, social and environmental risks of climate instability. We hope this is a model that can contribute to the community development field of practice and inform other important efforts across the U.S. and internationally.

Now, more than ever, the most vulnerable and least affluent places in the Bay Area and across the globe are looking to those with more resources and authority to not only own their contribution to the problem but also help ease a difficult future. As witnessed at the 2018 Conference of the Parties to the United Nations Framework Convention on Climate Change (COP 24) talks in Poland, the real point of contention remains who should pay to help the communities and countries with limited resources and capacity to adapt? This will be a central question for climate planners and community developers in the decades ahead, and the answers won't be simple or easy–just urgent.

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Promoting Equitable Climate Adaptation through Community Engagement

Kokei Otosi

The design process is an ideal structure for community participation and a uniquely nimble method of problem-solving through experimentation—an iterative cycle of research, analysis, prototyping, stress-testing, and refinement to reach a final product. Accordingly, design offers powerful tools for tackling complex social, ecological, and cultural issues. It can identify and define problems, breaking them into discrete parts to propose new solutions. It can also help communicate ideas by enabling people to visualize new possibilities and the steps to enact change. These tools present an opportunity to put communities at the center of efforts to confront the challenges of climate change. At its best, climate-adaptive design seeks to ensure that communities thrive in the face of both known and unknown impacts, augmenting and modifying physical, natural, economic, and social systems.[1] The challenge is to advance such design in ways that are attentive to the people who inhabit places and interact with those systems.

Design interventions of nearly any scale will inevitably intersect with social structures and other invisible forces at play. The success or failure of urban climate-adaptive design cannot be understood strictly on the basis of how such augmentation performs against climate conditions. Rather, design must fundamentally consider the human experience now and in the future. Creating flourishing ecosystems is crucial to climate adaptation, but the core aim of climate-adaptive design is to protect inhabitants and improve people's lives. By understanding the conflicts and synergies associated with these values, there is an opportunity to utilize design as a means of understanding the trade-offs associated with climate adaptation interventions. This article highlights some of the lessons and practices that Van Alen Institute has cultivated as part of its mission to advance design in the public realm.

Equity in Climate Adaptation

As is true of many other forms of economic investment, climate-adaptive design has the power to advance equity or inequity. Climate change impacts are not only unbalanced geographically, with certain swaths of populations at greater risk than others, but they may also have an economically disproportionate impact, with large numbers of those who are

1 McIntyre, M.H. "A Literature Review of the Social, Economic and Environmental Impact of Architecture and Design," Government of Scotland (August 10, 2006), available at https://www2.gov.scot/Publications/2006/07/21095819/11.

at greatest risk having the fewest resources to recover.[2] The result is that climate change presents unique challenges to communities that are already the most vulnerable to other shocks and stressors, and thus may be less prepared to adapt. These populations are often the most socially and politically marginalized and do not have the tools or direct lines of access to advocate for themselves. By ignoring these factors, design can inadvertently exacerbate inequity by reserving solutions for those with the resources for advocacy and by deploying interventions[3] with downstream impacts that further marginalize vulnerable communities.[4]

Climate adaptation efforts by practitioners and city leaders cannot ignore the power of design's potentially disparate impacts if they are to be successful. It is only when the various components that lend to a community's adaptive capacity are examined, acknowledged, and accounted for that design interventions can be tailored to the communities they aim to help. The lenses of distributive equity and procedural justice enable climate-adaptive work to be embedded in a community in a way that is contextually appropriate, providing the flexibility to accommodate climate impacts over time. While design cannot by itself deliver social services, an equitable approach to design can be part of a suite of services that enhance a community's adaptive capacity. As Shamar Bibbins, senior program officer for the environment at the Kresge Foundation put it, "[c]limate adaptation without equity provides interventions but not transformative solutions. Equity takes the long-view."[5]

The question of what it means for a project to be equitable presents a complex planning and policy challenge. While many people believe in the sentiment, there is little consensus on its parameters. Moreover, the vulnerabilities that drive a need for distributive equity translate into a diversity of priorities across stakeholder groups, many of which conflict or are in competition for limited resources. Regardless, because climate models predict consistent and accelerated climate threats to the global community, the process of ensuring equitable outcomes in adaptive design projects is an increasingly impossible challenge to ignore.

Inequitable design projects can, in part, be attributed to a lack of community inclusion in their process. This problem has been described as procedural justice, which acknowledges that fair participation in a process is as important as the outcome.[6] Approaches to procedural justice in design processes, known in design practice as participatory design, affirm the notion that a community's participation in the design process will benefit both the community and the efficacy of the outcome. Participatory design aligns with the notion that those who will be directly impacted by a design intervention should have material involvement

2 Roy, J., Tschakert, P., and Waisman, H. "Global Warming of 1.5 Degrees (Rep. No. 15)," Intergovernmental Panel on Climate Change (May 23, 2018), available at https://www.ipcc.ch/report/sr15/chapter-5-sustainable-development-poverty-eradication-and-reducing-inequalities/.

3 Marsh, L., O'Neill, S., and Lorenzoni, I. "Where Do We Go From Here?" *Climate Change and Law Collection*, 9(1) (2013), pp. 7-25. doi: 10.1386/macp.9.1.7_1

4 Reckien, D. et al. "Climate change, equity and the Sustainable Development Goals: an urban perspective," *Environment and Urbanization*, 29(1) (2017), pp. 159–182. doi: 10.1177/0956247816677778

5 Author interview with Shamar Bibbins, senior program officer for the environment, Kresge Foundation.

6 Wood, B. et al. "Socially Just Triple-Wins? A Framework for Evaluating the Social Justice Implications of Climate Compatible Development," *Sustainability*, 10(1) (2018), p. 211. doi: 10.10.3390/su10010211

in shaping that intervention. As a pragmatic submission, the process aligns with the notion that those who will adopt an intervention are best suited to define the criteria for success.[7]

At a minimum, the participatory design process can make accessible the rationale for interventions, which can diminish a perceived lack of transparency into how decisions are made. Democratic modes of participation encourage participants to compromise, as the public assemblage of varying priorities within and across stakeholder groups makes it easier to view personally unfavorable decisions objectively. As an optimal outcome, the participatory design process can result in tailored, favorable, and effective solutions that lift the adaptive capacity of the intended community. While the process of engagement alone cannot accomplish this, a community's active involvement in climate-adaptive design projects plays a significant role in lifting the adaptive capacity of a community.

That said, community engagement is challenging to execute. It can require additional government staff and significantly protract the project time-horizon, requiring resources governments may not have. Engagement activities must be conscientiously timed in order to fold community voices into early stages of the process, but project timelines are subject to shifts and delays due to funding, as well as changing administrative and political priorities. In addition, comprehensively identifying and consulting with stakeholders requires its own set of resources. Meaningful engagement can thus seem unrealistic for cash-strapped cities, or even simply inefficient. However, climate-adaptive projects without a concerted effort to equitably involve the community run the risk of jeopardizing the investment by producing design projects that are short-sighted and incomplete. Engagement is a tool to discover and address the economic, geographic, and political vulnerabilities that ultimately either help or hinder a community's adaptive capacity.

Community Engagement and the Design Process

In addition to spatial and material preferences, the design process has the potential to reveal a community's underlying values, as described by designer Liz Ogbu of Studio O, based in Virginia.[8] The active engagement process can serve as a research opportunity for the design process, revealing the community's attitudes, values, interests, needs, and concerns. Active engagement can play a role assessing community vulnerabilities, both those directly climate-related and those otherwise exacerbated by it, presenting opportunities to ask the community to determine how resilience is defined in its specific context.[9] A participatory vulnerability assessment through active engagement is the key to designing holistic, impactful, and sustainable climate solutions.

7 Stangle, M. and Szostek, A. "Empowering Citizens Through Participatory Design: A Case Study of Mstow," *ACEE*, 1 (2015), pp. 47-58, available at http://www.acee-journal.pl/.

8 Sherman, D. "How Community-Engaged Design Is Changing Development," *Next City* (May 18, 2016), available at https://nextcity.org/daily/entry/what-is-community-engaged-design.

9 Chandra, A. et al. "Building Community Resilience to Disasters: A Way Forward to Enhance National Health Security," *Rand Health Quarterly*, 1(1) (2011), p. 6.

Four key engagement typologies comprise a successful community engagement strategy:[10]

- Activities that aim to ***raise awareness*** about a particular project or problem, outline access points for feedback, or increase knowledge about an issue;
- Activities that ***build relationships***, establishing trust and alignment of goals between the community, practitioners, and city leaders;
- Activities that ***solicit guidance*** from a small cohort of key stakeholders to shape the community's involvement in the decision-making process; and
- Activities to ***spur co-development*** of design elements.

Engagement across these categories, deployed at various points in the design process, can serve to illuminate risks, stressors, strengths, and opportunities within the community. Case studies across these typologies are described below, followed by a discussion of applicability to climate-adaptive design.

Raising Awareness

Activities in the theme of raising awareness establish a baseline knowledge of a topic, issue, or project. Raising awareness is a two-way information exchange, where an engagement facilitator may solicit information from or may share information with the community. This exchange is a preliminary assessment of current conditions–the community's characteristics, challenges, and opportunities. Information is typically disseminated through flyers, surveys, and town halls.

By example, in 2014, a local government in England was interested to understand how its residents wanted to use over $1.3 million that had been allocated to community development.[11] A government agency partnered with a local theater to host a talent show to gather the community and share information about what the process would entail. Community members were encouraged to sign up for a performance slot or to bring family and friends to watch. This stage of increasing familiarity about a project is key for setting up the participatory process for success. This example successfully identifies a method of delivery that is informational and relational, building trust among members, and warming members to the experience of interacting. As a research tool, it provides a forum to gather initial ideas about what residents see as opportunities for neighborhood development.

10 Corbett, E. and Dantec, C. "The Problem of Community Engagement: Disentangling the Practices of Municipal Government," Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems, Association for Computing Machinery (2018), p. 574. doi: 10.1145/3173574.3174148

11 Kelly, V. "World's End and Lots Road Big Local," *City Living, Local Life* (September 22, 2014), available at https://citylivinglocallife.wordpress.com/2014/09/25/video-worlds-end-and-lots-road-big-local/.

Building Relationships

Building relationships elevates informants in the phase of raising awareness to active collaborators. Activities in this theme build on the existing conditions and goals identified through the awareness process and begin connecting relevant actors to goals and tasks. In order to build relationships, practitioners investigate the opinions, sentiments, and values connected to an issue, digging into the motivations that underlie them.

In 2015, President Obama's Hurricane Sandy Task Force implemented a project called Rebuild by Design (RBD). RBD was a design competition to initiate innovative processes and policymaking solutions to protect communities from future floods. The U.S. Department of Housing and Urban Development (HUD), Van Alen Institute, the Municipal Art Society, the Regional Plan Association, and New York University's Institute for Public Knowledge were partners on the project. Through an equitable and inclusive framework, based on geographic and demographic diversity and the involvement of one or more design teams in the area, RBD selected five locations around the New York region to focus community engagement: Asbury Park, New Jersey; Bridgeport, Connecticut; Far Rockaway, Queens; the Lower East Side of Manhattan; and Staten Island's North Shore.

In each place, local residents, nonprofit staff, business owners, and government officials were engaged in planning a public event centered on the theme of "resilience." Planning meetings were closely coordinated with design teams to ensure that the ultimate public event was uniquely tailored to the community and tied to proposed themes and strategies. Planning participants in Asbury Park, for example, emphasized the historic divide between the city's east- and west-side communities as a key barrier to citywide resilience. Engagement took the form of a parade that connected their physical resilience with social resilience. This example recognizes that engagement serves as both an opportunity for the community to identify its vulnerabilities and as a platform to begin to address them. As a research tool, it gave practitioners additional insight into interrelated vulnerabilities their own technical review could not provide.

Soliciting Guidance

While raising awareness and building relationships aim to reach as many community members as possible, engagement practices also scale down to smaller focus groups in order to advance project goals and enhance the overall engagement strategy. Activities in this category seek to distribute decision-making power among key stakeholders. Participants help to distill community needs and shape the communication between practitioners, city leaders, and the target community. Fairness in this distribution of power requires cultivation of balanced and representative perspectives. It requires careful attention to demographic groups that exist within a community and any existing power dynamics.

In the town of Utsunomiya, Japan, community members, volunteer designers, and private sector contributors took it upon themselves to develop a plan for revitalization.[12] The local government had reached a stalemate in efforts to implement interventions, and disenchanted community members had lost faith in the ability of city leaders to address their concerns. The special interest group decided to take the project on, as they believed community perspectives might propel the project forward.

In tandem with a series of engagement opportunities for the broader community, the group engaged smaller cohorts of local residents to gain deeper insight into community preferences and challenges. To attain geographical diversity, the group divided the district into five sampling areas and assembled a cohort of 20 individuals from each, seeking to understand problem areas in the city on which to focus. To go a step further in establishing a balance of power, the group prioritized inclusion of women, a group that had been historically excluded from decision-making, which tended to be male-dominated and male-driven. Representatives from a local women's group were brought into the planning process and were tasked with leading the design team on tours through the city. Ultimately, this resulted in a significant uptake in local women's participation in, and contribution to, the planning process.

As a research tool, community engagement at this scale facilitates a more rigorous vetting of community impressions that practitioners have developed from other engagement activities. Engagement of smaller cohorts also expands access to politically or socially marginalized groups. As an iterative research model, the participatory design process lends insight into the interrelated vulnerabilities that impact the future success of climate-adaptive design interventions. The participatory assessment developed across these three themes results in a design team with a firm grasp on community vulnerabilities and priorities, and a public with trust and investment in the process, and real-time opportunities to address those vulnerabilities.

Co-Developing Design Elements

Activities in the theme of co-development of design invite the community to give specific feedback on design elements for inclusion. Practitioners use methods such as design charrettes and rapid prototyping to understand community preferences and reimagine uses of space. For example, the government in Auckland, New Zealand commissioned a team to redevelop Waitemata Plaza on the city's waterfront. The selected design team's proposed solutions turned the space into a series of temporary activations. All of the activations provided a basic amenity that drew the public in to linger in the space. The design team gathered community feedback through interviews on site, social media, and surveys. Additionally,

12 Sanoff, H. "Democratic design: Participation case studies in urban and small town environments," VDM (2010), available at https://www.researchgate.net/publication/316605037_Democratic_Design_Case_Studies_in_Urban_and_Small_Town_Environments.

video monitoring allowed the team to observe uses of the space over time. Ultimately, the final design was positively received.[13]

Conclusions

Climate adaptation efforts cannot overlook the power of design to increase or decrease inequity. Participatory design as a research process allows for a more pluralistic approach[14] to this work and makes for a more holistic process to increasing a community's adaptive capacity in the name of community resilience.

That said, community engagement in climate-adaptive design practice does have its limitations. At their best, engagement efforts can aggregate the diversity of perspectives that exist in a population. They cannot safeguard the balance of distributed benefits of interventions, however. As a method of procedural justice, engagement can inform how such benefits should be allocated, but the specific process of allocation is a separate category of equitable pursuit. In addition, participation does not address the tension between the democratic ideals that motivate it and the strength of individual preferences. In theory, participants would acknowledge that democratic processes require some form of compromise but the process itself cannot correct for that in practice. Finally, it is possible that the community may not want to be engaged.

Van Alen Institute is a 125-year-old not-for-profit that uses design to catalyze positive change in cities. Over the last several years, Van Alen has focused on climate-adaptive projects including: Rebuild by Design; Changing Course, a design competition to reimagine a more sustainable Lower Mississippi River Delta; Shore to Core, a design and research competition inviting professionals to reimagine downtown West Palm Beach as a dynamic, resilient waterfront city; and Keeping Current, a series of initiatives seeking innovative solutions to protect South Florida's six million residents from the potentially catastrophic consequences of sea level rise. Through these initiatives we have led, explored, and tested different models of community engagement. While our approach to community engagement is constantly evolving, we have learned that it requires earnest and early communication with not only marginalized or impacted communities, but among stakeholders at every level. For this reason, we focus on inter-disciplinary solutions, tapping a broad stakeholder-base. We believe inclusive planning and implementation is essential to developing innovative, valuable, and future-looking infrastructure.

Kokei Otosi manages the Keeping Current Initiative at Van Alen Institute.

13 Savic, B. "Community Engagement in Urban Planning & Development (Rep.)," Winston Churchill Memorial Trust (October, 2015), https://www.wcmt.org.uk/sites/default/files/report-documents/Savic B Report Final_0.pdf.

14 Wood, B. et al. "Socially Just Triple-Wins?" (2018).

Investing in the Virtuous Cycle

Robert Freudenberg

The adverse impacts of climate change are increasingly becoming manifest in the New York metropolitan region. Superstorm Sandy in 2012 (Sandy) served as the proverbial wake up call for the region resulting in 91 deaths[1] and over $65 billion in damages across its path,[2] bringing New York City (NYC), the region's thriving economic engine, to a grinding halt for days. Tunnels and bridges shut down, wastewater treatment plants spilled billions of gallons of untreated sewage into the sensitive estuary system, and today, more than six years later, many neighborhoods are still working to recover.

Outside the context of extreme storms like Sandy, heavier precipitation events, compromised water and air quality, warmer temperatures, and sea level rise are increasingly taking their toll on communities, aging infrastructure, and stressed natural systems. As the Fourth National Climate Assessment highlights, all of these adverse impacts disproportionately affect low-income communities, which comprise about one-third of the population of the NYC metropolitan area (NYMA).[3] These communities are limited in their adaptive capacity to cope with such stressors–much less adapt.

Regional Plan Association (RPA) is a nearly century-old research, planning and advocacy organization that promotes the 31-county NYMA's prosperity, sustainability, health, and equity. Since the 1920s, RPA has developed groundbreaking long-range plans to guide the growth of the region. RPA's recently-released *Fourth Regional Plan* made climate change one of its key research pillars, with about one-third of the plan's recommendations directly tackling the issue.[4] The process to develop the plan was heavily influenced by the perspectives of local community-based organizations, which RPA integrated into the planning process with philanthropic support from the Ford and JPB foundations. Local community-based organizations–many without a core environmental mission or the capacity to integrate the latest climate change research into their work–are increasingly faced with addressing the impacts of climate change in their day-to-day work.

Building on the partnership model pioneered as part of its *Fourth Regional Plan*, RPA calls on financial institutions to invest in regional-local partnerships between research and planning groups and local community-based organizations. Greater proliferation of such pairings will result in a virtuous cycle of regional research driven by local experience

1 Centers for Disease Control. "Deaths Associated with Hurricane Sandy–October–November 2012," Morbidity and Mortality Weekly Report (2013), available at https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6220a1.htm.

2 National Hurricane Center. "Costliest U.S. Tropical Cyclones Tables Updated," National Oceanographic and Atmospheric Administration (2018), available at https://www.nhc.noaa.gov/news/UpdatedCostliest.pdf.

3 U.S. Global Change Research Program. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, Volume II (Reidmiller, D.R. et al. [eds.]), (2018). doi: 10.7930/NCA4.2018

4 Regional Plan Association. "Fourth Regional Plan" (2017), available at http://fourthplan.org/.

and local community development informed by regional data analysis and trends, which would advance better and more equitable policies and higher quality of life in all of our communities.

Advancing Climate Solutions for the NYMA

Since the 1920s, RPA has developed groundbreaking long-range plans to guide the growth of the NYMA. Ideas and recommendations put forth in these plans have led to the establishment of some of the region's most significant infrastructure, open space, and economic development projects, including new bridges and roadways, improvements to the transit network, the preservation of vital open space, and the renewed emphasis on creating sustainable communities centered around jobs and transit.

RPA's general research approach around a given topic typically involves compiling and analyzing relevant publicly-available data in concert with in-depth research into trends and best practices, guided by stakeholder input, in order to develop recommendations for innovations and policy changes at all levels of governance. The organization promotes its findings and recommended actions through a dedicated effort to build strategic alliances, communicate, and advocate for them.

The organization has been focused on the topic of climate change since the release of its *Third Regional Plan: A Region at Risk*,[5] which warned about the potential impacts of failing to curb our greenhouse gas emissions. As this and other similar warnings went unheeded and the threat of climate change impacts started to become a reality, the organization increasingly focused its environmental efforts to conduct research and communicate the need for climate solutions, including adaptation and mitigation.

One of the goals of RPA's work is to make complicated topics easier to understand for decision-makers, stakeholder organizations, and the general public. Our work to mainstream the issue of climate change has evolved over the years from an issue associated with other projects, to one that we provide strategic advice on, to a featured issue of our research and advocacy, including America 2050,[6] a national planning program which focused on the need to address greenhouse gas emissions through improved land use decisions, regional compacts, and better transportation options. RPA has produced and led research on over a dozen major climate related initiatives in the NYMA covering every-

5 Regional Plan Association. "3rd Regional Plan: A Region at Risk" (1996), available at http://library.rpa.org/pdf/RPA-Plan3-A-Region-at-Risk.pdf.

6 Regional Plan Association. "America 2050" (2005), available at http://www.america2050.org/pdf/America2050prospectus.pdf.

thing from managed retreat to climate finance.[7]

A Virtuous Cycle: Regional Policy Research and Local Community Experience

As a research-based organization focused on the long-term prosperity, sustainability, health, and equity of the NYMA, one of RPA's core strengths lies in the analysis of regional data to identify trends and build the case for improved policies and wise investments. At the same time, the region's many community-based organizations work hard every day to improve the lives of community members at the local level, while providing educational and other related services for them.

All too often, these processes—regional planning and community development—proceed in parallel with very little intersection. The end result can be a damaging disconnect between regional policy formulation and the local community experience and, at the same time, community development proceeding without the benefit of research trends and findings. Absent the input of individuals, particularly the region's most economically distressed residents and communities of color, valuable insights are lost and there is an inherent risk of repeating the planning and policy mistakes of the past.

Namely, policies that have perpetuated inequality between people of different races, ethnicities, abilities, incomes, ages, genders, and other social identities, including: unequal access to financing; restrictive covenants; blockbusting; redlining and racial steering; environmental injustices with disparate impacts; urban highway construction that tore apart immigrant communities and communities of color; and transportation that served only some parts of the population, all perpetuated an unequal society. Recognizing the importance of the local informing the regional and the regional informing the local, RPA has found ways to create a virtuous cycle between the two approaches in recent planning efforts, including the development of our *Fourth Regional Plan* and a project aimed at implementing some of the resilience measures proposed by the plan at a neighborhood scale, called "Equitable Adaptation."

The Fourth Regional Plan

The purpose of RPA is—once a generation—to research and produce a long-range plan with recommendations for new or improved policy and planning as well as investments into regional infrastructure, and to then advocate for the implementation of those recommendations. Over the course of its history, RPA has sought the engagement of stakeholders at many different levels to inform the research of its regional plans, from surveys and focus groups

7 Regional Plan Association. "Where to Reinforce and Where to Retreat" (2015), available at http://library.rpa.org/pdf/RPA-4RP-Whitepaper-Where-to-Reinforce-Where-to-Retreat.pdf; Keenan, J.M. "Regional Resilience Trust Funds: An Exploratory Analysis for the New York Metropolitan Region," Regional Plan Association (2017), available at http://library.rpa.org/pdf/Keenan-Regional-Resilience-Trust-Funds-2017.pdf; and Keenan, J.M. "Regional Resilience Trust Funds: An Exploratory Analysis for Leveraging Insurance Surcharges," *Environment Systems and Decisions*, 38(1) (2018), pp. 118-139. doi: 10.1007/s10669-017-9656-3

to Emmy Award-winning promotional videos. As it embarked on its most recent plan, the organization set out to reach deeper into communities than it ever had before with a new model of community engagement focused on including constituencies that have traditionally been underrepresented in planning processes. With support and guidance from the Ford and JPB foundations, RPA collaborated with organizations that have members or networks representing low-income individuals and communities of color, as well as other underrepresented constituencies. Collectively, the *Fourth Regional Plan* partner organizations represent over 50,000 low-income residents and residents of color in the region.

In the first phase of our multi-year collaboration, partners held dozens of workshops and surveyed more than 1,500 individuals and families from underrepresented groups around the region. Community partners surveyed individuals on busses, knocked on doors, held focus groups and larger workshops to learn that the most important challenge for low-income residents in the region is battling a growing sense of instability. Job insecurity, unsafe housing conditions, capricious evictions, lack of access to quality food, health care and other services, ever increasing cost of living, and racial discrimination combine to make the day-to-day feel unpredictable for the region's low-income communities. These residents expressed the desire to be more meaningfully included in decision-making processes with the potential to improve their quality of life and provided critical stories that shaped the plan.

In the second phase, partner organizations brought community leaders to RPA to participate in strategy and solutions sessions around draft recommendations directly with RPA research staff. RPA and a nonprofit community planning group, Hester Street Collaborative, created visuals and activities that communicated *Fourth Regional Plan* findings and preliminary proposals. These enabled the gathering of input on preliminary community development, resilience, and infrastructure recommendations. Community leaders used the same tools to communicate fourth plan findings and preliminary recommendations at community workshops around the region. Participants critiqued RPA's proposed mechanisms to revitalize communities while protecting against residential displacement, to protect vulnerable residents from rising sea levels, and to connect less dense areas. The process yielded many insights for RPA and community participants and strengthened plan proposals in their early stages to improve quality of life for low-income residents.

In the third phase and beyond, RPA and community partners shifted to implementation of *Fourth Regional Plan* recommendations that most strongly support improved quality of life for low-income residents in the tri-state region. RPA and partners focus work on building local capacity such that underrepresented constituencies become better equipped to advocate for more inclusive land use and planning, allowing for the construction of more affordable housing, better connectivity, and more environmental resilience. RPA and partners also jointly wrote an equity agenda for the NYMA, committing to continue collaborating in the future, in order to promote the equitable implementation of the *Fourth Regional Plan*.

Soon after its release, RPA, in partnership with Make the Road New York (MRNY), worked together to focus implementation of the plan at the local level in Central Queens.

MRNY is a community-based organization with a mission to build the power of Latino and working-class communities to achieve dignity and justice through organizing, policy innovation, transformative education, and survival services in the neighborhoods of Jackson Heights, Elmhurst, and Corona in the New York City borough of Queens. Tackling issues of equity and climate change, the project, Equitable Adaptation, has built on the comprehensive community engagement process initiated as part of the *Fourth Regional Plan* with the purpose of improving the adaptive capacity and community resilience of Queens' communities, in particular, those low-income communities of color whom MRNY serves.

Equitable Adaptation solidified RPA's and MRNY's working relationships and married RPA's research and planning capabilities with MRNY's on-the-ground knowledge and community organizing prowess to uncover the ways that climate change affects low-income households and communities of color and to increase the capacity of community organizers and community members to tackle its detrimental causes and effects. RPA had already carried out mapping analyses of such issues as storm surge and sea level rise flooding, urban heat island impact, and how they affect these communities. The organization's demographic analyses had also indicated that these communities were among the region's most ethnically diverse, had much higher levels of non-citizens than average, and had higher levels of poverty than surrounding neighborhoods. But working together with MRNY, through surveys of residents, stakeholder workshops, and local insights of community leaders, a deeper level of analysis was achieved that allowed the two groups to move beyond traditional policy recommendations. For example, the joint effort revealed that the obvious impacts of coastal storm-flooding and sea level rise experienced by waterfront communities are felt differently by more inland, low-income communities of color like East Elmhurst and Corona. In these communities, the impacts of climate change are experienced more as a domino effect that impacts a resident's ability to get to work or school, their physical and mental health, and their safety. The project's final report issued recommendations that reflected the multi-dimensional level of analysis, grouping them according to:

- ***Personal Adaptation,*** including small actions that individuals and families can take to cope with the stress of climate change and its direct and indirect effects;
- ***Collective Resiliency,*** focusing on the opportunity to build the capacity of MRNY as a community-based organization by adapting or enhancing existing programs and applying a resilience lens; and
- ***Community Advocacy,*** which identifies the cross-cutting, co-beneficial policy improvements that local residents and stakeholder groups such as MRNY can advocate for to help adapt their community and others like it to the effects of climate change.

The two organizations were recently awarded additional funding by New York Community Trust to carry out a subset of the actions recommended in the project's report. Such funding will continue to support the virtuous cycle this project has brought about.

Funding the Virtuous Cycle

The two examples described above could not have been possible without generous philanthropic support. The missions of the three foundations that supported RPA's work with community-based organizations were well-aligned with what the collaborative of groups set out to do. The unfortunate truth, however, is that in the long history of RPA, these collaborations comprise but a small percentage of the funded opportunities the organization has achieved. The value of such partnerships–to both the organizations involved as well as to greater society from the concepts and proposals that emerge from them–far exceed the investments to make them happen.

Going forward, RPA calls on financial institutions, under the umbrella of Community Reinvestment Act (CRA) community development activities, to expand investments into such regional-local partnerships. These investments would expand the virtuous cycle in more places and help to add capacity to local organizations and expand the body of knowledge to regional organizations, resulting in better policies and actions that improve the quality of life in neighborhoods. As financial institutions consider such investments, they should look to other models that have, to varying levels of success, enabled such virtuous pairings. Two examples include the Wells Fargo Regional Foundation and the 2011-15 Sustainable Communities Initiative Regional Planning Grant Program.

Wells Fargo Regional Foundation

The Wells Fargo Regional Foundation awards both planning and implementation grants for Neighborhood Planning initiatives to "support long-term, resident-driven neighborhood revitalization" in Eastern Pennsylvania, New Jersey and Delaware.[8] Grants are awarded primarily to local community-based organizations. However, they require the participation of planning consultants. The majority of projects employ private planning firms, but RPA in 2012 partnered with two local organizations–St. Joseph's Carpenter Society and Cooper's Ferry Partnership–in Camden, NJ to carry out a neighborhood plan for East Camden. St. Joseph's Carpenter Society's local knowledge plus Cooper's Ferry Partnership's outreach strength, along with RPA's research and planning expertise, resulted in an award-winning neighborhood plan called My East Camden which today is being implemented. This financial-institution-backed grant program has many notable qualities which could be replicated by other institutions.

Sustainable Communities Initiative: Regional Planning Grant Program

Between 2011 and 2015, a cross-section of federal agencies, including the U.S. Housing and Urban Development, the U.S. Department of Transportation, and the U.S. Environmental Protection Agency, among others, collaborated and offered funding to support

8 Wells Fargo Regional Foundation. "Mission," available at https://www.wellsfargo.com/about/corporate-responsibility/community-giving/regional-foundation/.

regional and local planning efforts to help communities integrate housing, transportation, infrastructure, and environmental goals into a vision for a better future under the Sustainable Communities Initiative. Under the initiative, a Regional Planning Grant Program supported locally-led efforts that encouraged collaboration between diverse regional interests. In 2011, RPA received a grant through the program and led the New York-Connecticut Sustainable Communities Consortium which was comprised of nine cities, two counties, and five regional entities focused on connecting communities, focusing growth in centers and integrating planning to achieve economic, equity, and environmental goals. Key advisors to the undertaking included local transportation, housing, economic development, and environmental justice and community organizations. Project outcomes included New York City's waterfront planning resilience approach, a housing strategy for Long Island and local smart growth initiatives for communities in Connecticut and the Hudson Valley. The program demonstrated the value of funding local efforts with a regional lens.

Conclusions

RPA's efforts to improve the prosperity, sustainability, health, and equity of the NYMA through regional planning and policy recommendations are ambitious yet built on a legacy of success. As the adverse impacts of climate change worsen, the effects on residents of local communities and the organizations that serve them will require changes to the way we plan and invest. Integrating community development and regional planning across scales and populations is key to advancing our collective adaptive capacity and community resilience.

Financial institutions should consider expanding investments into regional-local partnerships, like those in the NYMA and others across the country. Through such investments, regional planning organizations, like the Metropolitan Planning Council in Chicago and SPUR in San Francisco, as well as university-led planning centers, could become better informed as they develop and advance policy, while community-based organizations increase participation in planning processes and benefit from expanded capacity. Adaptation requires an informed and engaged populace. Informing without engaging and engaging without informing are the hurdles that we must cross in advancing equitable and just climate adaptation.

Robert Freudenberg is vice president for energy and environment at Regional Plan Association.

Pre- and Post-Disaster Investments in Housing and Community Development Under the CRA

Laurie Schoeman

After World War II, banking systems fed into a cycle of disinvestment in low-income urban areas across the country. These federally-insured banks collected deposits from neighborhoods where they were chartered to do business but made credit available only sparingly. This disinvestment was accelerated by "redlining"–essentially denying creditworthy loan applications based on erroneous assumptions of the creditworthiness of borrowers defined by their neighborhood and notably, in part, its racial demographic characteristics. The federal government's response was the Community Reinvestment Act (CRA) of 1977. Since its passage, the CRA has become a catalytic tool for encouraging banks and nonprofit lenders to pioneer strategies to increase private investment in underserved communities and to make low- and moderate-income (LMI) communities whole in the face of disinvestment, economic downtown, and lack of access to opportunity.

LMI communities are also exposed to an additional, potentially devastating, risk: natural disasters and climate change. From hurricanes to fires, from East Coast to West, LMI communities are disproportionately the first to suffer from extreme weather and the last to recover from its devastation. Additionally, LMI communities are particularly vulnerable to extreme weather and other natural disasters because they are more likely to be sited in floodplains and fire zones and in areas that have not benefitted from investment in hazard mitigation. Because the members of these communities typically have relatively fewer resources, they are also the slowest to recover. It is only appropriate that the CRA recognize that investments made in these communities can simultaneously serve to advance community resilience and the adaptive capacity of a broad set of community stakeholders and institutions.

Housing and Vulnerability

In most of the natural disasters that have occurred over the last 20 years, damage to housing and housing displacement are the most critical needs. These conditions have represented a significant challenge to first responder agencies like the U.S. Federal Emergency Management Agency (FEMA) seeking to triage communities in crisis. Both providing immediate and temporary housing to reduce homelessness and rebuilding long-term affordable housing are among the leading challenges for most reconstruction efforts. Investing in the engineering resilience functionality of post-disaster housing adds more time and costs to an already burdened system. When affordable housing is lost to an event, there is a risk that the

* The author wishes to acknowledge Esther Toporovsky for her contributions to this article.

housing stock will not be replaced. In Galveston, TX, nearly half of the area's public housing units were destroyed after Hurricane Ike and as of 2018 less than half had been rebuilt.[2] Research increasingly shows that affordable housing has a major impact on the quality of life of residents. Affordable housing controls housing costs, leaving more money for necessities such as health care, and increasing accessibility to better jobs and education.

Unfortunately, after a disaster, owners of affordable housing must balance myriad demands from regulators, investors, and residents. Affordable housing owners are often constrained by both lending and program requirements. For instance, lenders may require covenants that ensure timely payments, establish reserves, and meet program requirements. But for multi-family mortgage-holders and servicers, federal housing programs cap the amount of income tenants can pay. Having low-cost funding that owners can access after a disaster event to bring their units back online is a key way to mitigate a long-term community downturn and further degradation of affordable housing assets.

With some smart adjustments, CRA investments can strengthen and protect LMI communities, particularly their affordable housing stock, helping them prepare for and recover from new risks from natural hazards and climate change. This article details how a range of investments in resilience and adaptation could both fulfill the goals of CRA and save lives and money, as well as how small adjustments to the CRA examination process can lift up the most climate-vulnerable communities through both pre-disaster and post-disaster investments.

The Need for Pre-Disaster Investment

The direct costs of natural hazards to communities around the nation are staggering. In 2017, there were over 16 declared natural hazard events across the country with total costs of approximately $306 billion in direct impacts.[3] This figure does not include the secondary and tertiary effects, such as impact to community public health and the loss of social service continuity within impacted communities. Communities from Puerto Rico to Texas to northern California have lost housing, utilities, business, and institutional resources that may never be fully recovered, to the detriment of future generations.

It has become increasingly clear that investments in resilience and hazard mitigation are highly cost-effective. Depending on the study, each dollar spent in preparation can save up to $11.[4] While no two disasters are alike, and natural hazard events know no race, class, or demographic boundary, communities face risk and recovery in a disproportionate

2 Walters, E. "'It's our form of apartheid': How Galveston stalled public housing reconstruction in the 10 years after Ike," *Texas Tribute* (April 16, 2018), available at https://www.texastribune.org/2018/04/16/galveston-public-affordable-housing-hurricane-ike/.

3 National Oceanographic and Atmospheric Administration. "Billion-Dollar Weather and Climate Disasters: Table of Events" (2018), available at https://www.ncdc.noaa.gov/billions/events.

4 Porter, K. et al. "Natural Hazard Mitigation Saves 2017 Interim Report," National Institute of Building Sciences Multihazard Mitigation Council (2017), available at http://www.wbdg.org/files/pdfs/MS2_2017Interim%20Report.pdf.

way. For an LMI community affected by a disaster, how rebuilding proceeds, including if it does at all, can determine whether it recovers or declines. The level of need experienced by a community before an event is directly correlated to the recovery time after an event.

CRA, Hazard Mitigation, and Community Resilience

Those communities whose ambitions are not only to recover but to make investments in pre-disaster hazard mitigation and engineering and community resilience need a mix of funding from private and public stakeholders, as well as programmatic technical assistance. Because the necessary investments will be substantial, a well-balanced blend of public funds, foundation support, and bank credit will make it possible to avoid overburdening communities, particularly LMI communities.

Working to ensure the right combination of public and private sources, at the right time, is critical. If a bank acts too slowly, for example, communities may not have the opportunity to align bank funding with incoming federal resources. Because banks are ultimately looking to maximize their ability to leverage CRA credit for their investment, considerations for a potential CRA investment in hazard mitigation and pre-disaster investments should include a variety of factors. The first consideration relates to high-impact locations. For instance, is there a high probability for bank to get credit through a full-scope examination for an investment in this area even if the area is not in a traditional assessment zone? Unfortunately, the outcome of this consideration often disproportionately benefits urban areas with more affluent customer bases.

An additional consideration relates to whether investments will produce a range of co-benefits that can address multiple community needs, including increasing the supply of affordable housing in high-cost cities; addressing homelessness; improving health; advancing local small business economic activity; and even increasing recreational opportunities that can create more connectedness among residents. In many cases, these investments with clear co-benefits may be able to sync up with larger more substantial infrastructure projects. In New Orleans, for example, the Lakeview storm water drainage project, led by the local public utility, will reduce flooding in a downtown area that is prone to flooding from storm water. This project will also generate several notable co-benefits, including improved street access and traffic relief; renovation of the public alleys that many of the area residents use to access their homes; and resurfacing of badly degraded streets.

Investment should help incentivize action in communities with plans to mitigate natural hazards or with a reconstruction plan that includes attention to hazard mitigation, resilience, and adaptation. Investment activity will have greater impact if it is consistent with an existing plan. Los Angeles and New York City have such plans designed by their respective mayoral offices of resilience. These plans have already created regulatory and policy incentives and mandates for agencies and private and civic stakeholders to improve their resilience and hazard mitigation efforts.

While the CRA offers plenty of opportunities for investments in both pre-disaster and post-disaster projects, the CRA process could be expanded to ensure that communities vulnerable to natural hazards and climate change have a better shot at investment. Some of the adjustments might consider providing technical and planning support to banks to respond to community needs in high-risk areas to ensure recovery investments are strategic, responsive, and able to be leveraged up. If banks want to maximize their CRA credit to advance community resilience, they need to focus on the types of development that will have the biggest impact. As such, an additional potential modification may include creating credit incentives for banks to work outside of chartered areas. Incentivizing banks to invest in non-urban communities beyond their traditional assessment areas will help not only these communities but also the regions that these communities sit within.

Bank regulators and examiners should seek to increase the ability of private investors to invest in communities directly by enabling those investors to work with agencies such as FEMA and community development organizations focused on lifting up LMI communities. The goal would be to create a programmatic investment framework that leads to investment in climate-vulnerable, LMI communities, with an emphasis on affordable housing investment. Developing this framework should include federal agencies that fund recovery and reconstruction in order to ascertain when and how public funding comes into communities and where to align funding rules to reduce administrative burden on investors and jurisdictions looking to tee up and administer this funding both before and after disasters.

A component of these efforts should advance research and showcase demonstration projects that could serve as a model for what a resilient community recovery project looks like. This research could foster and diffuse more investment and more innovation on the ground. Standing up and disseminating projects that can demonstrate the incorporation of recovery, hazard mitigation, and community resilience that have received CRA credit will give communities, banks, investors, and CRA examiners examples and templates on which they can model future efforts. By extension, future effort could also include the provision of dedicated technical assistance that helps communities use CRA money before and after a disaster in a manner consistent with local hazard, housing, economic development, resilience, and climate adaptation planning. Areas that are vulnerable to natural disasters and climate change, particularly those that have suffered repeated losses, should have access to technical assistance for developing high-impact plans for an event, which they can use to prepare for natural disasters or advance long-term adaptation goals.

Finally, as part of the CRA process, banks should receive additional credit for pre-disaster resilience and adaptation investments. For example, they could fund mitigation in affordable housing communities, such as elevating boilers above ground level or investing in other improvements that limit flooding damages.

Urban Case Studies

Los Angeles has more than 13,000 affordable homes in soft-story buildings that may need seismic strengthening. To help affordable housing owners finance seismic mitigation, Enterprise Community Partners (Enterprise), a national Community Development Financial Institution (CDFI), is working with a consortium of partners–including the California Earthquake Authority, the Mayor's Office of Resilience, the Federal Reserve Bank of San Francisco, and the Los Angeles Housing + Community Investment Department–to identify financial and technical support for the retrofitting of these buildings, including funding, technical assistance, and policy change. The initiative seeks to ensure affordable housing can weather a major disaster. In addition, it aims to a preserve affordable housing in a high-cost city where homelessness and displacement of LMI community members is the leading community development challenge. Not only will that retrofitting reduce disruption and displacement, it will also encourage the social, historical, and business continuity of communities, which may exceed the direct value of housing preservation alone.

Flood Help New York City (Flood Help) is a technical assistance program, developed by the New York State Governor's Office of Storm Recovery with Community Development Block Grant Disaster Recovery (CDBG-DR) funding after Superstorm Sandy. Flood Help was created to provide housing owners, with an emphasis on affordable housing and LMI tenants, technical guidance to identify mitigation strategies that support climate-safe properties. Under this program, which Enterprise developed in collaboration with the NYC Center for Neighborhoods, resilience capital needs assessments were created to help owners understand their vulnerability to a variety of climate risks common in the Northeast and provide recommendations for resilience improvements. The program helps to establish pathways for affordable housing owners to map out capital planning work that will protect their buildings from climate risks. A program like this can be helpful to housing owners and communities before an event, and potentially after an event when there is support coming into communities for reconstruction. CRA investment could potentially pay for improvements and help owners stabilize their sites and increase the efficiency of their buildings.

Flooding from hurricanes, storm surge, and rain storm events are a great risk to the city of New Orleans. In 2016, the city was awarded more than $141 million through HUD's National Disaster Resilience Initiative to build the nation's first sanctioned "Resilience District" in the Gentilly neighborhood. The project uses various approaches to water and land management that have been successfully piloted throughout New Orleans and, when implemented together, are intended to create even greater neighborhood benefit, such as improved health, economic opportunity, environmental education, and recreation. The Gentilly Resilience District is a combination of efforts across that community to reduce flood risk, slow land subsidence, improve energy reliability, and encourage neighborhood revitalization. Enterprise is supporting the identification of storm water management approaches and providing technical assistance to community stakeholders. The Gentilly Resilience District

will be a model for how other neighborhoods in New Orleans, across the region, and across the country, can adapt to a changing environment. Regulators should consider the value that this program would bring to fortifying New Orleans' critical housing stock and how it fits within the scope of CRA.

Conclusions

The CRA has been a highly effective tool for ameliorating historical disinvestment in LMI communities. These same communities face grave and growing dangers from the increased probability and greater severity of natural hazard events attributable, at least in part, to climate change. CRA should encourage investment in hazard mitigation, resilience, and adaptation. These investments can start by supporting programs that will protect affordable housing and its residents before disaster strikes. Moreover, pre-disaster investments offer the opportunity to yield benefits for many generations to come. They also can advance community resilience and the stability and prosperity of local and regional economies.

The CRA can be a powerful tool for advancing the resilience and adaptive capacity necessary to address future climate risks. The list of communities around the nation that are reeling from disaster is rapidly growing. Investments that improve present-need housing conditions in these communities is recognized as a critical element of CRA; ensuring that this funding is also invested in prudent, strategic plans will position communities to be stronger, more resilient, and adaptive in the future as well.

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