ARTICLES

Rising Tides and Rearranging Deckchairs: How Climate Change Is Reshaping Infrastructure Finance and Threatening to Sink Municipal Budgets

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Abstract

The United States relies upon state and local governments to build, operate, maintain, and pay for most non-defense-related public infrastructure. State and local governments, in turn, rely upon the municipal bond market to raise capital for infrastructure projects. Climate change threatens to upend this system. As extreme storms and other climate change impacts become more frequent and more intense, state and local governments are facing mounting infrastructurerelated mitigation, adaption, and resiliency planning costs. Mindful of these developments, Wall Street has begun to take climate risk into account in credit rating determinations and municipal bond pricing, making it harder and more expensive for some state and local governments to raise capital to meet infrastructure needs. These developments threaten the underpinnings of the current system of infrastructure finance, as well as public health, safety, and welfare, nationwide.

This Article examines the risks, costs, and consequences of relying upon state and local governments to bear the financial burdens of public infrastructure at a time of increasing climate risk, and suggests strategies for strengthening infrastructure finance systems in the face of climate change.

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INTRODUCTION

In communities across the United States, public infrastructure operates in the background, far from the spotlight, most of the time. Residents pay property taxes and use fees, vote on occasional municipal bond referenda, and generally assume that their communities will have reliable power, safe drinking water, passable roads and bridges, and dependable public health and safety services. But then disaster strikes, revealing an inescapable and sometimes brutal truth: reliable infrastructure is *not* a given everywhere in the United States, and it is a matter of life and death. In Puerto Rico (Hurricane Maria), Texas (Hurricane Harvey) and New Orleans (Hurricane Katrina), for example, people died because the storms damaged or destroyed power, water, transportation, and communications infrastructure. Likewise, in Flint, Michigan, heavy metal contamination of the public water supply caused a still-unfolding public health crisis. Across the United States, communities with aging, damaged, or inadequate infrastructure are more likely to experience suffering and loss compared to their more prosperous neighbors, especially when disaster strikes.

The United States relies upon state and local governments to build, operate, maintain, and pay for most non-defense-related public infrastructure. This is why state and local governments spend more on public infrastructure than the federal government, on both a percentage basis and as a matter of absolute dollars. It is also why state and local governments issue billions of dollars of municipal bonds to fund infrastructure projects every year. As discussed below, climate change poses an existential threat to this system. With extreme storms, flooding, wildfires, extreme heat, and other impacts associated with climate change¹ becoming more frequent and more intense, state and local governments are facing mounting infrastructure-related mitigation, adaption, and resiliency planning costs. Having (finally) recognized that climate change will degrade infrastructure, and cause "cascading impacts" that "threaten our economy, national security, essential services, and health and well-being,"² Wall Street has begun to incorporate climate risk into credit rating determinations and bond pricing. These developments are making it harder and more expensive for some state and local governments to raise capital for infrastructure

^{1.} See, e.g., David Keellings & Jose Hernandez Ayala, Extreme Rainfall Associated With Hurricane Maria Over Puerto Rico and its Connections to Climate Variability and Change, 46.5 GEOPHYSICAL RES. LETTERS 2964, 2968–70 (2019) (Observing that a storm of Maria's magnitude is nearly five times more likely to form now than during the 1950s, an increase that the study's authors believe is linked to climate change). As the authors further note, there is a robust body of research examining links between human-induced climate change, and rainfall totals with respect to Hurricane Harvey, as well. See id. at 2695 ("A recent study by Risser and Wehner (2017) used a covariate-based extreme value analysis (EVA) approach where they found that human-induced climate change likely increased Hurricane Harvey's total rainfall by at least 19% and increased the chance of the observed precipitation by a factor of at least 3.5. Emanuel (2017) examined the annual probability of Hurricane Harvey's observed rainfall finding that it had become six times more likely since the end of the twentieth century and that a similar magnitude event will be roughly eighteen times more likely by 2081-2100. Another study found that Hurricane Harvey was three times more likely due to anthropogenic climate change (Van Oldenborgh et al., 2017). Patricola and Wehner (2018) examined the anthropogenic influence on major TCs finding that relative to preindustrial conditions, climate change has intensified extreme rainfall in Hurricanes Katrina, Irma, and Maria." (internal citations omitted)).

^{2.} See U.S. GLOB. CHANGE RES. PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOL. II: IMPACTS, RISKS, AND ADAPTION IN THE UNITED STATES 17 David Reidmiller, C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds. 2018) [hereinafter NCA4 REP.].

projects. With state and local governments already facing competing claims for government resources, rising infrastructure costs have the potential to crowd out other essential governmental services, and may also increase the risk of default on municipal bonds.

This state of affairs has profound implications for infrastructure finance, the municipal bond market, and state and local government budgets. Climate change poses a nationwide threat to infrastructure, but we do not have a coherent, comprehensive, fiscally sound strategy for addressing this threat. Instead, we tell state and local governments—including financially distressed or otherwise vulnerable communities—to figure out what needs to be done and how to pay for it. Relying upon this increasingly imperfect patchwork system to pay for public infrastructure, in the face of the potentially catastrophic costs of climate change, threatens public health, safety, and welfare, nationwide.

This Article examines the risks, costs, and consequences of relying upon state and local governments (and thus their taxpayers and ratepayers) to bear the financial burdens of public infrastructure at a time of increasing climate risk. Part I identifies connections between infrastructure, public health and welfare, and climate change. Part II examines how and why climate risk is a municipal finance issue, focusing on the risks and burdens that the current system allocates to state and local governments. Part III examines the legal, financial, and political context of the existing system of infrastructure finance. Part IV examines financial, technical, and political costs, risks, and consequences of the current system of infrastructure finance. Part V examines market-driven risks, costs, and consequences associated with current systems. Part VI examines developments in the governing legal regime and in emerging disclosure norms and best practices. Part VII examines strategies for strengthening public infrastructure in the face of climate change.

I. Identifying Connections Between Infrastructure, Public Health and Welfare, and Climate Change

Although there is no standard legal definition for the term infrastructure,³ the term generally is used to refer to the "substructure or underlying foundation or network used for providing goods and services."⁴ Infrastructure thus includes a range of public and private systems, facilities, and assets, including "roads, water systems, communications facilities, sewers, sidewalks,

^{3.} See, e.g., Claudia Copeland, Linda Levine & William J. Mallett, Cong. Res. Serv., R42018, The Role of Public Works Infrastructure in Economic Recovery 4–5 (2011).

^{4.} *Id.*; *Definition of "Infrastructure" for purposes of the American Recovery and Reinvestment Act of 2009*, U.S. EPA, OFF. OF GRANTS AND DEBARMENT (May 8, 2009), https://perma.cc/JUD5-SYF3.

cable, wiring, schools, power plants, and transportation and communication systems."⁵

A. RELIABLE INFRASTRUCTURE IS A PUBLIC HEALTH AND WELFARE IMPERATIVE

Reliable infrastructure is a public health, safety, and welfare imperative. Infrastructure forms "the backbone of the U.S. economy," and it is "a necessary input to every economic output."⁶ "[D]eteriorating infrastructure, long known to be a public safety issue, has a cascading impact on our nation's economy, impacting business productivity, gross domestic product ("GDP"), employment, personal income and international competitiveness."⁷ And, some infrastructure—particularly power,⁸ water, transportation, and communication infrastructure—is so essential that its incapacity or destruction risks having a "debilitating impact on national security, the economy or public health, safety, and welfare."⁹

Puerto Rico's experience with Hurricane Maria puts these facts and figures in concrete, human terms. When Maria slammed into Puerto Rico as a Category 5 hurricane with maximum sustained winds of 155 mph winds and an unprecedented amount of rainfall,¹⁰ the storm decimated the island's already-vulnerable infrastructure.¹¹ Catastrophic flooding knocked out access to safe drinking water.¹² Landslides destroyed transportation networks,

^{5.} U.S. EPA, *supra* note 4; *see also* HENRY PETROSKI, THE ROAD TAKEN: THE HISTORY AND FUTURE OF AMERICA'S INFRASTRUCTURE 13 (2016) ("Today, infrastructure connotes the sum of a society's physical improvements and denotes the public works—that is, structures and systems like roads, bridges, and water supplies that serve the public—as well as the works of private enterprise, for example, the fiber-optic, wireless, cellular, and other information and communication networks that enable a civilization to function in a civilized way").

^{6.} Report Card for America's Infrastructure, AM. SOC'Y OF CIV. ENG'RS (2017) [hereinafter 2017 Infrastructure Report Card], https://perma.cc/T5GH-HCK4.

^{7.} *Id.*; *see also* AM. SOC'Y OF CIV. ENG'RS, FAILURE TO ACT: CLOSING THE INFRASTRUCTURE INVESTMENT GAP FOR AMERICA'S ECONOMIC FUTURE 3 (2016) [hereinafter AM. SOC'Y OF CIV. ENG'RS, FAILURE TO ACT].

^{8.} Compared to water, sewer, and transportation infrastructure, much of the nation's power grid is owned and operated by private, for-profit business. The American Association of Public Power Providers estimates that almost 70% of energy customers are served by investor-owned entities. *See Stats and Facts*, AM. PUB. POWER ASS'N, https://perma.cc/3LBA-7DC4 (last visited Jan. 12, 2020).

^{9.} Policy Statement 518 - Unified Definitions for Critical Infrastructure Resilience, AM. SOC'Y OF CIV. ENG'RS (Oct. 8, 2013), https://perma.cc/FG3X-MJGT ("Critical infrastructure includes systems, facilities, and assets so vital that their destruction or incapacitation would have a debilitating impact on national security, the economy, or public health, safety, and welfare. Critical infrastructure may cross political boundaries and may be built (such as structural, energy, water, transportation, and communication systems), natural (such as surface or ground water resources), or virtual (such as cyber, electronic data, and information systems).").

^{10.} See, e.g., Major Hurricane Maria, NAT'L WEATHER SERV. (Sept. 20, 2017), https://perma.cc/XY2Z-AYKB; Keellings & Ayala, supra note 1, at 2964.

^{11.} See Keellings & Ayala, supra note 1, at 2964; see also Erin K. Bessette-Kirton et al., Landslides Triggered by Hurricane Maria: Assessment of an Extreme Event in Puerto Rico, 29 GSA TODAY 4 (2019), https://perma.cc/CA8Y-DTZU.

^{12.} See Keellings & Ayala, supra note 1, at 2964.

cutting off entire communities.¹³ High winds and rain left the island's power grid and communications systems in ruins. The collapse of Puerto Rico's critical infrastructure dealt a devastating blow to the island's healthcare system. For weeks and even months after the storm, as the island struggled to restore basic utility services, islanders struggled to obtain life-saving or life-sustaining treatments.¹⁴ These lingering disruptions¹⁵ to health care services exacted a horrifying toll, especially on elderly islanders and the chronically ill.¹⁶ One study found that there were 4,645 excess deaths in Puerto Rico in the wake of Maria. This was a "62% increase in the mortality rate as compared with the same period in 2016," and more than seventy times greater than official estimates.¹⁷ "Approximately one third of post-hurricane deaths were reported ... as being caused by delayed or prevented access to medical care."18 Similar stories emerged in the wake of Hurricanes Katrina and Harvey in New Orleans and Houston, respectively, demonstrating that infrastructure is an essential bulwark against threats to public health and welfare, especially when disaster strikes.¹⁹

15. See, e.g., U.S. DEP'T OF ENERGY, HURRICANES MARIA & IRMA JANUARY 3 EVENT SUMMARY (REPORT #85) 1 (2018), https://perma.cc/GPL3-KNSG (Reporting that, as of Jan. 3, 2018, "Puerto Rico: Approximately 69.4% of normal peak load and 57% of customers have been restored and all 78 municipalities are at least partially energized. DOE continues to coordinate closely with FEMA, Puerto Rico, and the U.S. Army Corps of Engineers to support restoration efforts and facilitate industry support, including additional mutual aid as requested by PREPA.").

16. Nishant Kishore, *Mortality In Puerto Rico After Hurricane Maria*, 379 N. ENGL. J. MED. 162, 169 (May 29, 2018); *see also* R. Hernández & Laurie McGinley, *Harvard Study Estimates That Thousands Died In Puerto Rico Because of Hurricane Maria*, WASH. POST (May 29, 2019), https://perma.cc/LR3S-CMFQ ("The Harvard findings indicate that health-care disruption for the elderly and the loss of basic utility services for the chronically ill had significant impacts, and the study criticized Puerto Rico's methods for counting the dead—and its lack of transparency in sharing information—as detrimental to planning for future natural disasters.").

17. Id. at 162. But see Steven Kopits, Excess Deaths in Puerto Rico from Hurricane Maria: Reviewing the Milken Study, PRINCETON POL'Y ADVISORS (Sept. 5, 2018), https://perma.cc/LB22-YS6P.

18. Kishore, supra note 16, at 167.

19. Reports from Puerto Rico match up with reports of illness, injuries, and deaths that occurred in New Orleans in the wake of Hurricane Katrina and in Texas following Hurricane Harvey. Of the 1,400 people who perished in New Orleans as a result of Hurricane Katrina, "[t]he dead were overwhelmingly old," and "most lived near the levee breaches in the 9th Ward and Lakeview," according to researchers. Mark Schleifstein, *Study of Katrina's Dead Show Most Were Old, Lived Near Levee Breaches*, NOLA. COM (Aug. 28, 2009), https://perma.cc/29R7-W749; Although about two-thirds of Katrina's victims "either drowned or died from illness or injury brought on by being trapped in houses surrounded by water," "[t]he rest died from maladies or injuries suffered in or exacerbated by an arduous evacuation –

^{13.} Bessette-Kirton et al., *supra* note 11, at 1.

^{14.} See, e.g., Armando Valdés Prieto, I Saw What Maria Did to Puerto Rico's Hospitals: The Death Toll Is No Surprise, WASH. POST (June 5, 2018), https://perma.cc/5PJU-C338 ("We found an ongoing human disaster during the months of September, October and November, when we made daily visits to more than 60 senior homes and independent-living facilities. At one high-rise, within walking distance of a hospital, residents were trapped on the upper floors because the backup generator had failed and they couldn't walk down the stairs. Some folks I spoke with didn't remember when they had last eaten. There was no potable water because the pump to get it up to the apartments also depended on electricity. Dialysis patients hadn't been treated in days; diabetics couldn't refrigerate their insulin.").

B. AGING, DETERIORATING AND DAMAGED INFRASTRUCTURE THREATENS PUBLIC HEALTH AND WELFARE

Despite its foundational role in public health, safety, and general welfare, infrastructure in the United States is in terrible shape. In its latest report on the state of domestic infrastructure, the American Society of Civil Engineers ("ASCE") assigned it at D+ rating.²⁰ Although there is some variation among sectors, the overall picture is bleak.²¹ Across the country, dams, roads, and bridges are crumbling; power infrastructure is unreliable or inadequate to meet demand; water and sewer treatment facilities are in need of upgrades and repairs; and transportation infrastructure is deteriorating and often wholly inadequate.²² The ASCE estimates that it would take at least \$4.6 trillion to bring U.S. infrastructure to a state of good repair (a grade of B) by 2025, of which only about \$2.5 trillion had been committed at the time of the Report Card's publication.²³ The ACSE further estimates that failing to close this funding gap will lead to \$3.9 trillion in losses to the U.S. GDP by 2025, \$7 trillion in lost business sales by 2025, 2.5 million American jobs lost in 2025,²⁴ and losses to American families of "upwards of \$3,400 in disposable income each year."²⁵

Once again, Puerto Rico's devastation at the hands of Hurricane Maria puts the ASCE's facts and figures in concrete terms. Even before Maria hit, Puerto Rico's power grid was in a state of disarray.²⁶ Power outages were common, even in cities, and Puerto Rico Electric Power Authority ("PREPA") had defaulted on a deal to restructure approximately \$9 billion in bond debt, and sought court protection from its creditors, several months earlier.²⁷ An austerity budget imposed by

or an inability to evacuate quickly enough, including many who died in local hospitals that lost power and other life-sustaining services." *Id.* There were reports of health care workers making "deadly choices" in hospitals and nursing homes in Katrina's aftermath. *See* Sheri Fink, *The Deadly Choices at Memorial*, N.Y. TIMES (Aug. 25, 2009), https://perma.cc/8WAX-HWT7. Despite public debate over emergency preparedness in the wake Katrina, years later, some nursing homes in Texas reportedly failed to evacuate elderly residents as flood waters rose during Hurricane Harvey. *See* Jennifer Emily & Dana Branham, *Nursing Homes That Didn't Evacuate As Harvey Flooding Rose Remain Closed As State Investigation Reopens*, DALLAS NEWS (Aug. 12, 2018), https://perma.cc/W6Z2-W23A.

^{20. 2017} Infrastructure Report Card, supra note 6.

^{21.} *Id.* (ports (C+), parks (D+), rail (B), roads (D), schools (D+), solid waste (C+), transit (D-), waste water (D+)); *see also* AM. SOC'Y OF CIV. ENG'RS, FAILURE TO ACT, *supra* note 7, at 5.

^{22. 2017} Infrastructure Report Card, supra note 6; see also AM. SOC'Y OF CIV. ENG'RS, FAILURE TO ACT, supra note 7, at 8.

^{23. 2017} Infrastructure Report Card, supra note 6.

^{24.} Id.

^{25.} Id.

^{26.} Luis Ferre-Sadurni, *Irma Grazes Puerto Rico but Lays Bare an Infrastructure Problem*, N.Y. TIMES (Sept. 10, 2017), https://perma.cc/LXV3-4ZNS.

^{27.} Mary Williams Walsh, *Puerto Rico's Power Authority Effectively Files for Bankruptcy*, N.Y. TIMES (July 2, 2017), https://perma.cc/JNB3-2CH2. It was not until May 2019 that the power authority announced that it had reached a deal with bondholders to restructure the authority's debt. *Puerto Rico Utility, Bondholders Reach Restructuring Agreement*, BOND BUYER (May 6, 2019), https://perma.cc/8KLV-WWGK.

PROMESA, Puerto Rico's (appointed, not elected) financial control board in response to the island's fiscal distress had driven deep cuts to the island's public health, safety, and welfare infrastructure.²⁸ Prior storms (including Hurricane Irma, which hit shortly before Maria) had taken a toll on the island's infrastructure, as well. As a result, when Maria made landfall, the island's already-precarious finances and vulnerable infrastructure made it much harder for Puerto Rico to absorb and recover from a storm of Maria's destructive force.²⁹

The public health crisis involving Flint, Michigan's public water supply—an entirely manmade disaster—also speaks to the costs and consequences of deteriorating infrastructure. The roots of Flint's water crisis date to 2011, when the city began explore whether it could save money by switching from its then-provider Detroit Water and Sewerage Department ("DWSD") to the Karegnondi Water Authority ("KWA").³⁰ To effect the change, which was projected to save the Flint region \$200 million over twenty-five years, Flint needed to a build a pipeline to connect its municipal water system to the KWA. The problem was that Flint's connection to the KSA was not scheduled to be operational as of April 2014—the date that the DWSD had announced it would cease providing water services to Flint.³¹

To bridge the gap between the date of termination of DWSD services and the availability of the KSA connection, Flint's (appointed not elected) Emergency Manager made the decision to switch the city's water supply to the Flint River.³² In an April 25, 2014 press release, the city characterized the switch to the Flint

^{28.} The Puerto Rico Oversight, Management, and Economic Stability Act (PROMESA) was enacted in 2016 in response to Puerto Rico's crushing debt crisis. *See* Puerto Rico Oversight, Management and Economic Stability Act, 48 U.S.C. §§ 2101–2241 (2016). PROMESA established a financial oversight board with extensive powers respecting Puerto Rico's budget and finances. *Id.* §§ 2121–2177. Under PROMESA's auspices, the fiscal oversight board implemented an austerity budget for Puerto Rico's 2016-2017 fiscal year that included deep cuts to Puerto Rico's public health, safety, and welfare networks. *See, e.g.,* Laura Sullivan, *How Puerto Rico's Debt Created a Perfect Storm Before the Storm,* NPR (May 2, 2018), https://perma.cc/BUU3-2YGL. PROMESA has been controversial from the start. *See, e.g.,* Pedro Caban, *Puerto Rico and PROMESA: Reaffirming Colonialism,* NEWPOLITICS (2017), https://perma.cc/P4SS-BD9A; Natasha Lycia Ora Bannan, *Puerto Rico's Double Devastation: Hurricanes and Austerity,* HUFF. POST (Sept. 26, 2017), https://perma.cc/BNA5-SSRK.

^{29.} See also Naomi Klein, There Is Nothing Natural About Puerto Rico's Disaster, INTERCEPT (Sept. 21, 2018), https://perma.cc/V2MD-8VJG.

^{30.} *See*, *e.g.*, Complaint, Mays v. Snyder, Case No. 15-14002, §§ 51–53 (E.D. Mich. Nov. 13, 2015) [hereinafter Complaint, *Mays v. Snyder*] (alleging Flint government officials commissioned study in 2011 to determine if Flint River could safely be used as a source for drinking water, and further alleging, based on media reports, that the report stated that the water from the river was highly corrosive and could not be used without an anti-corrosive agent to prevent lead, copper, and other heavy metals from leaching into the water supply); *see also* Merrit Kennedy, *Lead-Laced Water In Flint: A Step-By-Step Look At The Makings Of A Crisis*, NPR: THE TWO WAY (Apr. 20, 2016), https://perma.cc/P4XS-AZLB.

^{31.} U.S. EPA OFF. OF INSPECTOR GEN., AT A GLANCE: MANAGEMENT WEAKNESS DELAYED RESPONSE TO FLINT WATER CRISIS 1 (July 19, 2018); *see also* Complaint, *Mays v. Snyder*, at § 54 (noting water service from KWA was not scheduled to become operational until 2016).

^{32.} U.S. EPA OFF. OF INSPECTOR GEN., *supra* note 31, at 1; *see also* Complaint, *Mays et al. v. Snyder et al.*, at § 54 (noting water service from KWA was not scheduled to become operational until 2016).

River as temporary and sought to assuage residents' concerns about water quality.³³ Almost immediately, however, residents began expressing concern about the color and the odor of the city's water.³⁴ By August 2014, testing had detected bacteria (E. coli) in the water supply, prompting city-wide orders to boil water and the increased use of chlorine as a disinfectant.³⁵ In October 2014, General Motors decided to stop using water from the Flint River, citing concerns about the corrosive effect of chorine upon its equipment.³⁶ Still, the city persisted in using water from the river as its source for drinking water.

By early 2015, tests detected elevated levels of heavy metals in Flint's water supply, and shortly thereafter, testing revealed that some children in Flint had high levels of lead contamination.³⁷ "Lead exposure can affect nearly every system in the body," according to the Centers for Disease Control ("CDC"), and "[n]o safe blood lead level in children has been identified."³⁸ Also, according to the CDC, children are at higher risk for lead exposure, especially children who are poor, are members of racial-ethnic minority groups, are recent immigrants, live in older, poorly maintained rental properties, or who have parents who are exposed to lead at work.³⁹ The majority of Flint's residents are black, and many are poor, leading some to question whether race and class were factors in the state government's "agonizingly slow and antagonistic" response to the crisis.⁴⁰ It was later revealed that the city had never implemented corrosion controls at the Flint water treatment facility, and that the combination of river water and the lack of anti-corrosion additives corroded

37. See U.S. EPA OFF. OF INSPECTOR GEN., supra note 31, at 14; Complaint, Mays v. Snyder, at § 77.

39. Id.

^{33.} *See* U.S. EPA OFF. OF INSPECTOR GEN., *supra* note 31; *see also* Press Release, City of Flint, Mich., City of Flint Officially Begins Using Flint River as Temporary Primary Water Source (Apr. 25, 2014), https://perma.cc/D546-CCJB.

^{34.} Complaint, Mays v. Snyder, at §§ 59-61.

^{35.} Anna Clark, *Nothing To Worry About, The Water Is Fine: How Flint Poisoned Its People*, THE GUARDIAN (July 3, 2018), https://perma.cc/4YEA-5LD8; *see also* Mich. Dep't of Envtl. Quality, Governor's Office Briefing Paper: City of Flint Drinking Water (Oct. 1, 2014) (unpublished manuscript), https://perma.cc/5MEP-LGZB.

^{36.} Ron Fonger, *General Motors Shutting Off Flint River Water at Engine Plant Over Corrosion Worries*, MLIVE.COM (Oct. 23, 2014), https://perma.cc/Z48S-LT2U.

^{38.} Lead Poisoning Fact Sheet, U.S. CTR. FOR DISEASE CONTROL 1 (2019), https://perma.cc/87N2-XPQX; see also U.S. EPA OFF. of INSPECTOR GEN., supra note 31, at 3.

^{40.} See, Julia Craven and Tyler Tynes, *The Racist Roots of Flint's Water Crisis*, HUFFPOST (Feb. 3, 2016), https://perma.cc/93G4-5RTL; see also John Eligon, A Question of Environmental Racism in *Flint*, N.Y. TIMES (Jan. 21, 2016), https://perma.cc/88CE-4MBK; see also Peter J. Hammer, Written Testimony Submitted to the Michigan Civil Rights Commission, Hearings on the Flint Water Crisis, *The Flint Water Crisis, KWA and Strategic-Structural Racism*, 1, 7–11 (Jul.18, 2016), https://perma.cc/EB3C-GE4J.

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pipes, causing lead and other heavy metals to leach into the city's water system.⁴¹

- C. CLIMATE CHANGE IS CREATING NEW RISKS AND EXACERBATING EXISTING CHALLENGES POSED BY AGING, DAMAGED, OR OTHERWISE INADEQUATE INFRASTRUCTURE
- 1. Climate Change Exacerbates Existing Challenges

Climate change is intensifying and exacerbating existing "challenges to prosperity posed by aging and deteriorating infrastructure, stressed ecosystems, and economic inequality," especially in already-vulnerable communities like Puerto Rico and Flint, and especially for vulnerable populations such as the elderly, children, and the chronically ill.⁴² As the Third National Climate Report ("NCA3 Report") observes, climate change threatens human health and well-being in many ways, with "impacts from increased extreme weather events, wildfire, decreased air quality, threats to mental health, and illnesses transmitted by food, water, and disease-carriers such as mosquitoes and ticks."⁴³ Many of these impacts are direct—for example, increases in the rates of respiratory diseases caused by carbon emissions in the atmosphere. But, there are and will be indirect impacts as well, often driven by damage to water, transportation, power, and communication infrastructure and associated resources.⁴⁴

2. Critical Water, Power and Transportation Infrastructure at Risk

As the NCA3 Report observes, rain, snow, and runoff patterns are changing in the United States, and the number and intensity of very heavy precipitation events is increasing across the country in ways that appear to be fueled by (or are at least consistent with) predicted impacts of climate change.⁴⁵ These changing weather patterns are likely to increase the

^{41.} U.S. EPA OFF. OF INSPECTOR GEN., supra note 31, at 1-2, 13-15.

^{42.} See, e.g., NCA4 REP., supra note 2, at 25 (observing future climate change threatens to further disrupt infrastructure, ecosystems, social systems that provide essential benefits to communities, exacerbating challenges already posed by aging and deteriorating infrastructure, stressed ecosystems and economic inequality); see also id. at 26. ("Climate change presents added risks to interconnected systems that are already exposed to a range of stressors such as aging and deteriorating infrastructure, land-use changes, and population growth."); id.at 30; U.S. GLOB. CHANGE RES. PROGRAM, CLIMATE CHANGE IMPACTS IN THE UNITED STATES: THE THIRD NATIONAL CLIMATE ASSESSMENT 221 (Jerry M. Melillo, Terese (T.C.) Richmond, & Gary W. Yohe eds., 2014) [hereinafter NCA3 REP.], https://perma.cc/8TAQ-WSWH, ("Climate change will, absent other changes, amplify some of the existing health threats the nation now faces. Certain people and communities are especially vulnerable, including children, the elderly, the sick, the poor, and some communities of color.").

^{43.} See NCA3 REP., supra note 42, at 221; see also id. at 9 ("Increases in ocean and freshwater temperatures, frost-free days, and heavy downpours have all been documented. Global sea level has risen, and there have been large reductions in snow-cover extent, glaciers, and sea ice. These changes and other climatic changes have affected and will continue to affect human health, water supply, agriculture, transportation, energy, coastal areas, and many other sectors of society, with increasingly adverse impacts on the American economy and quality of life.").

^{44.} See, e.g., id. at 1, 9, 11, 12, 16, 17, 70, 80, 81.

^{45.} Id. at 71–72, 75.

frequency or duration (or both) of wet and dry extremes (heavy precipitation events and length of dry spells) "substantially" almost everywhere in the United States in coming years.⁴⁶ Models predict that such developments will intensify seasonal droughts, increase the risk of flooding in many parts of the United States, and impact groundwater availability, leading to changes in water demand and usage patterns and competition among water users.⁴⁷ The Southwest, Great Plains, and Southeast are particularly vulnerable to changes in supply and demand.⁴⁸ Increases in flood frequency and severity linked to climate change will "affect critical water, wastewater, power, transportation and communications infrastructure," as well, potentially resulting in interconnected and casting cascading failures" that will "affect human safety and health, prosperity, infrastructure, economies, and ecology in many basins across the U.S."⁴⁹ Such failures risk exacerbating human health risks; for example, by causing increases in both waterborne and airborne disease.⁵⁰

Climate change also threatens the nation's energy production and delivery facilities, according to the NCA3 Report, and because "so many components of U.S. energy supplies—like coal, oil, and electricity—move from one area to another," disruptions in one region can ripple across the nation.⁵¹ For example, wildfires fueled by droughts have the potential to disrupt California's energy transmission grid; storm surges in coastal areas risk inundating nearby refineries or other energy facilities (as occurred during Hurricane Harvey in Houston); and river flooding risks disrupting adjacent rail lines used to carry coal to power plants.⁵² As with water resources and water-related infrastructure, changing weather patterns also have the potential to increase demand during peak periods, constrain different forms of energy production, and create competition amongst users.⁵³ These sorts of disruptions to the energy grid threaten human health and

53. Id. at 118.

^{46.} Id.

^{47.} *Id.* at 71–78. In this regard, focusing on the economic costs of climate change in the United States, scientists who developed an "integrated architecture to compute potential economic damages from climate change based on empirical evidence," reported that the "combined value of market and nonmarket damage across analyzed sectors – agriculture, crime, coastal storms, energy, human mortality, and labor – increases quadratically in global mean temperature, costing roughly 1.2% of gross domestic product per +1 degree (Celsius) on average," with "risk distributed unequally across locations, generating a large transfer of value northward and westward that increase economic inequality." Solomon Hsiang, et. al., *Estimating economic damage from climate change in the United States*, 356 SCIENCE 1362, 1362 (2017). These same scientists noted that "by the late 21st century, the poorest third of counties are projected to experience damages between 2 and 20% of county income (90%) chance under business-as-usual emissions." *Id.*

^{48.} See NCA3 REP., supra note 42 at 82.

^{49.} Id. at 86–87.

^{50.} Id.

^{51.} Id. at 115-116.

^{52.} Id. at 115, 119.

well-being, particularly in times of crisis, as evidenced by the Hurricane Maria death toll in Puerto Rico.

Climate change threatens transportation infrastructure, as well. As the NCA3 Report observes, changing weather patterns, rising sea levels and storm surges, and an increase in the number and intensity of severe weather events—all of which are predicted to occur with climate change—are affecting the reliability and capacity of U.S. transportation infrastructure.⁵⁴ For example, flooding caused by Superstorm Sandy dealt a "massive blow" to the transportation systems of New York and New Jersey.⁵⁵ As with water, transportation, and energy infrastructure, adapting transportation infrastructure in the face of climate risk requires expertise, money, and coordination across a range of disciplines and stakeholders, including those involved in transportation and land-use planning, vulnerability and risk assessment, infrastructure design, maintenance and operational planning, and emergency response planning.⁵⁶ Such resources and opportunities for collaboration and cooperation may be in short supply, particularly during times of crisis.

As this list of threats and impacts suggests, infrastructure is the "canary in the coal mine" when it comes to the risks, costs, and consequences of climate change. As the Fourth National Climate Assessment Report ("NCA4 Report") observes, climate change is "expected to cause growing losses to American infrastructure and property and impede the rate of economic growth over this century."⁵⁷ Infrastructure also speaks to the public health consequences of climate change: damage to water, power, and transportation systems can cause illness, injury, or death.⁵⁸ Infrastructure also shows how and why climate change impacts are interconnected, with failures in one system leading to a cascading set of failures in other resources or sectors.⁵⁹ Taken together, threats and impacts involving infrastructure show how and why climate change is having—and will continue to have—lasting implications for public health, safety, and welfare nationwide.

II. CLIMATE CHANGE IS A MUNICIPAL FINANCE ISSUE BECAUSE STATE AND LOCAL GOVERNMENTS BUILD, OPERATE, MAINTAIN AND PAY FOR CRITICAL INFRASTRUCTURE

A. OVERVIEW

The poor state of the country's infrastructure, its vulnerability to climate change, and the public health and welfare consequences of infrastructure

^{54.} Id. at 132.

^{55.} Id. at 136.

^{56.} *Id.* at 137–40.

^{57.} NCA4 REP., supra note 2, at 25.

^{58.} Id. at 27–28.

^{59.} See id. at 25-26.

failure, present municipal finance issues in the United States because we fund and finance infrastructure largely at the state and local level. In particular, as discussed below, state and local governments build, operate, maintain, and pay for most non-defense public infrastructure in the United States.⁶⁰ This is why state and local governments spend more on public infrastructure than the federal government, on both a percentage basis and as a matter of absolute dollars.⁶¹ State and local governments also must raise the capital needed for this work. This obligation, together with political, practical, and legal constraints on revenue collection, intergovernmental transfers, expense reduction, and debt relief at the state and local level, explains why state and local governments issue billions of dollars of municipal bonds for infrastructure projects every year. Because state and local governments are financially responsible for most public infrastructure, they are first in line, as a financial matter, when that infrastructure deteriorates or is damaged or destroyed. Increasingly, this means that state and local governments are on the financial front lines with respect to risks, costs, and consequences associated with infrastructure and climate change.

B. FEDERAL VERSUS STATE AND LOCAL GOVERNMENT INFRASTRUCTURE SPENDING

To get a sense of what it means for state and local governments to bear the lion's share of the financial burden of public infrastructure, consider water and transportation infrastructure outlays. According to a report issued by the Congressional Budget Office (the CBO Report) in 2014, state and local outlays for water and transportation infrastructure accounted for about 75% of total public infrastructure spending. Of the \$416 billion spent on transportation and water infrastructure (including highways, mass transit and rail, aviation, water transportation, water resources, and water utilities), state and local governments spent \$320 billion, while the federal government accounted for only \$96 billion of total spending.⁶² As the following graphic from the CBO Report reflects, state and

^{60.} See Elizabeth C. McNichol, It's Time for States to Invest in Infrastructure, CTR. ON BUDGET AND POL'Y PRIORITIES 5 (Aug. 10, 2017), https://perma.cc/T6RH-6TFZ. ("State and local governments are the stewards of most of the country's public capital. They own over 90 percent of non-defense infrastructure assets, and although the federal government assists in the building and maintaining of these assets, state and local governments pay 75 percent of the cost of maintaining and improving them.") (internal citations omitted). See also Christine Sgarlata Chung, *Municipal Securities: The Crisis of State and Local Government Indebtedness, Systemic Costs of Low Default Rates, and Opportunities for Reform*, 34 CARDOZO L. REV. 1455, 1458–60 (2013), for a discussion of the municipal bond market as a source of funding for public infrastructure and services.

^{61.} See, e.g., Municipal Securities: Financing the Nation's Infrastructure, MUN. SEC. RULEMAKING BD. 3 (2019), https://perma.cc/XMD9-8DNY (noting state and local governments "commit the bulk of the capital required to pay for infrastructure," spending "more on infrastructure . . . compared to the federal government, as a matter of both absolute dollars and as a percentage of total spending.").

^{62.} NATHAN MUSICK & AMY PETZ, CONG. BUDGET OFF., CBO PUBLICATION 49910, PUBLIC SPENDING ON TRANSPORTATION AND WATER INFRASTRUCTURE 1956-2014 1 (2015) [hereinafter CBO REP.], https://perma.cc/6VJY-KAPH.

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local government spending exceeded federal government spending by a wide margin with respect to both capital and operation and maintenance of infrastructure.⁶³



Data presented by the Bureau of Economic Analysis ("BEA") matches up with the CBO Report. The BEA reports that state and local government investment in non-defense-related fixed assets exceeded that of the federal government from 2009-2016.⁶⁴

Digging further into the numbers, federal spending is "highly concentrated" on three types of transportation infrastructure—highways (48%), aviation (17%), and mass transit and rail (16%).⁶⁵ By comparison, water-related infrastructure

^{63.} Id. at 11.

^{64.} See Government Investment in Fixed Assets, National Income and Product Accounts (NIPA), U.S. BUREAU OF ECON. ANALYSIS, https://perma.cc/LA4B-KAWE (last visited Aug. 23, 2017). The NIPA data reflect spending at the national and state and local levels on "fixed assets," a category that includes a range of assets with long useful lives (e.g., intellectual property), but mostly infrastructure, including transportation, education, and public safety-related infrastructure. I used the BEA charting functionality to show total investment in government fixed assets, total state and local investment in government fixed assets, and federal investment in government fixed assets broken down by defense versus non-defense spending. As the chart reflects, state and local spending on government fixed assets far outstrips federal spending on non-defense-related government fixed assets.

^{65.} CBO REP., supra note 62, at 17.



accounted for a much smaller share of federal infrastructure outlays from 1956 to 2014, with only 10% devoted to water resources (water containment systems such as dams, levees, resources, and watersheds; and sources of freshwater, such as lakes and rivers), 5% devoted to water utilities (water supply and waste water treatment facilities), and 4% devoted to water transportation.⁶⁶ While state and local government spending on public infrastructure outstripped federal government spending for each type of infrastructure examined in the CBO Report, water-related infrastructure showed the largest differential.⁶⁷

^{66.} *Id.* Note, however, that while the allocation of federal spending across public infrastructure has been relatively stable for the past two decades, there have been shifts in the allocation of federal infrastructure dollars over the years, typically tied to legislative action. *Id.* For example, as the CBO Report notes, there was an uptick in spending on highways in the late 1950s (and a reduction in federal infrastructure spending allocated to dams and other water resources) a construction began on the Interstate Highway System. *Id.* Similarly, spending devoted to water utilities increased to between 15% and 20% for about a decade in response to the passage of the Clean Water Act. *Id.*

^{67.} Id. at 28.



At the state and local level, of the total amount allocated to transportation and water infrastructure spending, states and localities allocated 37% of total infrastructure spending to highways and 33% on water-related infrastructure, with states directing the bulk of highway spending, and local governments having almost exclusive responsibility for water-related infrastructure spending.⁶⁸ According to the CBO's analysis, the bulk of state and local government spending for transportation and water infrastructure is devoted to the operation and maintenance (\$208 billion in 2014, compared with \$112 in outlays for capital projects).⁶⁹

Notably, while real spending on critical infrastructure has declined in recent years at all levels of government, the decline has been greatest at the federal level, according to the CBO Report. The CBO observed that from 2003 to 2014, federal spending on transportation and water infrastructure fell by approximately 19%, whereas spending by state and local governments declined by 5%, as reflected in the following graphic:⁷⁰

In fact, the federal share of spending on water and transportation infrastructure is at a low-point: The federal share of such spending "typically [was] much larger than it is today, reaching a high of 38 percent in 1977," compared to roughly onequarter of public spending on water and transportation infrastructure since 1987, according to the CBO Report.⁷¹ Federal outlays for transportation and water infrastructure accounted for an average of 3% of public spending over the past three decades, according to the CBO Report, and while 2014 spending was only

^{68.} Id. at 21.

^{69.} Id. at 22.

^{70.} Id. at 14.

^{71.} Id.

Exhibit 7.



slightly below this average (2.4% of total federal spending), it was less than one-half of its peak (almost 6%) in 1965.⁷²

C. THE BURDEN OF RAISING CAPITAL: THE MUNICIPAL BOND MARKET

For state and local governments, the financial burdens of infrastructure include financing costs because, while tax collections and intergovernmental transfers are important sources of funding for infrastructure,⁷³ state and local governments "rely principally upon the municipal securities market to finance and fund public infrastructure projects."⁷⁴ The municipal securities market in the United States is

^{72.} Id. at 16. State and local governments (and local governments in particular) are primarily responsible for school-related infrastructure expenditures. McNichol, *supra* note 60, at 6; *see also Where Do State and Local Government Employees Work? A Focus on How Education Jobs Vary Between State and Local Governments*, U.S. CENSUS BUREAU (2013), https://perma.cc/SKL3-GNR5.

^{73.} MUN. SEC. RULEMAKING BD., *supra* note 61, at 4. See Chung, *supra* note 60, at 1458–60, for a discussion of the municipal bond market as a source of funding for public infrastructure and services.

^{74.} MUN. SEC. RULEMAKING BD., *supra* note 61, at 4; *see also* CBO REP., *supra* note 62, at 23 (noting that while federal grants are an "important source" of funds for state and local government infrastructure spending, state and local governments "rely primarily on their own revenue to purchase capital."); Justin Marlowe, *Municipal Bonds and Infrastructure Development – Past, Present, and Future: An International City/County Management Association (ICMA) and Government Finance Officers Association (GFOA) White Paper, GOV. FIN. OFFICERS ASS'N. (Aug. 2015), https://perma.cc/2GXK-DKDY. According to Professor Marlowe, "[a]pproximately 90 percent of state and local capital spending is financed with debt." <i>Id.*

a debt market: State and local governments and their political subdivisions⁷⁵ issue municipal bonds⁷⁶ to pay for public-purpose projects such as the construction of water, sewer and power plants, highways, bridges, hospitals and schools.⁷⁷ As of December 31, 2018, there were approximately \$3,675 trillion in municipal bonds outstanding with approximately \$338 billion in new issuances that year.⁷⁸

State and local governments traditionally have used two types of municipal bonds—general obligation bonds and revenue bonds.⁷⁹ General obligation bonds are secured by the taxing power or "full faith and credit" of the issuer,⁸⁰ and are subject to laws which prohibit state and local governments from incurring debt without voter approval or from exceeding state-imposed debt limits.⁸¹ Issuers typically use long-term general obligation bonds to finance infrastructure projects that do not produce revenues, or when it is thought to be inappropriate to levee fees for use as a matter of public policy.⁸² If an issuer defaults on a general

81. In addition to straightforward limits, some state statutes seek to spread the costs of public projects over their useful life. For example, New York law prohibits municipalities, school districts, or public corporations from incurring indebtedness for a period longer than the useful life of the project. *See* N.Y. LOCAL FIN. LAW § 11 (McKinney 2011) (stating, in part, "A municipality, school district or district corporation may not contract indebtedness for any object or purpose for a period longer than the period of probable usefulness set forth below....").

^{75.} ROBERT A. FIPPINGER, THE SECURITIES LAW OF PUBLIC FINANCE § 1:1, at f1–3 (3rd ed. 2018). Instrumentalities include entities like school districts, special districts, and public authorities; *See generally* William J. Quirk & Leon E. Wein, *A Short Constitutional History of Entities Commonly Known as Authorities*, 56 CORNELL L. REV. 521 (1971). Over the past one hundred years, the number of authorities and special districts has grown significantly. *See 2002 Census of Governments, Government Organization*, U. S. CENSUS BUREAU (2002), https://perma.cc/4YPY-QKPC (discussing historical increases in the number of municipal governments in the United States). Commentators have opined that this growth reflects increasing demand for services provided by authorities and special districts, as well as the desire to circumvent restrictions on issuances of debt by state and local governments. NEIL O'HARA, THE FUNDAMENTALS OF MUNICIPAL BONDS 57 (6th ed. 2012).

^{76.} See FIPPINGER, supra note 75, at § 1.2.1, 1-7-1-11.

^{77.} See U.S. SEC. & EXCH. COMM'N, REPORT ON THE MUNICIPAL SECURITIES MARKET 7 (2012) [hereinafter SEC REP.], https://perma.cc/5BHZ-5FN3.

^{78.} Research & Data, U.S. Bond Market Issuance and Outstanding, SIFMA, https://perma.cc/X28N-N4MY (last visited Jul. 30, 2019).

^{79.} In addition to the types of securities listed above, municipal securities issuers have used a variety of other instruments over the years. *See*, *e.g.*, JOE MYSAK, ENCYCLOPEDIA OF MUNICIPAL BONDS 117–18 (2012).

^{80.} See, e.g., Annual Survey of State Government Finances — Definitions, U.S. CENSUS BUREAU, https://perma.cc/E4GH-B4Y9 (last visited Aug. 8, 2019) (Full faith and credit debt is "[1]ong-term debt for which the credit of the government concerned, implying the power of taxation, is unconditionally pledged. Includes debt payable initially from specific taxes on nontax sources, but representing a liability payable from any other available resources if the pledged sources are insufficient.").

^{82.} See Ann J. Gellis, *Mandatory Disclosure for Municipal Securities: A Reevaluation*, 36 BUFF. L. REV. 15, 23 (1987) ("Long-term general obligation bond financing, once the mainstay of municipal financing, is used for funding those public facilities that either do not produce revenues (for example, town halls, police stations[,] etc.), or for which it is considered, as a matter of public policy, inappropriate to levy fees for public use (for example, public schools or parks.").

obligation bond, bondholders typically have the right to compel a tax levy or a legislative appropriation.⁸³

Revenue bonds are bonds secured by revenues or receipts from the funded project or other special funds.⁸⁴ The idea is that issuers will use bond proceeds to construct facilities that, "theoretically, through the imposition of fees or charges, will generate sufficient revenues to amortize the debt over the useful life of the facility."⁸⁵ "[R]evenue bond financing has been traditionally associated with the construction of toll roads, bridges, and community water, sewer, and power systems."⁸⁶ Issuers are not always required to obtain voter approval before issuing revenue bonds.⁸⁷ Prior to the mid-1970s, most municipal bond offerings took the form of general obligation bonds with standardized terms.⁸⁸ Today, issuers raise more capital via revenue bond issuances.⁸⁹

D. INFRASTRUCTURE SPENDING, DEBT SERVICE, AND STATE AND LOCAL GOVERNMENT BUDGETS

As with any debt instrument, municipal bonds are built upon a fundamental promise: that in exchange for investors' money, the issuer will repay the amount borrowed plus interest. Data from the U.S. Survey of State and Local Government Finances provides insight into the burden of infrastructure spending

86. Gellis, supra note 82, at 22.

87. See BLAND, *supra* note 85, at 274–75 ("Because of the more limited pledge, voter approval is usually not required, and the bonds incur slightly higher interest rates because of the higher risk of default. However, investors can see a clear link between the use of the debt and the repayment of the bonds, which normally increases their confidence that the government will repay the debt.").

88. Gellis, *supra* note 82, at 428.

^{83.} *See, e.g.*, Eugene McQuillin, The Law of Municipal Corporations, vol. 15 1045–47 (3d ed. 2005).

^{84.} Revenues pledged for repayment may be derived from "operation of the financed project, grants or excise or other specified non-ad-valorum taxes." *Revenue Bond*, MUN. SEC. RULEMAKING BD., http://msrb.org/Glossary/Definition/REVENUE-BOND.aspx (last visited Aug. 5, 2019). Some revenue bonds are issued by governmental agencies to fund facilities for essential public services like water and sewer systems. With these types of revenue bonds, the issuer typically pledges revenues obtained through assessments towards repayment. *Id.* Such pledges typically identify the specific assessments that the issuer can use to pay interest and repay principal, the issuer's authority and ability to increase assessments to satisfy payment and repayment obligations, and any other, superior claims on the assessment. *Id.*

^{85.} Gellis, *supra* note 82, at 22; ROBERT L. BLAND, A BUDGETING GUIDE FOR LOCAL GOVERNMENT 274 (3d ed. 2013) ("[A] revenue bond represents a limited pledge of revenue sources to the repayment of qualifying bonds. Usually, revenue bonds are used to finance a revenue-producing project, such as a public housing complex, public hospital, toll road, water or wastewater facilities and lines, or a parking garage. Only revenues earned from the project can be used to repay the bonds used to build it. The government does not pledge its full faith and credit to the repayment of these bonds, although it may subsidize the project with general tax revenues, especially during the development phase.").

^{89.} Statistics: Municipal: US Municipal Issuance, SIFMA, https://perma.cc/TGC3-X7FX (last visited Aug. 5, 2019). See Christine Sgarlata Chung, Zombieland / The Detroit Bankruptcy: Why Debts Associated With Pensions, Benefits, and Municipal Securities Never Die . . . And How They Are Killing Cities Like Detroit, 41 FORDHAM URB. L.J. 771, 795–801 (2014), for an in-depth discussion of the municipal bond market. See also Chung, supra note 60, at 1456–60, 1463–68.

(at the state and local level, as a component of all state and local government expenditures) and associated debt service obligations.⁹⁰ According to 2016 data, of the \$3,517,971,479 in total expenditures by state and local governments that year, \$350,969,900 was attributable to capital outlays (which consist of construction of buildings or improvements, and purchases of land or of equipment (items expected to last at least five years). Although infrastructure projects are not limited to capital spending, infrastructure projects fall into (and comprise a significant chunk of) this category. An additional \$120,625,814 in expenditures was attributable to interest payments on outstanding debt and \$369,814,059 was attributable to the retirement of long-term debt (including repayment of principal on long-term municipal bonds).⁹¹

III. CONTEXT FOR THE EXISTING INFRASTRUCTURE FINANCE SYSTEM

The existing infrastructure finance system looks and operates the way it does for a combination of reasons, including practical, political, and legal constraints on revenue collection, expense reduction, debt relief, and intergovernmental transfers. The following discussion of these attributes, and characteristics of the current regime provides important context for the initiatives and reforms suggested in Part VII.

A. THE PUBLIC PURPOSE DOCTRINE: STATE AND LOCAL GOVERNMENTS AND THE OBLIGATION TO PROVIDE CRITICAL INFRASTRUCTURE AND ESSENTIAL SERVICES

First, the existing system recognizes that government has a fundamental obligation to use public resources to provide for the public good.⁹² For state and especially local governments, this means spending on essential public health, safety, and welfare infrastructure and services. Indeed, as Bankruptcy Court Judge Stephen Rhodes observed in the context of municipal bankruptcy, because the very "purpose of municipalities (i.e., police protection, fire protection, sewage, garbage removal, schools, hospitals) is to provide essential services to residents,

^{90. 2016} State and Local Government Finance, 2016 State and Local Summary Table By Level of Government and By State, U.S. CENSUS BUREAU, https://perma.cc/2KCJ-YTZY (last visited Aug. 10, 2019).

^{91.} Breaking these data down further into state versus local figures, on the state level, total expenditures were approximately \$2,225,106,823. Of this amount, \$128,605,961 was attributable to capital outlays; \$47,125,531 was attributable to interest on debt; and \$134,505,031 was attributable to the retirement of long-term debt. On the local level, of the \$1,838,514,959 in total expenditures, \$222,363,939 was attributable to capital outlays; \$73,500,283 was attributable to interest on debt; and \$235,309,028 was attributable to the retirement of long-term debt. *See id.*

^{92.} See, e.g., Shaheen Borna & Krishna G. Mantripragada, *Morality of Public Deficits: A Historical Perspective, in* PUB. BUDGETING & FIN. 33, 35 (1989) ("The goal of public finance . . . is, ideally, to bring about maximum social welfare"); GERALD E. FRUG & DAVID BARRON, CITY BOUND: HOW STATES STIFLE URBAN INNOVATION 92–95 (2008) (discussing local government's obligation to provide police and fire protection services).

it is crucial that chapter 9 relief allow these entities enough flexibility to remain viable."⁹³

In fact, the obligation to borrow and spend for a public purpose is embedded in public finance law, federal tax law, federal securities laws, municipal bankruptcy law, and state and local government law. For example, § 103 of the Internal Revenue Code provides, in part, that interest on any state or local bond is exempt from federal income tax provided the bond is not a private activity bond which is not a qualified bond within the meaning of the Code.⁹⁴ Relatedly, under the public purpose doctrine,⁹⁵ state and local governments generally must use the proceeds of tax exempt municipal bond offerings for public purposes and not to benefit private actors pursuing exclusively private ends.⁹⁶ Likewise, as Judge Rhodes remarked in above-referenced decision, chapter 9 of the bankruptcy code (the municipal bankruptcy section) recognizes that even insolvent municipalities must be able to provide essential public health and safety services.⁹⁷ As Judge Rhodes observed, in this way, chapter 9 seeks to "foster the continuation of

See Brian Libgober, The Harvard John M. Olin Discussion Paper Series, Discussion Paper No.
The Death of the Public Purpose Doctrine (and How to Prevent It) (discussing origins and development of, and threats to, the public purpose doctrine) (Mar. 2016), https://perma.cc/2F97-UEPE.
See id.

^{93.} *In re* Addison Comm. Hosp. Auth., 175 B.R. 646, 648 (Bankr. E.D.Mich.1994). Similarly, when Harrisburg, Pennsylvania was placed in receivership following the declaration of a fiscal emergency, the receiver stated that his "first priority" was to "ensure that vital and necessary services such as police and fire are maintained." *See e.g.*, *GOB-Smacked: Harrisburg to Default on General Obligation Bonds*, INVESTMENTNEWS.COM (Mar. 9, 2012), https://perma.cc/7LCJ-NUYH. For a discussion of Pennsylvania law and Harrisburg, or Pennsylvania's experiences in receivership, see Juliet M. Moringiello, *Goals and Governance in Municipal Bankruptcy*, 71 WASH. & LEE L. REV. 403, 475–78 (2014).

^{94. 26} U.S.C. § 103. Section 141 states, in pertinent part, that a private activity bond refers to any bond which meets the private business use test. 26 U.S.C. § 141. An issue meets the private business use test if more than 10 percent of the proceeds of the issue are to be used for any private business use. *Id.* Qualifying municipal securities are exempt from registration under § 3(a)(2) of the Securities Act of 1933.

^{97.} Bankruptcy Act Revision: Hearing on H.R. 31 and H.R. 32 Before the Subcomm. on Civil and Constitutional Rights of the Comm. on the Judiciary, 94th Cong. 63 (1975) (statement of Rep. Badillo). To this end, § 903 provides that a bankruptcy court may not in any way "limit or impair the power of a State to control, by legislation or otherwise, a municipality of or in such State in the exercise of the political or governmental powers of such municipality." 11 U.S.C. § 903 (2012). And, § 904 provides that, "[n]otwithstanding any power of the court, unless the debtor consents or the plan so provides, the court may not, by any stay, order, or decree, in the case or otherwise, interfere with (1) any of the political or government powers of the debtor; (2) any of the property or revenues of the debtor; or (3) the debtor's use or enjoyment of any income-producing property." Id. § 904. Taken together, these sections have been interpreted to mean that bankruptcy courts may not interfere with political or governmental power of a municipal debtor to decide what services and benefits the debtor will provide to its inhabitants. See also H.R. REP. No. 95-595, at 530 (2012) ("This section makes clear that the court may not interfere with the choices a municipality makes as to what services and benefits it will provide to its inhabitants."); 121 CONG. REC. 30,39409-10 (1975) (statement of Rep. Edwards) (noting that as the code's legislative history reflects, "[t]he powers of the court are subject to a strict limitation [under Chapter 9]-that no order or decree may in any way interfere with the political or governmental powers of the petitioner, the property or revenue of the petitioner, or any income-producing property.").

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municipalities" rather than their dissolution, to ensure that local governments will be able to meet basic community needs.⁹⁸

B. CONSEQUENCES OF CHOOSING TO NOT FULLY FUND OR FINANCE PUBLIC INFRASTRUCTURE AT THE FEDERAL LEVEL

Second, the current system functions the way it does because the United States has chosen to not fully fund or finance non-defense public infrastructure at the federal level. As Hildreth and Zorn observe, beginning in the late 1970s and early 1980s, state and local governments started to face "mounting capital needs and fewer degrees of freedom to deal with those needs because of high interest rates, inflation and a slowing economy, reduction in federal aid as a result of concern over mounting federal budget deficits, and tax and expenditure limitations on state and local governments."99 Reductions in federal grants for infrastructure during this period, together with the deteriorating financial condition of state and local governments, put pressure on infrastructure funding mechanisms, as well.¹⁰⁰ These developments explain why state and local governments began turning to the municipal bond market as an important source of capital for infrastructure and public health and safety services at that time.¹⁰¹ The capital intensive nature of public infrastructure, coupled with the federal government's unwillingness to step up financially, explains why state and local governments continue to rely principally upon the municipal securities market to finance and fund public infrastructure projects today, with all of the attendant risks and costs that this choice entails.102

C. RESOURCE CONSTRAINTS: LIMITS ON REVENUES COLLECTION, EXPENSE EDUCTION, DEBT RELIEF, AND RISK MANAGEMENT

Third, having made the decision to put the burden of funding and financing non-defense public infrastructure mainly upon state and local governments, the

^{98.} *In re Addison Comm. Hosp. Auth.*, 175 B.R. at 648. Judge Rhodes further observed that "chapter 9 was created to give courts only enough jurisdiction to provide meaningful assistance to municipalities that require it, not to address the policy matters that such municipalities control." *Id.* at 649.

^{99.} W. Bartley Hildreth & C. Kurt Zorn, *The Evolution of the State and Local Government Municipal Debt Market Over the Past Quarter Century*, in PUB. BUDGET & FIN. 127, 132–33 (2005); U.S. GEN. ACCOUNTING OFFICE, GAO-01-1163T, TRENDS AND CHANGES IN THE MUNICIPAL BOND MARKET AS THEY RELATE TO FINANCING STATE AND LOCAL PUBLIC INFRASTRUCTURE i–ii (1983) [hereinafter GAO REPORT], https://perma.cc/2QHN-UU3E.

^{100.} Hildreth & Zorn, supra note 99, at 132-33; see also GAO REPORT, supra note 99, at i-ii.v.

^{101.} See GAO REPORT, supra note 99, at i-ii; see also Hildreth & Zorn, supra note 99, at 132-33.

^{102.} MUN. SEC. RULEMAKING BD., *supra* note 61, at 4; *see also* CBO REP., *supra* note 62, at 23 (noting that while federal grants are an "important source" of funds for state and local government infrastructure spending, state and local governments "rely primarily on their own revenue to purchase capital."); Marlowe, *supra* note 74, at 1. According to Professor Marlowe, "[a]pproximately 90 percent of state and local capital spending is financed with debt." *Id.* at 1. See Chung, *supra* note 60, at 1458–60, for a discussion of the municipal bond market as a source of funding for public infrastructure and services.

current system reflects practical, political, and legal constraints upon revenue collection, expense reduction, and risk management at the state and local levels. Together, these constraints explain why state and local governments cannot easily raise the substantial additional capital required for climate risk adaption and resiliency planning, and why subnational governments thus will continue to rely upon the municipal bond market as their primary source of capital for infrastructure work for the foreseeable future.

1. Limits on Revenue Collection, Other Sources of Capital

If a private business needs additional capital to expand business operations, repair or replace business assets, or to pay down debt, the business has a number of potential funding sources upon which to draw, including internally generated funds (for example, profits on operations), returns on investments, proceeds from a sale of corporate assets, or the proceeds of debt or equity securities offerings. Although there may be limits on securities offerings or indebtedness set forth in the business's organic documents, or in agreements between the business's owners, federal and state law generally do not restrain a for-profit corporation from tapping any of these sources.

State and local governments have far fewer and far more limited options for raising capital. They cannot, as a practical matter, issue equity securities,¹⁰³ nor can they easily leverage or sell off assets to generate funds. State and especially local governments also may be subject to tax caps or other limits on levy power or indebtedness, as noted above.¹⁰⁴ There may be practical or political constraints on the taxing power of state and local governments as well, especially in financially distressed municipalities.¹⁰⁵ Also, while the merger, consolidation or dissolution of subnational governments, shared services agreements, or some combination thereof have the potential to generate cost savings or improved service delivery, residents generally have not embraced these approaches and savings are not guaranteed.¹⁰⁶ Since neither the federal government nor the states have the political will or (in the case of state governments) the resources to fund every infrastructure project that a local government might need, intergovernmental transfers are also unlikely to solve public infrastructure woes.

^{103.} See FIPPINGER, supra note 75, at § 1.2.1, 1–7 (noting that while there is nothing in the securities laws that prevents public corporations from issuing equity securities, the municipal securities market in the U.S. is a debt market for historical reasons and as a "by-product of the economics of capitalism.").

^{104.} See, e.g., CAL. CONST., art XVI, § 18 (prohibiting cities from incurring debt that exceeds the available revenue of the city for that year without the approval of two-thirds of qualified voters).

^{105.} See, e.g., Chung, supra note 60, at 791–92 n.100, 792–94.

^{106.} See Michelle Wilde Anderson, Dissolving Cities, 121 YALE L.J. 1364, 1364 (2012); see also, e.g., Adam Milsap, Local Government Consolidation Is Not a Panacea, FORBES (Nov. 6, 2017), https://perma.cc/4PX7-343P; Ted Roelofs, Should Two Towns Become One? Merger Question Moves to Saugatuck-Douglas, BRIDGE MAG. (Oct. 6, 2013), https://perma.cc/ZUW3-P7FJ.

2. Limits on Expense Reduction

In addition to constraints on revenue collection and intergovernmental transfers, limits on expense reduction also make it difficult for state and local governments to raise the capital needed for climate change adaption and resiliency planning projects. Because they have a fundamental and non-waivable obligation to provide for the public good, state and local governments cannot just close up shop or get out of the business of providing infrastructure merely because costs are high or community needs are great. They also cannot easily reduce expenses associated with providing basic health and safety services for residents, given prior infrastructure investments and commitments made to public employees.¹⁰⁷

3. Constraints on Default and Debt Relief

State and local government budgets are further constrained because they cannot easily obtain relief from liabilities or debts. If a private business faces overwhelming liabilities, it may seek bankruptcy protection. This is what Pacific Gas & Electric ("PG&E")—the company whose power infrastructure reportedly sparked the deadly Camp Fire in California—did when faced with billions of dollars in potential liabilities.¹⁰⁸ The company's bankruptcy filing paved the way for a \$1 billion settlement with fourteen California cities, counties, and agencies impacted by the Camp Fire, the 2017 North Bay Fires, and the 2015 Butte Fire, including Paradise, California, which was almost entirely leveled by the Camp Fire.¹⁰⁹

State and local governments facing extraordinary liabilities are in a different position. As sovereigns, state governments are not eligible for bankruptcy protection under chapter 9. Although non-state entities (cities, counties) may be able to seek bankruptcy protection, there are meaningful eligibility requirements under chapter 9 of the bankruptcy code (including state authorization).¹¹⁰ Specifically,

^{107.} As discussed in Section IV.B below, these costs can overwhelm state and local budgets, even before considering climate change. *See* Chung, *supra* note 60, at 791–92 n.94 (2014) (observing that state and local governments cannot easily reduce labor-related costs because they are much more likely to operate in a union environment and pursuant to collective bargaining agreements.)

^{108.} In re PG&E Corp., No. AP 19-03003, 2019 WL 2477433, at *1 (Bankr. N.D. Cal. June 12, 2019).

^{109.} Baron & Budd Announces \$1 Billion Settlement with PG&E on Behalf of Cities' and Counties' Wildfire Claims, BUS. WIRE (June 18, 2019), https://perma.cc/3MD6-LF48.

^{110.} To be eligible for chapter 9 relief, an entity must meet the five criteria listed in § 109(c). 11 U.S.C. § 109(c) (2010). Specifically, the entity must (1) be a municipality, as defined by the Code; (2) be specifically authorized to be a bankruptcy debtor; (3) be insolvent as defined by § 101(32)(C); (4) genuinely desire to effect a plan to adjust its debts that exist as of the commencement of the case; and (5) satisfy one of the four alternative statutory requirements for negotiating with its creditors before filing its petition. *Id*. The debtor bears the burden of establishing that it meets each of these statutory requirements. *See*, *e.g.*, *In re* Cty. of Orange, 183 B.R. 594, 599 (Bankr. C.D. Cal. 1995). With respect to the "specifically authorized" criteria, fewer than half of the states authorize municipal bankruptcy petitions, assuming the filing municipality meets certain conditions. *See*, *e.g.*, ALA. CODE § 11-81-3

involuntary bankruptcies are not permitted,¹¹¹ liquidation is not an option,¹¹² and the issuer's power (and obligation to) to operate (and in some cases make payments on debt) are not always affected.¹¹³ These requirements and limitations mean that the states and many municipalities do not have the option of seeking debt reorganization or relief in federal bankruptcy court, or may face constraints upon debt relief even if a chapter 9 filing is an option.

Moreover, even when municipal bankruptcy is an option, relief comes at a cost. For example, when the City of Vallejo, California emerged from bankruptcy protection, sales taxes remained high, public services remained "hollowed-out" and there were still neighborhoods with dilapidated homes.¹¹⁴ Residents of Jefferson County, Alabama also reported lasting harm to the county's finances and residents' quality of life¹¹⁵ in the wake of the County's default on municipal

111. See 11 U.S.C. §§ 301, 904 (2012).

112. Id. § 943 (2012).

115. See, e.g., Mary Williams Walsh, In Alabama, a County That Fell Off the Financial Cliff, N.Y. TIMES, Feb. 19, 2012, at BU1.

⁽Westlaw through Act 2019-540); ARIZ. REV. STAT. ANN. § 35-60 (Westlaw through the First Regular Session of the Fifty-Fourth Legislature (2019)); ARK. CODE ANN. § 14-74-103 (Westlaw through the end of the 2019 Regular Session of the Ninety-Second Arkansas General Assembly); CAL. GOV'T CODE § 53760 (Westlaw through Ch. 860 of the 2019 Regular Session); CONN. GEN. STAT. § 7-566 (2013); COLO. REV. STAT. § 37-32-102 (2013) (taxing, drainage and irrigation districts); FLA. STAT. § 218.01 (2013); IDAHO CODE ANN. § 67-3903 (Westlaw through the 2019 First Regular Session of the 65th Idaho Legis.); 20 ILL. COMP. STAT. ANN. 3855/1-20(b)(15) (West 2017); 50 ILL. COMP. STAT. ANN. 320/ 9(b)(4) (West 2008) (power); KY. REV. STAT. ANN. § 66.400 (Westlaw through the end of the 2019 Regular Session and the 2019 First Extraordinary Session); LA. REV. STAT. ANN. §§ 13:4741, 39:619-620 (Westlaw through the 2019 Regular Session); LA. REV. STAT. ANN. § 39:619 (2013); MICH. COMP. LAWS § 141.1566 (West 2005); MINN. STAT. § 471.831 (Westlaw through January 1, 2020 from the 2019 Regular and First Special Sessions); Mo. ANN. STAT. § 427.100 (Vernon, Westlaw through the end of the 2019 First Regular and First Extraordinary Session of the 100th General Assembly); MONT. CODE ANN. § 7–7–132 (Westlaw through the 2019 Session); NEB. REV. STAT. § 13–402 (Westlaw through the end of the First Regular Session of the 106th Legislature (2019)); N.J. STAT. ANN. § 52:27-40 (West 2010); N.Y. LOCAL FIN. LAW § 85.80 (McKinney, Westlaw through L.2019, chapter 436); N.C. GEN. STAT. § 23-48 (2013); OHIO REV. CODE ANN. § 133.36 (West 2012); OKLA. STAT. ANN. Tit. 62, § 283 (Westlaw through the First Regular Session of the Fifty-Seventh Legislature (2019)); OR. REV. STAT. ANN. § 548.705 (West 2010) (drainage and irrigation districts); 53 PA. CONS. STAT. § 5571 (2014); 45 R. I. GEN. LAWS § 45-9-7 (2009); S.C. CODE ANN. § 6-1-10 (Westlaw through the 2019 Session); TEX. LOC. GOV'T CODE ANN. § 140.001 (West 2008); WASH. REV. CODE ANN. § 39.64.040 (West 2012).

^{113.} For example, despite the automatic stay provision of the Bankruptcy Code, 11 U.S.C. § 922(d) allows municipalities to continue paying pledged special revenue, or revenue bonds without obtaining the court's permission or notifying other creditors. *See id.* § 922(d). By comparison, corporate reorganizations occur in the content of the potential liquidation of the debtor. *See id.* § 1123(a). Likewise, because § 928 of the Bankruptcy Code provides that special revenues obtained by a municipal debtor after a bankruptcy filing are subject to liens granted prior to the bankruptcy filing, eligible (revenue) bondholders may be entitled to receive revenue pledged to them notwithstanding the filing of a chapter 9 bankruptcy petition. *See id.* § 928. The Bankruptcy Code also provides that payments received by holders of municipal bonds or certain note obligations within ninety days of a municipal bankruptcy petition are not preferences subject to claw-back. *See id.* § 926.

^{114.} See, e.g., Marlowe, *supra* note 74, at 1 (discussing tax increases and reductions in public services in Vallejo, California after the city declared bankruptcy in 2008 in the face of declining revenues, soaring costs and municipal bond-related obligations).

bonds issued to finance improvements to the county's water and sewer systems and subsequent bankruptcy.¹¹⁶

Market-driven and political realities also limit access to debt relief. Even if state law allows the state's municipalities to seek bankruptcy protection, state officials may refuse to grant permission for fear of contagion. As then-representative Barney Frank from Massachusetts explained during 2008 hearings on turmoil in the municipal bond market, a bankruptcy filing by one municipality threatens financial and reputational harm to other municipalities within the state.¹¹⁷ As the Securities and Exchange Commission also has observed, municipal bankruptcy filing can make it difficult for the debtor (or other issuers within the state) to access capital markets in the future:

"The low number of bankruptcies in the municipal sector can be attributed to several factors, both legal and practical, including: the negative effects of a bankruptcy filing on the credit ratings not only of the municipalities themselves, but also the states in which they are located, which means that bankruptcy is often used only as a last resort; the public nature of bankruptcy; state restrictions against filing under Chapter 9; and the negative effects on access to future capital markets, which motivates financially distressed municipalities to rely on mechanisms other than Chapter 9 (including state refinancing authorities, receiverships, and commissions) to restructure debt."¹¹⁸

These are not idle concerns. The city of Vallejo, California reportedly was unable to access the municipal bond market for three years during its bankruptcy (2008–2011) for money to maintain its streets or replace its aging police cars and fire trucks.¹¹⁹ In the wake of Detroit, Michigan's bankruptcy filing—the largest municipal bankruptcy filing in U.S. history—other Michigan municipalities

^{116.} Complaint at 8-33, Sec. & Exch. Comm'n v. Langford, (N.D. Ala. 2008) (No. CV-08-B-0761-S).

^{117.} See also Municipal Bond Turmoil: Impact on Cities, Towns, and States: Hearing Before the H. Comm. on Fin. Servs., 110th Cong. 25 (2008) (statement of Rep. Barney Frank, Chairman, H. Comm. on Fin. Servs.) ("No State, no State legislators, no governor, can allow any one of its municipalities to default because then every other municipality would pay through the nose. So that is why this is not just some charity here; this is self-defense. The particular municipality, you might pity the municipal workers there. Services may get cut back. Maybe the trash won't get picked up. But we can guarantee you, we have all been there, you can't do that [default]. Because if any one municipality falters, every municipality in that State would pay, and there isn't a State governor and legislature in the country who doesn't understand that, and that's why the State guarantee is such a good one.") See also PEW CHARITABLE TRS., THE STATE ROLE IN LOCAL GOVERNMENT FINANCIAL DISTRESS 14, 16 (2013), https://perma.cc/N8UG-E6SB. [hereinafter PEW CHARITABLE TRS., THE STATE ROLE]. ("States that intervene often want to avoid the stigma that would come from their cities filing for bankruptcy protection," "as well as reduce impacts on other municipalities within the state associated with contagion.").

^{118.} SEC REP., supra note 77, at 24-5 (internal citations omitted).

^{119.} Id. at 14.

reportedly were forced to delay planned offerings.¹²⁰ More recently, in the wake of the Camp Fire in California, commentators expressed concerns over whether the California communities impacted by the fire would be able to access the municipal bond market in a timely or cost-effective way given the near total destruction of the property and retail tax base in some locations.¹²¹ Additionally, a March 2019 decision in Puerto Rico's bankruptcy is roiling markets, as investors rethink risks associated with bankruptcy.¹²²

4. Limits on Risk Management

Finally, focusing on climate change, state and local governments face budgetary strain because they cannot easily reduce or manage risks or associated costs. To better understand this, consider the options available to a real property insurer facing climate risk as compared with those available to a local government. If an insurer believes that climate change is increasing the risk of loss with respect to insured properties, the insurer can increase policy premiums, cover certain properties or customers but not others (for example, commercial but not residential, only high-end properties), or exit a market entirely. This is why private flood insurance is not readily available in certain coastal areas, for example,¹²³ or

122. See In re Fin. Oversight & Mgmt. Bd. for P.R., 919 F.3d 638 (1st Cir. 2019). In this matter, general obligation bondholders filed suit under § 310 of PROMESA seeking a declaration that they possess a priority over the Puerto Rican government, and property interest, with respect to certain revenues. Id. at 642. (Specifically, the bondholders sought (i) a declaration confirming their rights to the revenues; and (ii) a declaration that the diversion of the revenues constitutes an unconstitutional taking.) Id. In addition to dismissing certain claims on justiciability and ripeness grounds, the First Circuit Court of Appeals affirmed the dismissal of counts 1 and 2 (which sought declarations that Puerto Rico could not use or collect the revenues at issue for any purpose other than paying the debt owed to the Bondholders) and counts 9 and 10 (which sought declarations that the revenues at issue has to be segregated and deposited into a designated account and not be used for anything but repayment) for failure to state a claim. Citing a section of PROMESA modeled after § 904 of the Bankruptcy Code (municipal bankruptcy), which is discussed in Section III.A, the Court held that the declaration sought would impermissibly interfere with Puerto Rico's exercise of political and governmental powers. Id. at 647-49. This ruling has rolled bond markets as investors reassess priority and property rights with respect to bonds issued by municipalities eligible for municipal bankruptcy relief. See also Alexandra Scaggs, Puerto Rico's Bankruptcy Case Casts a Shadow on Billions in Municipal Bonds, BARRON'S (May 23, 2019), https://perma.cc/XJ37-3XVN; Will Legal Challenges to Illinois GO Bonds Increase Credit Risk?, NUVEEN (Aug. 26, 2019), https://perma.cc/BN74-3XBW.

123. DIANE P. HORN & BAIRD WEBEL, PRIVATE FLOOD INSURANCE AND THE NATIONAL FLOOD INSURANCE PROGRAM 9 (2019) ("One of the reasons that Congress created the NFIP in 1968 was the

^{120.} See, e.g., Bloomberg News, Battle Creek Becomes Second Michigan Municipality to Delay Bond Sale, CRAIN'S DETROIT BUS. (Aug. 6, 2013), https://perma.cc/7BJZ-KMFY.

^{121.} See Kellen Browning and Michael Finch II, Fire Areas Have High Poverty and Small Tax Bases. Will that affect future construction?, SACRAMENTO BEE (Aug. 16, 2018), https://www.sacbee.com/latest-news/article216405720.html; JACOB FOWLES ET AL., ACCOUNTING FOR NATURAL DISASTERS: THE IMPACT OF EARTHQUAKE RISK ON CALIFORNIA MUNICIPAL BOND PRICING 68 (2009) ("In the event of natural disaster, municipal market issues are often tied to concerns of how an affected issuer will meet debt obligations in the face of not only damage to local infrastructure, but also loss of revenue due to the disaster's negative impacts on the local tax base.").

available only for certain customers or types of properties.¹²⁴

A local government does not have the same tools as an insurance provider at its disposal. For practical and often legal reasons (such as restraints on levy power, limits on indebtedness, political consequences of tax increases), a local government cannot easily increase "premiums" (property tax, sales tax, use fees) in response to climate risk, nor can it provide infrastructure or services to some residents but not others based on climate risk assessment. Local governments also are not free to exit the market for infrastructure or municipal services. They are obligated to provide at least basic infrastructure and health and safety services for all residents at all times, and, as noted above, they cannot just exit the market because risks are increasing, or costs are high. Finally, municipal securities issuers cannot easily move public infrastructure out of harm's way to reduce risks or costs. If a municipality's sea wall is damaged during a hurricane, for example, the municipality likely will have to repair it to prevent further losses; there is no point in moving a sea wall to a less risky location, and it may be costly or otherwise not feasible to move properties or assets at risk if the sea wall fails.

IV. RISKS, COSTS, AND CONSEQUENCES OF THE CURRENT INFRASTRUCTURE FUNDING AND FINANCE REGIME

A. OVERVIEW

Climate change exposes risks and vulnerabilities in the existing infrastructure finance system because it imposes costs and burdens upon state and local governments that some are ill-equipped to bear. Some of these risks are technical or financial: What happens, for example, if a local community is too cash-strapped to identify or make (or both) needed improvements to infrastructure to manage climate change risk? Some are political: What happens if federal, state, or local officials deny climate change? Some reflect the nationwide nature of climate risk, but the local nature of the response: What happens if climate change impacts are regional rather than local, but neighboring communities are not interested in a collaborative or coordinated response? And some risks and vulnerabilities are

general unavailability of flood insurance from private insurers. Private flood insurance was offered between 1895 and 1927, but losses incurred from the 1927 Mississippi River floods and additional flood losses in 1928 led most insurers to stop offering flood policies. Private flood insurance companies largely concluded that flood peril was uninsurable because of the catastrophic nature of flooding, the difficulty of determining accurate rates, the risk of adverse selection, and the concern that they could not profitably provide risk-based flood coverage at a price that consumers felt they could afford." (internal citations omitted)).

^{124.} *Id.* ("Currently, the private flood insurance market most commonly provides commercial coverage, secondary coverage above the NFIP maximums, or coverage in the lender-placed market. The 2018 premiums for private flood insurance as reported to the National Association of Insurance Commissioners (NAIC) 47 totaled \$644 million, up from \$589 million in 2017 and \$376 million in 2016, compared to the \$3.5 billion total amount of NFIP premiums. In general, the private flood market tends to focus on high-value properties, which command higher premiums and therefore the extra expense of flood underwriting can be more readily justified.") (internal citations omitted).

driven by financial markets and the governing legal regime: What happens now that financial markets and evolving legal norms are demanding more robust analysis and disclosure around climate risk?

As discussed below, these risks and vulnerabilities have the potential to overwhelm the technical, financial, and political capacities of state and especially local governments. Communities that are already economically, politically, or environmentally vulnerable may be the most at risk and may be hit the hardest when disaster strikes.¹²⁵

B. INFRASTRUCTURE COSTS CAN OVERWHELM STATE AND LOCAL GOVERNMENT BUDGETS

One risk of the current system is that costs of climate risk-focused mitigation, adaption, and resiliency planning will overwhelm state and local government budgets. Whereas defaults are comparatively rare in the municipal bond market,¹²⁶ suggesting that the vast majority of issuers find a way to repay municipal bond debt, debt repayment obligations associated with infrastructure can strain state and local government budgets, even before considering climate change.¹²⁷ Jefferson County, Alabama, the second largest municipal bankruptcy on record, offers one such cautionary tale. In a series of transactions marred by public corruption, Jefferson County issued \$5 billion in bonds and entered into associated interest rate swaps to finance improvements to water and sewer systems.¹²⁸ Due to the way the interest rate swaps were structured, the annual payment of Jefferson County's debt grew from \$53 million to \$636 million between 2008 and 2009.¹²⁹ As debt service obligations spiked and the county's finances

^{125.} NCA3 REP., *supra* note 42, at 228–30, 298–328, 334–59. In its report examining the challenges of climate adaption and resilience building, entitled *Rising to the Challenge, Together* ("Kresge Report"), the Kresge Foundation identified many of these issues and challenges as potential barriers to climate change adaption and resiliency planning. KRESGE FOUND., RISING TO THE CHALLENGE, TOGETHER 43 (2017) [hereinafter KRESGE REPORT], https://perma.cc/B8MN-S7MD.

^{126.} See, e.g., MOODY'S INV'RS SERV., SPECIAL COMMENT: U.S. MUNICIPAL BOND DEFAULTS AND RECOVERIES, 1970–2009 1 (2010); MOODY'S INV'RS SERV., SPECIAL COMMENT: U.S. MUNICIPAL BOND DEFAULTS AND RECOVERIES, 1970–2011 1 (2012) [hereinafter MOODY'S 2012 SPECIAL COMMENT], https://perma.cc/BN9Q-ABS4. Default rates are comparatively low in the municipal securities market because issuers pledge their taxing power (for general obligation bonds) or dedicated revenue streams (for revenue bonds) as security for repayment. Chung, *supra* note 60, at 1469. This means that issuers may be legally obligated to raise taxes or use fees to satisfy debt service obligations and prevent default. *Id.*

^{127.} See Chung, supra note 60, at 1474-80.

^{128.} In 2008, the Securities and Exchange Commission brought civil enforcement actions again Larry Langford (then major of Birmingham), the former president of the Jefferson County Commission, J.P. Morgan Securities, Inc. and two former Morgan Stanley managing directors in connection with a kick-back scheme whereby J.P. Morgan allegedly made more than \$8 million in undisclosed payments to local broker-dealers with ties to local officials in an effort to obtain underwriting business for J.P. Morgan's broker-dealer and the swaps business for its affiliated bank. Complaint at 8–33, Sec. & Exch. Comm'n v. Langford, (N.D. Ala. 2008) (No. CV-08-B-0761-S).

^{129.} See J.P. Morgan Sec. Inc. ¶ 46, Securities Act Release No. 9078, Exchange Act Release No. 60,928, 2009 WL 3652405, at *7 (Nov. 11, 2009). On March 3, 2009 certain of the county's interest rate swaps were terminated. *Id.* On March 6, 2009, J.P. Morgan's affiliated commercial bank notified the

deteriorated, the county increased sewer taxes and cut public services.¹³⁰ As noted above, residents reported lasting harm to county finances and quality of life in the wake of the scandal and the project's collapse.¹³¹

Climate risks and impacts threaten to stretch state and especially local budgets to the breaking point. As Hurricane Maria demonstrates, extreme storms wipe out entire water, transportation, power, and communication networks, causing overwhelming financial losses. Wildfires sparked by climate change-fueled storms have the potential to level entire towns, destroying both public infrastructure and the homes and businesses that contribute to the local residential and commercial tax base, as happened in Paradise, California. Coastal flooding caused by extreme weather or sea level rise also has the potential to cause lasting harm. As the NCA4 Report recognized, these impacts of climate change exacerbate risks and costs associated with aging and deteriorating infrastructure, already-stressed ecosystems, and pre-existing economic inequality.¹³² All of these risks and costs have the potential to decimate state and especially local government budgets, and to cause lasting harm to public health and welfare.

\mathbf{C} . The technical burdens of climate change adaption and resiliency planning

Another risk of the current system is that the technical challenges of responding to climate change will overwhelm state and especially smaller local governments. Consider water infrastructure. In the face of changing weather patterns, droughts, floods, and other climate change-fueled impacts on water resources and water infrastructure, water managers and planners in cities, towns, villages, and states across the United States will "encounter new risks, vulnerabilities, and opportunities" that cannot be addressed solely through existing infrastructure or water management practices, according to the 2014 NCA3 Report.¹³³ The NCA3 Report identifies a number of strategies for water infrastructure adaption and resiliency planning designed to mitigate or address these risks and potential impacts.¹³⁴ Municipal water authorities may wish to consider adopting "water conserving plumbing codes, and improving flood forecasts, telecommunications, and early warning systems."¹³⁵ Municipalities also may wish to consider strategies for greening existing infrastructure, such as "green roofs, rain gardens,

county that it owed \$647,804,118 as a result of the termination of the swap agreements. *Id.* According to Jefferson County's official operating budget, the total budgeted revenue for the 2009 fiscal year was \$724,689,637. *See* BUDGET MGMT. OFF., OFFICIAL OPERATING BUDGET, JEFFERSON COUNTY, ALABAMA, FISCAL YEAR OCT. 1, 2008–SEPT. 30, 2009 50 (2008), https://perma.cc/37YC-LP93.

^{130.} See, e.g., Mary Williams Walsh, In Alabama, a County That Fell Off the Financial Cliff, N.Y. TIMES (Feb. 19, 2012), https://perma.cc/M3NM-E4K2.

^{131.} See supra notes 114-16 and accompanying text.

^{132.} NCA4 REP., supra note 2, at 25.

^{133.} NCA3 REP., supra note 42, at 12.

^{134.} Id. at 89.

^{135.} Id.

roadside plantings, porous pavements, and rainwater harvesting."¹³⁶ Changes to water law regimes may be necessary, and regional strategies and public/private partnerships may be useful, as well.¹³⁷ All of these strategies require expertise, financial resources and coordination (not competition) among stakeholders—all of which may be in short supply, especially during times of crisis.

D. POLITICAL RISKS AND COSTS OF THE CURRENT REGIME

1. The Federal Government and Climate Change

Political risks and realities also affect climate change. Since taking office, President Donald Trump, his administration, and his allies have pursued a political and legislative agenda that reflects a hostility towards climate science and climate change. On July 1, 2017, President Trump announced that the United States would cease implementing the Paris Climate Accord, making the U.S. the only signatory to reject the Accord's commitments to emissions reductions.¹³⁸ The Trump Administration has sought systematically to undo prior adaption and resiliency planning efforts, as well. On August 15, 2017—less than two weeks before Hurricane Harvey slammed into Texas—President Trump rescinded President Barack Obama's Federal Flood Risk Management Standard (Executive Order ("EO") 13690).¹³⁹ EO 13690, signed on January 30, 2015, had called for federal infrastructure projects and disaster rebuilding investments to take rising sea levels and other consequences of climate change into account.¹⁴⁰

Trump Administration officials reportedly cancelled federal government research programs focused on climate science and climate change¹⁴¹ and buried evidence of climate change developed at the agency level, including evidence gathered or generated by federal government researchers.¹⁴² To this end, Trump Administration officials reportedly have caused documents, webpages, and entire

^{136.} Id.

^{137.} Id.

^{138.} See President Trump Announces U.S. Withdrawal From the Paris Climate Accord, WHITEHOUSE.GOV (June 1, 2017), https://perma.cc/H2YC-UDM8.

^{139.} See Presidential Executive Order on Establishing Discipline and Accountability in the Environmental Review and Permitting Process for Infrastructure, WHITEHOUSE.GOV (Aug. 15, 2017), https://perma.cc/QM8A-B9QR; see also Trump Rolls Back Obama-Era Flood Standards for Infrastructure Projects, NPR: THE TWO WAY (Aug. 16, 2017), https://perma.cc/8K56-Q6HU.

^{140.} See Executive Order – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, WHITEHOUSE.GOV (Jan. 30, 2015), https://perma.cc/R882-388M; See Executive Order – Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, WHITEHOUSE.GOV (Jan. 30, 2015), https://perma.cc/R882-388M.

^{141.} Paul Voosen, NASA Cancels Carbon Monitoring Research Program, SCI. MAG. 586 (May 11, 2018).

^{142.} For example, the Trump Administration reportedly has "refused to publicize dozens of government-funded studies that carry warnings about the effects of climate change, defying a longstanding practice of touting such findings by the Agriculture Department's in-house scientists," including studies that were "peer-reviewed by scientists and cleared through the non-partisan

websites concerning climate change to be revised or removed.¹⁴³ Such changes reportedly have included (i) overhauling the Environmental Protection Agency's ("EPA") climate change website, raising concerns about the potential loss of access to information for state, local, and tribal governments, educators, policy makers, and the public; (ii) removing or significantly reducing the prominence of climate change content on federal agency websites; (iii) removing information about international obligations and commitments regarding climate change and downplaying prior U.S. government involvement in climate change-related initiatives; and (iv) systematically changing language relating to climate change across agency and program websites.¹⁴⁴

The Trump Administration also recently announced plans to revoke the State of California's authority under the federal Clean Air Act to set certain automobile emissions standards.¹⁴⁵ California, Colorado, Connecticut, Delaware, Hawaii, Illinois, Maine, Maryland, Minnesota, Nevada, New Jersey, New Mexico, New York, North Carolina, Oregon, Rhode Island, Vermont, Washington, Wisconsin, Massachusetts, Michigan, Pennsylvania, and Virginia, as well as the District of Columbia, Los Angeles, and New York City have filed an action for declaratory and injunctive relief seeking to block the regulation.¹⁴⁶

Finally, President Trump has used the bully pulpit of the presidency and the power of the executive branch to deny climate change and to empower those who are hostile to climate science. Although "[h]uman-caused climate change is a scientifically firmly established and well-documented reality ... [and is] widely acknowledged as a crucial, even existential threat to humans," President Trump and senior members of his administration have repeatedly denied this scientific consensus.¹⁴⁷ President Trump has described climate change as a hoax and has argued that the concept of climate change was created by the Chinese to make U.S. manufacturing less competitive.¹⁴⁸ He has sent out tweets denying or

Agricultural Research Service. . . ." See Helena Botemiller Evech, Agriculture Department Buries Studies Showing Dangers of Climate Change, POLITICO (June 23, 2019), https://perma.cc/C8ET-8S3Y.

^{143.} Envtl. Data & Governance Initiative, CHANGING THE DIGITAL CLIMATE: HOW CLIMATE CHANGE WEB CONTENT IS BEING CENSORED UNDER THE TRUMP ADMINISTRATION 3, 14–38 (2018).

^{144.} Id.

^{145.} See Press Release, U.S. EPA, Trump Administration Announces One National Program Rule on Federal Preemption of State Fuel Economy Standards (Sept. 19, 2019), https://perma.cc/VD9S-2SMC. In particular, the National Highway Traffic Safety Administration ("NHTSA") promulgated regulations to be codified at 49 C.F.R part 531 and 533 that purpose to revoke California's authority to set automobile emissions standards. See The Safer Affordable Fuel-Efficient (SAFE) Vehicles Rule Part One: One National Program, RIN 2127-AM20 (Sept. 19, 2019) (to be codified at 49 C.F.R. §§ 531, 533), https://perma.cc/H8ZR-VC4A.

^{146.} Complaint, California v. Chao, Case No. 1:19-cv-02826 (D.D.C. Sept. 20, 2019).

^{147.} KRESGE REPORT, supra note 125, at 15.

^{148.} Donald J. Trump (@realDonaldTrump), Twitter (Nov. 6, 2012, 2:15 PM), https://perma.cc/B37 6-N5RH; Tim Marcin, *What Has Trump Said About Global Warming? Eight Quotes on Climate Change as He Announces Paris Agreement Decision*, NEWSWEEK (Oct. 1, 2017), https://perma.cc/WR57-GXWG.

mischaracterizing risks and costs of climate change, including a series of tweets about the Camp Fire in California that an expert characterized as "unmitigated nonsense and dangerous thinking."¹⁴⁹ And, despite record-setting heat across the United States,¹⁵⁰ devastating wild fires,¹⁵¹ and hurricanes and other extreme weather events, the Trump Administration has repeatedly and publicly pushed back on both the concept and the causes of climate change.

2. State and Local Government Response

In the face of the Trump Administration's hostility to climate science and to the realities of climate change, many state and local governments are exercising technical, financial, and political leadership.¹⁵² New York State recently adopted a sweeping and comprehensive set of reforms focused on climate change.¹⁵³ New York City has convened an expert panel to examine local and regional climate change impacts;¹⁵⁴ appointed a senior director for climate policy and programs;¹⁵⁵ and included attention to climate change in city zoning and building codes, including through design guidelines for infrastructure.¹⁵⁶ California has appointed a climate action team; implemented a climate action plan;¹⁵⁷ adopted mitigation goals; and enacted legislation focused on adaption, mitigation, and resiliency planning, all with an eye towards mitigating impacts upon human health and,

^{149.} Peter Gleick, *Trump's Nonsense Tweets on Water and Wildfires are Dangerous*, WASH. POST (Aug. 8, 2018), https://perma.cc/EYQ5-S8QF.

^{150.} Jason Samenow, *Red-Hot Planet: All-Time Heat Records Have Been Set All Over the World During the Past Week*, WASH. POST (July 5, 2018), https://perma.cc/DKE4-JHSF.

^{151.} Angela Fritz, *How Climate Change is Making Disasters like the Carr Fire More Likely*, WASH. POST (July 30, 2018), https://perma.cc/2V6K-9NZZ.

^{152.} See, e.g., S&P GLOB. RATINGS, 2018 U.S. MUNICIPAL GREEN BOND & RESILIENCY OUTLOOK 11 (2018) (observing that states and cities are leading the way with respect to climate change adaption and resiliency planning); Joe Eskenazi, *The Fight Against Climate Change: Four Cities Leading the Way in the Trump Era*, THE GUARDIAN (June 12, 2017), https://perma.cc/3VYU-ALGZ (describing efforts in New York, Houston, Miami and San Francisco to mitigate risks associated with climate change); Natasha Balwit, *Portland's Answer to Climate Change Denial: Local Action*, CITYLAB (Dec. 7, 2016), https://perma.cc/XSD9-KFDA (referencing C40, a network of megacities around the world focused on addressing climate change.); Linda Poon. *Paris, D.C. Mayors Vow to Make City Voices Louder Than Trump's*, CITYLAB (Nov. 18, 2016), https://perma.cc/SX8M-WW39.

^{153.} See New York State Climate Leadership and Community Protection Act, S.6590 (ch. 106 of the laws of 2019) and S.2385 (2019).; 7, 2019); ng climate change.);in Coastal Management Policies, upon election and annually thereafterctorstee charters contain*See also* Jessie McKinley and Brad Plumer, *N.Y. to Approve One of the World's Most Ambitious Climate Plans*, N.Y. TIMES (June 18, 2019), https:// perma.cc/DP9E-M8J8.

^{154.} NPCC 2019 Report, N.Y.C. PANEL ON CLIMATE CHANGE, https://perma.cc/3Y35-XYJP (last visited Jan. 13, 2019).

^{155.} OneNYC 2050, N.Y.C. CLIMATE POL'Y & PROGRAMS, https://perma.cc/46A7-335W (last visited Jan. 13, 2019).

^{156.} See Mayor Announces New Resiliency Guidelines to Prepare City's Infrastructure and Buildings for Effects of Climate Change, NYC.GOV (Apr. 28, 2017), https://perma.cc/8AG5-UFPZ.

^{157.} Climate Action Team & Climate Action Initiative, CA.GOV, https://perma.cc/E973-SEYY (last visited Jan. 13, 2019).

relatedly, infrastructure.¹⁵⁸ Other municipalities, such as San Francisco, have identified climate change as a key component of resiliency planning, as well.¹⁵⁹ Regional collaboratives are springing up across the United States¹⁶⁰ along with local and regional public-private partnerships focused on adaption and resiliency planning. In addition, state and local governments across the United States are joining forces with cities and regions around the world to take action on climate change, as demonstrated by organizations such as C40¹⁶¹ and 100 Resilient Cities.¹⁶²

State and local governments also are exercising legal leadership. For example, the attorneys general of New York and Massachusetts initiated investigations of Exxon Mobile in 2015 and 2016 in the wake of investigative reporting suggesting that Exxon understood the science of climate change, predicted dire consequences, and then spent millions of dollars to obscure the truth or promote misinformation.¹⁶³ On October 24, 2018, after years of legal skirmishes, then-New York Attorney General Barbara Underwood sued Exxon, alleging that the company had engaged in a "longstanding fraudulent scheme by Exxon … to deceive investors and the investment community, including equity research analysts and underwriters of debt securities … concerning the company's management of the risks posed to its business by climate change regulation."¹⁶⁴ That lawsuit remains pending as of this writing.¹⁶⁵

Several cities and counties have filed civil actions against oil and gas companies using nuisance theories and citing climate change impacts, such as sea level

^{158.} *California Climate Strategy*, CA.GOV, https://perma.cc/N26E-R4D7 (last visited Jan. 13, 2019). Notably, California has, as part of its adaption and resiliency planning efforts, examined how climate change is likely to impact insurance markets and other businesses and sectors with assets or lines of business exposed to climate change. *See, e.g.*, CAL. DEP'T OF INS., TRIAL BY FIRE: MANAGING CLIMATE RISKS FACING INSURERS IN THE GOLDEN STATE (2018); CAL. NAT. RES. AGENCY, THE IMPACT OF CHANGING WILDFIRE RISK ON CALIFORNIA'S RESIDENTIAL INSURANCE MARKET: A REPORT FOR CALIFORNIA'S FOURTH CLIMATE CHANGE ASSESSMENT (2018).

^{159.} See CITY & CTY. OF S.F., RESILIENT SAN FRANCISCO (2016), https://perma.cc/X3KX-ZZQE.

^{160.} KRESGE REPORT, *supra* note 125, at 56 (Multiple local governments (cities and counties) have joined together in regional collaboratives to advance adaptation. Collaboratives are underway in Southeast Florida, Metro Boston, the San Francisco Bay Area, Los Angeles, San Diego, Puget Sound, and the Twin Cities—and also in less-urbanized areas such as the Sierra Nevada region, New England, and the Intermountain West.).

^{161.} *About*, C40 CITIES, https://perma.cc/W34Y-DMPC (last visited Jan. 13, 2019) ("C40 Cities connects 94 of the world's greatest cities to take bold climate action, leading the way towards a healthier and more sustainable future.").

^{162.} About Us, 100 RESILIENT CITIES, https://perma.cc/4WZK-WCM8 (last visited Jan. 13, 2019).

^{163.} Sara Jerving, Katie Jennings, Masako Melissa Hirsh, and Susanne Rust, *What Exxon Knew About The Earth's Melting Arctic*, L.A. TIMES (Oct. 9, 2015), https://perma.cc/RVT9-LGW9.

^{164.} Summons and Complaint, New York v. Exxon Mobil Corporation, Index No. 452044/2018 (N.Y. Sup. Ct. Oct. 24, 2018).

^{165.} The State of Rhode Island also initiated litigation. *See* Complaint at 1, State of Rhode Island v. Chevron Corp., No. PC–2018–4716 (R.I. Super. Ct. 2018).

rise.¹⁶⁶ Results have been mixed. Jurisdictional battles continue in a number of these cases, and several cases have been dismissed on the grounds that climate change should be dealt with by Congress.¹⁶⁷

The oil and gas industry has pushed back aggressively against these efforts. In seeking pre-suit depositions, Exxon argued that municipal government plaintiffs had acted in bad faith in bringing claims:

"The stark and irreconcilable conflict between what these municipal governments alleged in their respective complaints and what they disclosed to investors in their bond offerings indicates that the allegations in the complaints are not honestly held and were not made in good faith. It is reasonable to infer that the municipalities brought these lawsuits not because of a bona fide belief in any tortious conduct by the defendants or actual damage to their jurisdictions, but instead to coerce ExxonMobil and others operating in the Texas energy sector to adopt policies aligned with those favored by local politicians in California."¹⁶⁸

Industry allies also petitioned the Securities and Exchange Commission to initiate an investigation into whether plaintiff cities and counties had violated anti-fraud laws in connection with municipal bond offerings allegedly by failing adequately to disclose climate risk.¹⁶⁹

As all of this suggests, leadership at the state and local level, while critically important, comes at a cost. Not only are state and local governments footing the bill for this work, they are having to expend political capital in convincing residents, not all of whom may be on board with the idea of climate change, to expend resources on adaption and resiliency planning. There is always the risk that an individual state or local government will not acknowledge the realities of climate change or support adaption efforts or resiliency planning.¹⁷⁰ In the absence of federal leadership, hostility to climate science and climate change at the

^{166.} See, e.g., Complaint at 2, 28, Bd. of Cty. Comm'rs of Boulder Cty. v. Suncor Energy (U.S.A), No. 1: 18–cv–01672 (D. Colo. 2018); Complaint at 1, City of New York v. BP, No. 18 cv 182 (S.D.N.Y. 2018); Complaint at 2, City of Oakland v. BP PLLC, Case Nos. C 17–06011 (WHA) & C 17 17–06012 (WHA) (N.D. Cal. 2017); Complaint at 4, City of Richmond v. Chevron Corp., No. C18–00055 (Cal. Super. Ct. 2018); Complaint at 4, County of San Mateo v. Chevron Corp., No. 17 CIV 03222 (Cal. Super. Ct. 2017).

^{167.} See Order Granting Motion to Dismiss at 10, City of Oakland et al. v. BP et al., Nos. C 17–06011 (WHA) and C 17–06012 (WHA) (N.D. Cal. 2018).

^{168.} Petition for Pre-Suit Depositions at 6, Exxon Mobil Corp. (Petitioner), No. 096-297222–18, (Tex. Dist. Ct. 2018).

^{169.} Letter from Martha Mahan Haines to LeeAnn Ghazil Faunt, Chief of the Public Finance Abuse Unit 1 (Apr. 27, 2018), https://perma.cc/YFZ6-JTFR.

^{170.} In 2012, for example, North Carolina enacted legislation directing state and local agencies that develop coastal land use policy effectively to ignore scientific research and data models concerning the risk of sea level rise. *See also* John Schwartz & Richard Fausset, *North Carolina Warned of Rising Seas, Chose to Favor Development*, N.Y. TIMES (Sept. 12, 2018), https://perma.cc/43QG-8DXY ("a 2012 law, and subsequent actions by the state, effectively ordered state and local agencies that develop coastal policies to ignore scientific models showing an acceleration in the rise of sea levels"); Simon Worrall,

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sub-national level can undermine or even prevent state or local adaption or resiliency planning efforts.

V. MARKET-DRIVEN RISKS, COSTS, AND CONSEQUENCES

The financial, technical, and political realities of relying upon state and local governments to shoulder the burden of climate change adaption and resiliency planning are starting to have an impact on financial markets. Wall Street now understands that climate change poses risks for investor portfolios; consequently, investors and other market stakeholders are starting to press municipal bond issuers for more due diligence and more disclosure around climate risk. With investors now armed with more information about climate risk, some issuers are facing higher issuance costs, the possibility of credit rating downgrades, and shifting disclosure norms. All of this has the potential to strain state and especially local governments (again, particularly local governments) to raise capital to meet infrastructure needs.

A. MUNICIPAL BOND INVESTORS PRESSING FOR MORE ROBUST ANALYSIS AND DISCLOSURE AROUND CLIMATE RISK

1. Due Diligence

With institutional investors leading the way, municipal bond investors are pressing state and local governments for additional due diligence and disclosure around climate change risk and community resilience, particularly in connection with water and sewer projects. In 2010, Ceres (a coalition of investors, environmental groups and other public interest organizations) released a report entitled *The Ripple Effect: Water Risk in the Municipal Bond Market*.¹⁷¹ This report found that droughts, surging water demand and other climate change-fueled risks were "threaten[ing] water supplies in many parts of the United States," and observed that then-existing models used by credit rating agencies "largely ignore[d] water risk and may even unintentionally foster wasteful water consumption."¹⁷² The report proposed models and methodologies for assessing water risk and made recommendations for utilities, underwriters, investors and rating agencies.¹⁷³

Three years later, in 2013, Ceres released a disclosure framework for water and sewer enterprises that outlined six key areas of due diligence and disclosure– supply security, demand management, asset management, water quality, energy

Tiny U.S. Island is Drowning. Residents Deny the Reason, NAT'L GEOGRAPHIC, Sept. 7, 2018, at 3, https://perma.cc/D4PB-NUYM.

^{171.} See Sharlene Leurig, The Ripple Effect: Water Risk in the Municipal Bond Market 4, 7 (2010).

^{172.} *Id.* at 4, 7.

^{173.} Id. at 35-42; 70-75.

use and generation, and rates.¹⁷⁴ Citing a United States EPA report on water utilities and climate readiness, the Ceres report highlighted risks and costs posed by climate change to the water sector generally (including drinking water, waste water, and storm water), and urged utilities to "disclose their approach to assessing the effects of climate change on their systems."¹⁷⁵

Ceres also has released a water toolkit for investors that includes a United States municipal bond "cheat sheet."¹⁷⁶ The toolkit and cheat sheet, which were developed in collaboration with more than forty institutional investors, provide a framework for investors to analyze climate-related risks associated with water and wastewater projects financed through the issuance of municipal bonds.¹⁷⁷ The cheat sheet outlines a number of risks and vulnerabilities associated these types of projects—supply vulnerability, lack of drought preparedness, and the quality of the issuer's climate change and resiliency planning. It also identifies issuer best practices around water and waste water infrastructure and investor due diligence guidelines, and it provides a framework for investors to identify strate-gic investment opportunities and opportunities for engagement with issuers around climate change risk.

2. Rating Agencies Identify Extreme Weather Events and Climate Change as Long-Term Credit Risks for Municipal Bond Issuers

Credit rating agencies are pressing bond issuers to get a handle on climate risk and community resiliency. In October 2017, S&P Global Ratings issued a Credit FAQ entitled *Understanding Climate Change Risk and U.S. Municipal Ratings* ("S&P FAQ").¹⁷⁸ The S&P FAQ observed that, "[i]n addition to episodic event risk from natural disasters ... it is important to consider the current long-term credit implications of the physical impact of climate change that municipal debt issuers must contend with."¹⁷⁹ In considering these long-term credit implications, S&P recognized the profound and wide-ranging potential impacts of climate change upon municipal issuers, including the costs of extreme weather events, land use implications, and risks to critical infrastructure associated with longterm changes in temperature and precipitation.¹⁸⁰

179. Id.

^{174.} See CERES, DISCLOSURE FRAMEWORK FOR WATER & SEWER ENTERPRISES 3 (2013), https://perma.cc/3AUL-Q7P5.

^{175.} *Id.* at 5. *See also* U. S. EPA, RISK AND RESILIENCE: CONSIDERING THE INTEGRATION OF CLIMATE READINESS IN FINANCIAL ANALYSES OF DRINKING WATER & WASTEWATER UTILITIES 2 (2014).

^{176.} Investor Water Toolkit, CERES, https://perma.cc/C7FW-XMEW (last visited Oct. 31, 2019).

^{177.} CERES, INVESTOR WATER TOOLKIT: U.S. MUN. BOND CHEAT SHEET 10 (2017), https://perma.cc/3PWG-WQQ6.

^{178.} Credit FAQ: Understanding Climate Change Risk and U.S. Municipal Ratings, S&P GLOB. RATINGS (Oct. 17, 2017), https://perma.cc/YC4Z-FSGM.

^{180.} *Id.* at 1 ("The implications can be broad: from the direct costs of increasingly expensive weather events, to the long-term implications of coastal land use, including the viability and variability – economic and otherwise – of property exposed to sea level rise, which exacerbates coastal flooding and

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One month later, in November 2017, Moody's released a research report entitled *Evaluating the Impact of Climate Change on US State and Local Issuers* ("the Moody's Report").¹⁸¹ The Moody's Report observes that climate change is expected to cause more frequent and more severe extreme weather events and associated impacts ("heatwaves, droughts, nuisance flooding, wildfire and more damaging coastal storm surges"), the report further observes that such events are likely to heighten "U.S. exposure and vulnerability to economic loss across industries and geographic regions" and discusses how Moody's "assess[es] the impact of these risks on US state and local issuers."¹⁸² The Moody's Report states that credit risk resulting from climate change is a key factor in credit risk analysis for municipal bond offerings, and it suggests that a municipality's resilience to climate change—or, alternatively, its failure to engage in resiliency planning—could have an effect upon the pricing and rating of the municipality's bond offerings.¹⁸³

3. Investors are Pressing the Insurance Sector and Other Businesses with Vulnerable Physical Assets or Business Lines

Relatedly, investors are pressing insurers, utilities, and other businesses with physical assets or lines of business exposed to climate risk for better analysis and disclosure.¹⁸⁴ In a 2012 report entitled *Stormy Future for U.S. Property/Casualty*

181. MOODY'S INV'RS SERV., EVALUATING THE IMPACT OF CLIMATE CHANGE ON US STATE AND LOCAL GOVERNMENT ISSUERS (2017) [hereinafter MOODY'S, EVALUATING THE IMPACT OF CLIMATE CHANGE], https://perma.cc/VFH6-3MTH. Around the same time, Moody's released a report entitled *How Moody's Assesses the Physical Effects of Climate Change on Sovereign Issuers*. MOODY'S INV'RS SERV., HOW MOODY'S Assesses THE PHYSICAL EFFECTS OF CLIMATE CHANGE ON SOVEREIGN ISSUERS 5 (Nov. 7, 2016). As with the report on municipal issuers referenced in the main text, the report on sovereign issuers recognized that "climate shocks can inflict significant damage to the infrastructure assets of an economy." *Id.* "They may lead to the breakdown of supply chain networks and damage critical services such as electricity or water supply," as the Sovereign Report noted, and "[r]econstruction costs can be large and impose a significant burden on public finances." *Id.* As the Sovereign Report also observed, "[p]ersistent climate shocks may also increase expenses related to adaption and prevention." *Id.; see also* S&P's RATING SERVS., CLIMATE CHANGE IS A GLOBAL MEGA-TREND FOR SOVEREIGN RISK 2 (2014), https://perma.cc/3Q6M-J8VY (opining that "climate change is likely to be one of the global mega-trends impacting sovereign creditworthiness, in most cases negatively").

182. MOODY'S, EVALUATING THE IMPACT OF CLIMATE CHANGE, *supra* note 181, at 1.

184. See, e.g., U.S. Sec. & Exch. Comm'n, Commission Guidance Regarding Disclosure Related to Climate Change, Exch. Act Rel. No. 33-9106 7 (Feb. 2, 2010) ("There have been increasing calls for

increases high tides, which can reduce the property tax base many public finance entities rely on. In addition to the environmental implications of sea water encroachment into coastal areas, infrastructure, and fresh water aquifers, the higher average and extreme temperatures associated with climate change can have many effects: increase electricity loads in many regions; cause and contribute to droughts and desertification; affect crop production, soften pavement and make roadways more susceptible to wear and tear; make rail tracks buckle; and prevent aircraft from taking off under some conditions. . . . As noted, the costs of mitigating and adapting to climate change could strain the debt metrics of entitles responsible for financing the adaption costs, potentially leading to downgrades.")

^{183.} *Id.* Other market stakeholders have identified climate change as a key risk for municipal bonds, as well. *See, e.g.*, Leslie Norton, *Wildfires, Hurricanes, and Muni Bonds*, BARRON'S, Sept. 23, 2019, at 30–31.

Insurers: The Growing Costs and Risks of Extreme Weather Events, Ceres examined the state of the domestic insurance industry and its vulnerability to climate change, and it proposed a number of reforms and best practices relating to risk assessment, pricing, and adaption and resiliency planning.¹⁸⁵ This report observed that rising losses associated with extreme weather events, the then-sluggish economy, and historically low investments returns were having a significant impact upon the insurance industry's risk models and underwriting capabilities.¹⁸⁶ The report further observed that climate change was likely to worsen future losses as "extreme weather events, including heat waves, droughts and floods[,]" became more intense.¹⁸⁷ With these risks and costs in mind, the report urged insurers to evaluate and price increased risk exposure of insured property in the face of climate change; update insuring pricing and underwriting to reflect extreme weather risks and impacts; and inform land use planning, infrastructure design, and building codes with an eye towards continued insurability in the face of climate change.¹⁸⁸

Other market stakeholders are also focused on climate change and investor risk. Many of the nation's largest financial services firms have begun pushing for more robust disclosure around climate risk.¹⁸⁹ Also, more than 2,000 investment firms, pension systems, and other financial institutions around the world have signed the United Nations-backed Principles for Responsible Investment

187. Id. at 4-5, 17-19.

189. See, e.g., Jeremy Berke, The World's Largest Mutual Fund Provider is Pushing Companies to Disclose How Climate Change Could Hurt Their Bus., BUS. INSIDER (Nov. 28, 2017), https://perma.cc/ DXR4-HSVU; ESG Info. – 2018 Highlands, JPMORGAN CHASE & Co., https://perma.cc/E94L-4P9V (last visited Jan. 16, 2020); Jamie Kramer, Sustainable Investing: Investment Perspective on Climate Risk, JPMORGAN ASSET MGMT. (Feb. 21, 2017), https://perma.cc/GYLJ-CR37; Sustainable Signals, MORGAN STANLEY 2 (2018), https://perma.cc/L3NH-TRTK; The Investor's Guide To Climate Change, MORGAN STANLEY (Dec. 11, 2015), https://perma.cc/S5MQ-VCWW; Rakhi Kumar & Michael Younis, Climate-Related Disclosures in Oil and Gas, Mining, and Utilities., STATE ST. GLOB. ADVISORS 1–2 (June 2019), https://perma.cc/P2DD-RJV6.

climate-related disclosures by shareholders of public companies"); *see also* CLIMATE ACTION 100+ 1, https://perma.cc/RBJ8-NS8D (last visited Jan. 17, 2020).

^{185.} See generally Cynthia McHale & Sharlene Leurig, Ceres, Stormy Future for U.S. Property/Casualty Insurers: The Growing Costs and Risks of Extreme Weather Events (2012).

^{186.} *Id.* at 3–4, 13–16.

^{188.} *Id.* at 24. Other groups have published like-minded white papers, educational pieces, and best practices literature as well, often at the behest of institutional investors. For example, in a report prepared for Deutsche Asset Management, Four Twenty Seven observed that while "[n]atural disasters have always been with us . . . they are now becoming more frequent, more intense, and importantly, more predictable." *See* DEUTSCHE ASSET MGMT., MEASURING PHYSICAL CLIMATE RISK IN EQUITY PORTFOLIOS 5 (2017). Four Twenty Seven further observed that with climate science "point[ing] to an increase in extreme weather events and long term climactic changes that will dramatically alter the environment upon which human societies and economic activity depends," ignoring climate science and the long-term climate risk is a "massive market failure." *Id.; see also* MARYAM GOLNARAGHI, CLIMATE CHANGE AND THE INSURANCE INDUSTRY: TAKING ACTION AS RISK MANAGERS AND INVESTORS, THE GENEVA ASSOCIATION 7 (2018) (identifying climate risk as a "core" business issue).

("PRI").¹⁹⁰ PRI signatories commit to incorporate environmental, social, and governance ("ESG") issues into investment analysis and decision-making, with climate change identified as a high priority item.

B. CREDIT RATINGS AND PRICING IMPACTS

These developments are starting to affect credit determinations and pricing in the municipal bond market. Even before S&P Global and Moody's issued the research reports referenced above, extreme weather events caused rating agencies to issue credit downgrades in several cases. The S&P FAQ notes, for example, that "several local governments and municipal enterprises in the New Orleans area and Galvaston, Texas, were downgraded following hurricanes Katrina, Rita, and Ike."¹⁹¹ More recently, PG&E's credit rating was cut to near junk status over concerns that the company's insurance would not be sufficient to address losses associated with the Camp Fire and other catastrophic blazes;¹⁹² the company ultimately filed for bankruptcy protection on January 29, 2019.¹⁹³ While some municipal bond issuers reportedly have continued to receive top ratings despite risks and threats associated with climate change,¹⁹⁴ commentators are becoming increasingly vocal about the potential for downgrades due to perceived or demonstrated climate risk.¹⁹⁵

There also is evidence that markets are starting to take climate risk into account in pricing municipal bonds.¹⁹⁶ One recent study examined whether a county's climate risk (measured by expected mean annual loss, as a percentage of the county's GDP, from sea level rise) affected the county's cost of issuing municipal

191. S&P GLOB. RATINGS, supra note 178.

192. See Ciara Linnane, PG&E Stock at its Lowest in 15 Years on Concern Over California Utility's Wildfire Liability, MARKETWATCH (Nov. 15, 2018), https://perma.cc/86KR-LMHJ; Allison McNeely, PG&E Credit Cut to Brink of Junk by Moody's on Wildfire Risk, BLOOMBERG NEWS (Nov. 15, 2018), https://perma.cc/77AY-38ME.

195. See, e.g., S&P GLOB. RATINGS, supra note 178 ("Resiliency has developed into a key theme for municipal issuers in U.S. public finance, underscored by two trends. First, the rising acceptance that climate change-related risks represent exposures for public entities and their infrastructure (highlighted during recent hurricanes in North America. Second, the interlinked trends of growing and urbanizing populations, which bring concentrations of social and economic assets in areas already susceptible to extreme-weather related events (such as hurricanes and flooding."); Jay Newman, *Climate Change Could Swamp Your Muni-Bond Portfolio*, WALL ST. J. (Feb. 2, 2018), https://perma.cc/7KED-F9KE.

196. See generally Marcus Painter, An Inconvenient Cost: The Effects of Climate Change on Municipal Bonds, 132 J. FIN. ECON. 1 (2019) (examining whether the cost of issuing municipal bonds is affected by county's exposure to risk of sea level rise).

^{190.} See, e.g., PRINCIPLES FOR RESPONSIBLE INV., ANNUAL REPORT 2018 5 (2018), https://perma.cc/ HV8Z-68L3.

^{193.} In re PG&E Corp., No. AP 19-03003, 2019 WL 2477433, at *1 (Bankr. N.D. Cal. June 12, 2019).

^{194.} Christopher Flavelle, *Cities Threatened By Climate Risk Still Getting AAA Bond Ratings*, BLOOMBERG NEWS (Nov. 2, 2018), https://perma.cc/9B8K-ECH2 ("Last fall, after a trio of deadly hurricanes, rating companies warned vulnerable coastal cities to get ready for climate change . . . Twelve months, two catastrophic storms and thousands of credit ratings later, those companies have yet to downgrade a single city because of climate change.").

bonds.¹⁹⁷ The study found that, "on average, a one percent increase in climate risk for a county" was associated with "a statistically significant increase in annualized costs of 23.4 basis points for long-term maturity bonds."¹⁹⁸ This additional cost is associated with an "an average rise in total annualized issuance costs of approximately \$1.7 million for the average county," according to the study.¹⁹⁹ The study also found that the market "accounts for differences in credit quality when assessing climate risk."²⁰⁰

C. EMERGING MARKET FOR GREEN BONDS AND CLIMATE BONDS

Issuer and investor concerns about climate risk also appear to be behind the growth of so-called green bond²⁰¹ and climate bond²⁰² initiatives. Green bonds "enable capital-raising and investment for new and existing projects with environmental benefits."²⁰³ Eligible green project categories include, among others: (i) renewable energy; (ii) pollution prevention and control; (iii) clean transportation; (iv) sustainable water and wastewater management; (v) climate change adaption projects; and (vi) green buildings.²⁰⁴ The European Investment Bank issued the first green bond in 2007, and over the past decade or so, the global market for green bonds has grown substantially, according to market analysts.²⁰⁵ Municipal bond issuers are reportedly using green bonds to fund both mitigation and adaption projects, with the majority of bonds issued for water, green buildings, and transportation purposes.²⁰⁶

In one study of the U.S. green bond market, researchers concluded that green municipal bonds are priced at a premium, with after-tax yields that are roughly

201. See, e.g., GREEN CITY BONDS COAL., HOW TO ISSUE A GREEN MUNI BOND: THE GREEN MUNI HANDBOOK 3 (2015), https://perma.cc/R5VL-WYR3 (defining green municipal bond as a municipal bond that is labeled "green" by the issuer; where the proceeds are "earmarked for green investments," and where the issuer "tracks and reports on the use of the proceeds to ensure green compliance.").

202. Climate bonds are bonds that are used to finance (or re-finance) projects to address climate risk – for example, building a sea wall in a municipalities threatened by rising sea levels. *See Climate Bond Standard Version 2.1*, CLIMATE BOND INITIATIVE 3 (Jan. 2017), https://perma.cc/URV9-9NBD.

203. Green Bond Principles, INT'L CAPITAL MGMT. ASS'N, https://perma.cc/TN3E-K4LP (last visited Jan. 13, 2020). Note, however, that there "is not yet a single universally-recognized system for determining the green status of a bond." Malcolm Baker, Daniel Bergstresser, George Serafei & Jeffrey Wurgler, *Financing the Response to Climate Change: The Pricing and Ownership of U.S. Green Bonds* 1–2 (Nat'l Bureau of Econ. Research, Working Paper No. 25194, 2018); INT'L CAPITAL MGMT. ASS'N, GREEN BOND PRINCIPLES: VOLUNTARY PROCESS GUIDELINES FOR ISSUING GREEN BONDS 3 (June 2018) [hereinafter INT'L CAPITAL MGMT. ASS'N, GREEN BOND PRINCIPLES], https://perma.cc/TN3E-K4LP.

204. INT'L CAPITAL MGMT. ASS'N, GREEN BOND PRINCIPLES, *supra* note 203, at 4; see also Baker et al., *supra* note 203, at 9–10, 32 (finding in sample of 2,083 green municipal bonds, that the most popular uses for green municipal bonds "include public power, mass transit, education (e.g., energy-efficient school buildings and dormitories), and water and sewer projects.")).

205. S&P GLOB. RATINGS, 2018 U.S. MUNICIPAL GREEN BOND & RESILIENCY OUTLOOK 2, 3 (2017). 206. *Id.* at 3.

^{197.} Id. at 2.

^{198.} Id. at 2.

^{199.} Id. at 2.

^{200.} Id. at 11.

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six basis points below yields paid by otherwise equivalent bonds.²⁰⁷ Researchers noted that this premium "doubles or triples for bonds that are not only self-labeled as green (and confirmed by Bloomberg) but also externally certified as green by a third party according to industry guidelines, and publicly registered with the Climate Bonds Initiative ("CBI").²⁰⁸ Data also suggest that green bond ownership is more concentrated, according to the researchers, "with a subset of investors holding them at higher weights, particularly when the par value is small or the bond is especially low risk."²⁰⁹ Researchers hypothesized that green bonds are more likely to be held by concerned investors who are willing to accept lower returns in exchange for the opportunity to invest in securities that meet social objectives, and they found supportive evidence for this proposition.²¹⁰

VI. EVOLVING DISCLOSURE NORMS AND REQUIREMENTS

In addition to impacts on due diligence, credit determinations, and pricing, increased attention to climate risk also seems to be re-shaping disclosure norms. But, because the registration and disclosure regime applicable to municipal securities is considerably less robust than its corporate securities counterpart, things are changing comparatively faster in the corporate securities market.

A. MUNICIPAL SECURITIES, CLIMATE CHANGE, AND DISCLOSURE

When Congress enacted Section 3(a)(2) of the Securities Act of 1933 more than eighty years ago, it exempted municipal securities issuers and municipal securities from the registration, disclosure, and periodic reporting requirements applicable to covered corporate registrants and publicly traded corporate securities.²¹¹ While the Securities and Exchange Commission eventually adopted Rule

211. According to a 1975 Senate report, Congress maintained the prohibition against direct issuer regulation for a number of reasons, including comity principles and respect for the ability of state governments to access capital markets, concerns about the costs of regulation for state and local government issuers and perceived lack of abuses in the municipal market sufficient to justify incursions on state prerogatives. *See* S. REP. No. 94-75, at 223 (1975). *See* Securities Exchange Act of 1934, 15 U. S.C. §§ 780-4(d)(1)–(2) (2010). An official statement is a document prepared by or on behalf of a state or local government in connection with a new issue of municipal securities. Though far more limited than their corporate securities counterparts, official statements are comparable, in some respects, to a

^{207.} Baker et al., *supra* note 203, at 2–3 (studying 2,083 green municipal bonds issued between 2010 and 2016).

^{208.} Id.

^{209.} Id. at 28.

^{210.} *Id.* at 4. The researchers observed that this funding fits with existing literature on socially responsible investing. *Id.* at 8 (citing Luc Renneboog, Jenke Ter Horst, and Chendi Zhang, *Socially Responsible Investments: Institutional Aspects, Performance, and Investor Behavior* 32 J. OF BANKING & FIN. 1723, 1723 (2008) (surveying literature and finding that a subset of investors is willing to accept lower financial performance to invest in funds that meet social objectives)). Apart from differences in pricing, researchers also concluded that "[g]reen municipal bonds carry higher credit ratings than . . . ordinary [municipal] bonds," with the modal green bond carrying "an essentially riskless AAA rating." *Id.* at 11. Green bonds also are likely to have longer maturities, according the study's authors, and they are less likely to be identified as being sold with third-party insurance or other credit guarantees. *Id.*

15c2-12, which (as amended) imposes certain due diligence and information reporting obligations upon underwriters and others, there are no specific due diligence or disclosure rules or requirements concerning climate change.²¹²

Even in the absence of specific regulatory requirements, however, stakeholders are beginning to reshape disclosure best norms and practices in the municipal securities market. In addition to the due diligence developments referenced above, the National Federation of Municipal Analysts ("NFMA") issued updated disclosure best practices for water and sewer bonds in April 2018,²¹³ including the following recommended best practices for disclosures concerning climate change and natural disaster risk and readiness: (i) "[d]isclose the potential impact of climate change on assets, water supplies, and pledged revenues;" (ii) "[b]ased on the assessment, describe changes to planning including long-term water supply planning, operations, capital investment and risk management;" (iii) "[d]escribe plans for implementing flood mitigation strategies, and other measures for system resilience and long-term sustainability to address such things as rising sea levels and more intense and frequent storm events;" and (iv) "[d]escribe potential risks to facilities from seismic activity or other natural disasters, and any mitigation measures."²¹⁴

B. CLIMATE CHANGE AND CORPORATE SECURITIES MARKETS

Disclosure trends in the corporate securities markets around climate risk are more straightforward. Prior to 2010, most climate change-related disclosure by U.S. public companies was in response to voluntary disclosure initiatives or state or other federal agency regulatory requirements.²¹⁵ Thus, in a June 2009 report

213. NAT'L FED'N OF MUN. ANALYSTS, RECOMMENDED BEST PRACTICES IN DISCLOSURE FOR WATER AND SEWER BONDS (Apr. 2018); see also Brooke Barton, *Commentary: How Climate Change Threatens to Leave Water Bonds High and Dry*, CERES (Oct. 16, 2018), https://perma.cc/UYU8-JMGD ("Climate resiliency is becoming an increasingly material issue for utilities that manage water infrastructure and investors who buy bonds to finance these assets.").

prospectus for a corporate securities offering. See Official Statements, MUN. SEC. RULEMAKING BD. EDUC.

CTR., https://perma.cc/98UV-FTYZ (last visited Jan. 13, 2020).

^{212.} See Section 15(d)(1) and (2) of the Securities Exchange Act of 1934, 15 U.S.C. § 780-4(d). An official statement is a document prepared by or on behalf of a state or local government in connection with a new issue of municipal securities. Though far more limited than their corporate securities counterparts, official statements are comparable, in some respects, to a prospectus for a corporate securities offering. See MUN. SEC. RULEMAKING BD. EDUC. CTR., supra note 211. See also Chung, supra note 60, at 1455, 1501–06, for a discussion of the evolution of the origins and evolution of Rule 15c2-12.

^{214.} NAT'L FED'N OF MUN. ANALYSTS, supra note 213, at 10.

^{215.} U.S. Sec. & Exch. Comm'n, *supra* note 184, at 8 ("Although some information relating to greenhouse gas emissions and climate change is disclosed in SEC filings, much more information is publicly available outside of public company disclosure documents filed with the SEC as a result of voluntary disclosure initiatives or other regulatory requirements." (internal citations omitted)). The Release noted, for example, that The Climate Registry, a non-profit collaboration among North American states, provinces, territories and native sovereign nations, set standards to calculate, verify, and publicly report greenhouse gas emissions into a single public registry. *Id.* at 8–9. The Release also observed that

entitled *Climate Risk Disclosure in SEC Filings: An Analysis of 10-K Reporting by Oil and Gas, Insurance, Coal, Transportation and Electric Power Companies*,²¹⁶ Ceres observed that although climate change was a material risk for many companies, particularly insurers and businesses with vulnerable infrastructure or other physical assets, "few companies" were providing information about how climate change was affecting or likely to affect their businesses at that time.²¹⁷

In 2010, a divided Securities and Exchange Commission issued an Interpretive Release on disclosure requirements relating to climate change.²¹⁸ The Release identified several non-financial statement disclosure rules that might require disclosure of climate change issues, depending on a registrant's risks and circumstances. These included Item 101 of Regulation S-K (which requires disclosure respecting material costs of complying with environmental laws);²¹⁹ Instruction 5 to Item 103 of Regulation S-K (which provides specific requirements respecting the disclosure of certain environmental litigation);²²⁰ Item 503(c) of Regulation S-K (which requires a registrant to discuss certain risk factors);²²¹ and Item 303

The Global Reporting Initiative, a collaboration amongst representatives from business, labor, and professional institutes, had developed a widely used sustainability reporting framework. *Id.* at 9.

218. U.S. Sec. & Exch. Comm'n, supra note 184, at 1.

220. Id. § 229.103 ("Notwithstanding the foregoing, an administrative or judicial proceeding (including, for purposes of A and B of this Instruction, proceedings which present in large degree the same issues) arising under any Federal, State or local provisions that have been enacted or adopted regulating the discharge of materials into the environment or primary for the purpose of protecting the environment shall not be deemed "ordinary routine litigation incidental to the business" and shall be described if: A. Such proceeding is material to the business or financial condition of the registrant; B. Such proceeding involves primarily a claim for damages, or involves potential monetary sanctions, capital expenditures, deferred charges or charges to income and the amount involved, exclusive of interest and costs, exceeds 10 percent of the current assets of the registrant and its subsidiaries on a consolidated basis; or C. A governmental authority is a party to such proceeding and such proceeding will result in no monetary sanctions, or in monetary sanctions, exclusive of interest and costs, or in monetary sanctions, exclusive of interest and costs, of less than \$100,000; provided, however, that such proceedings which are similar in nature may be grouped and described generically.")

221. See id. § 229.503(c) [reserved by 84 FR 12718].

^{216.} See Beth Young, Celine Suarez, & Kimberly Gladman, The Corporate Library, CLIMATE RISK DISCLOSURE IN SEC FILINGS: AN ANALYSIS OF 10-K REPORTING BY OIL AND GAS, INSURANCE, COAL, TRANSPORTATION AND ELECTRIC POWER COMPANIES (2009), https://perma.cc/7AQY-M56N.

^{217.} *Id.* at iv; *see also id.* at 3 (noting "the increasing incidence of extreme weather under a warming climate is already placing major strains on the insurance industry;" and further noting that the "[i]ncreasing frequency of extreme weather events could impact a wide range of infrastructure investments," including "major energy, industrial and manufacturing facilities.").

^{219. 17} C.F.R. § 229.101(c)(1)(xii) (2018) ("Appropriate disclosure also shall be made as to the material effects that compliance with Federal, State and local provisions which have been enacted or adopted regulating the discharge of materials into the environment, or otherwise relating to the protection of the environment, may have upon the capital expenditures, earnings and competitive position of the registrant and its subsidiaries. The registrant shall disclose any material estimated capital expenditures for environmental control facilities for the remainder of its current fiscal year and its succeeding fiscal year and for such further periods as the registrant may deem materials.").

of Regulation S-K (which requires certain disclosures in Management's Discussion and Analysis of Financial Condition and Results of Operations).²²²

With these rules and requirements in mind, the Release outlined several climate change-related issues that might need to be disclosed, depending upon the registrant's circumstances, including (i) the impact of federal and state legislation and regulation regarding climate change; (ii) the impact of international climate-related accords; (iii) indirect consequences of regulation or business trends, including legal, technological, political, and scientific developments regarding climate change that have the potential to create new opportunities or risks for registrants; and (iv) significant physical impacts of climate change that have the potential to affect a registrant's business or results of operations.²²³ Six years later, the Commission published a Concept Release soliciting public comment on modernizing Regulation S-K's disclosure requirements.²²⁴ The Concept Release specifically requested comments on disclosure practices relating to sustainability, including topics such as climate change, resource scarcity, and corporate social responsibility.²²⁵

Other regulatory constituencies also are calling for improved analysis and disclosure in respect to climate change. For example, the Financial Stability Board has released a set of recommendations on climate-related financial disclosures.²²⁶ The National Association of Insurance Commissions has a climate risk disclosure survey that is designed "to assess insurer strategy and preparedness in the areas of investment, mitigation, financial solvency (risk management), emissions/carbon footprint and engaging consumers."²²⁷ Shareholders have also begun to press for climate risk initiatives and disclosures through the proxy system.²²⁸ These developments are consistent with a market-driven push towards more robust analysis and disclosure around climate change risk generally, particularly for energy and insurance industry businesses, and other enterprises with significant physical assets or lines of business exposed to climate risk.²²⁹

224. U.S. Sec. & Exch. Comm'n, Business and Financial Disclosure Required By Regulation S-K, Exchange Securities Act Rel. No. 33-10064 (Apr. 2016), https://perma.cc/D767-VTZH.

225. See id.

226. See Publications, FIN. STABILITY BD. TASK FORCE ON CLIMATE-RELATED FIN. DISCLOSURES, https://perma.cc/LG5A-8FK8 (last visited Jan. 13, 2020). The Financial Stability Board coordinates national financial authorities and international standard-setting bodies with an eye towards promoting international financial stability. *Id*.

227. *Climate Risk Disclosure*, NAT'L ASS'N OF INS. COMM'RS (Jan. 10, 2019), https://perma.cc/7E72-MLY3.

228. See Early Review of 2019 US Proxy Season Vote Results, INSTITUTIONAL S'HOLDER SERVS. (June 5, 2019), https://perma.cc/FP8L-X8S2 (finding "[e]nvironmental and social ("E&S") shareholder proposals outnumber governance shareholder proposals for [the] third consecutive year, as the breadth of governance topics addressed by proponents is narrowing, while the range of E&S issues continues to expand.").

229. See, e.g., MAX MESSERVY, CERES, INSURER CLIMATE RISK DISCLOSURE SURVEY REPORT & SCORECARD: 2016 FINDINGS AND RECOMMENDATIONS 6 (Oct. 2016) (finding "clear evidence of industry improvement on disclosure of climate risk and management practices," especially in certain market

^{222.} See id. § 229.303.

^{223.} U.S. Sec. & Exch. Comm'n, supra note 184, at 22-27.

VII. STRATEGIES FOR GOVERNMENTS AND COMMUNITY STAKEHOLDERS GOING FORWARD

Given these developments—in state and local government budgets, financial markets, industry norms and legal regimes, and at the political level—what are some strategies to improve adaption and resiliency planning without breaking the budgets of vulnerable state and local government issuers?

A. IMPROVING THE QUALITY AND TIMELINESS OF DISCLOSURE IS IMPORTANT, BUT STRUCTURAL CHALLENGES REMAIN

As the due diligence and disclosure norms and requirements described in Part V suggest, market-focused stakeholders, such as investors, financial market regulators, and insurers, have tended to focus on improving the quality of due diligence and disclosure around climate risk. The idea is that by encouraging or requiring state and local governments and certain private sector businesses to provide more robust and timely disclosure, issuers will have market-driven incentives to reduce risk and improve resilience, and investors will be able to more easily identify and price climate change risk.²³⁰

Without a doubt, the quality of disclosure in the municipal securities market could be improved, and not just with regard to climate risk. The municipal securities market is less liquid and more opaque than markets for corporate equity securities, U.S. Treasury securities, and even futures and foreign exchange markets. It is a dealer market, meaning there is no centralized, organized exchange where municipal securities are listed or traded, and there is not a formal, two-sided quotation system, either.²³¹ The municipal securities market is also characterized by a large number of both issuers and highly disparate offerings.²³² For all of these reasons, the municipal securities market does not offer the same level of price transparency as do markets with more actively traded securities (e.g., corporate equities). The exemptions and comparatively weak disclosure regime in the

segments, but also finding that "most of the 148 insurers evaluated continue to show an overall lack of focus in addressing climate risks and related opportunities.").

^{230.} See e.g., EXEC. OFF. OF THE PRESIDENT OF THE U.S., STANDARDS AND FINANCE TO SUPPORT COMMUNITY RESILIENCE 10 (2016) (Noting the reports issued by rating agencies, and commenting on the importance of resilience and municipal bond ratings: "Given that municipal bonds are one of local government's primary means of securing project funding, it is important for community resilience to factor more directly into municipal credit rating, both to drive state and local action to achieve long-term resilience with less dependence on Federal funds and to assure transparency and protect investor interest."); see also Junbo Wang, et al., *Liquidity, Default, Taxes, and Yields on Municipal Bonds*, 32 J. OF BANKING AND FIN. 1133, 1137–39 (2007); John A. Miller, *Credit Downgrade Threat as a Non-Regulatory Driver for Flood Risk Mitigation and Sea Level Rise Adaption* 1 (U. of Pa. Master of Envtl. Studies Capstone Project 73, May 2018), https://perma.cc/DP9K-GPDR; cf. Matthew E. Kahn, Brian Casey, & Nolan Jones, *How the Insurance Industry Can Push Us to Prepare for Climate Change*, HARV. BUS. REV. (Aug. 28, 2017), https://perma.cc/4KDA-ENE7.

^{231.} SEC REP., supra note 77, at v-vi; see also id. at 18-20.

^{232.} See also Chung, supra note 60, at 1485.

municipal securities market only add to the difficulties that investors already face in getting a handle on pricing risk.

That said, disclosure-focused reforms address only part of the problem, because even if disclosure rules were perfect, and even if markets could perfectly and efficiently price climate risk, a there are still fundamental structural challenges respecting infrastructure finance with profound implications for public health, safety, and prosperity. Climate change is an existential threat to public health, safety, and welfare *nationwide*—in part, because extreme storms, heatwaves, and other impacts have the potential to damage or destroy the public infrastructure nationwide—but the United States does not have a nationwide, fiscally-sound strategy for addressing these risks. While improved disclosure would help municipal bond investors identify and price climate risk—certainly, a worthy goal—it would not help state or local governments manage climate risk, adaption, or resiliency planning costs. Without structural changes to municipal finance systems, more robust disclosure norms have the potential to add to the cost of issuing municipal bonds by imposing additional technical and financial burdens on state and local governments that they may be in no position to bear.

With these challenges and concerns in mind, the next section discusses strategies for helping state and local governments identify and manage climate change-fueled risks to public infrastructure. These strategies are intended to supplement the disclosure-focused initiatives discussed above.

B. THE ROLE OF THE FEDERAL GOVERNMENT

The federal government is unlikely, in the short term, to enact legal, regulatory, or policy reforms designed to assist, encourage, or support state or local governments in climate change adaption or resiliency planning. Even so, it is worth considering how the federal government might support climate risk adaption and resiliency planning going forward.

1. Sponsor of Climate Research, Clearinghouse for Climate Science

One key role for the federal government is to serve as a sponsor of, and clearinghouse for, climate change research. Continuing to support the work of the United States Global Change Research Program ("USGCRP") would be a helpful start. The USGCRP is federal program with a congressional mandate to coordinate federal research and investments into the forces shaping the global environment."²³³ Among other tasks, the USGCRP facilitates collaboration and cooperation across thirteen federal member agencies "to advance understanding of the changing Earth system and maximize efficiencies in Federal global change research."²³⁴

234. Id.

^{233.} See About USGCRP, U.S. GLOB. CHANGE RES. PROGRAM, https://perma.cc/PV4F-8Q4H.

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The USGCRP has carried out this mandate, in part, through the National Climate Assessment ("NCA") project.²³⁵ Through the NCA, climate science experts have collected, integrated, and assessed climate change-related observations and research from around the country, and, in a series of reports, these experts have addressed climate change-fueled impacts on human health, water, energy, transportation, agriculture, forests, and ecosystems.²³⁶ The NCA reports also have assessed key impacts on all U.S. regions, including the Northeast, Southeast and Caribbean, Midwest, Great Plains, Southwest, Northwest, Alaska, Hawai'i and the Pacific Islands, as well as the country's coastal areas, oceans, and marine resources.²³⁷

The USGCRP's role in coordinating the work of relevant federal agencies, serving as clearing house for climate science, and producing the NCA reports is incredibly important because state and (especially smaller) local governments do not have the financial resources or technical expertise needed to collect data, or to analyze and report on climate risk or impacts at the local, regional, and national levels. Moreover, even if they did have the requisite resources, examining climate change impacts on a city-by-city, state-by-state basis would be massively inefficient and would lead to "blind spots" in places where resources are constrained.²³⁸ Federal-level research, analysis, and educational outreach is a far more efficient and effective strategy; better still would be to combine vigorous federal government support for climate change research, analysis, and educational outreach with coordinated efforts at the state and local levels.

2. Clearinghouse for Technical Assistance, Establish Regulatory Floors and Best Practices with Respect to Adaption and Resiliency Planning with Input from Local Communities

The United States federal government would do well to leverage the work of the USGCRP and participating federal agencies by developing climate riskinformed guidelines, best practices, and (or as an alternative) minimum

^{235.} See U.S. GLOB. CHANGE RES. PROGRAM, THE NATIONAL GLOBAL CHANGE RESEARCH PLAN 2012–2021: A STRATEGIC PLAN FOR THE U.S. GLOBAL CHANGE RESEARCH PROGRAM 69 (2012) ("The USGCRP is required on a periodic basis (not less frequently than every four years) to submit to the President and the Congress a report that: Integrates, evaluates, and interprets the findings of the USGCRP and discusses the scientific uncertainties associated with such findings; Analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and Analyzes current trends in global change, both human- induced and natural, and projects major trends for the subsequent 25 to 100 years.").

^{236.} See, e.g., NCA4 REP., supra note 2, at 72-638.

^{237.} Id. at 115-1242.

^{238.} *Cf.* EXEC. OFF. OF THE PRESIDENT OF THE U.S., *supra* note 230, at 11 ("Despite rapid progress, "blind spots" where data is inadequate to provide a complete and accurate assessment or risk over the life of an asset or the true costs and complete benefits of all resilience investments continue to mask the true nature of risk, undervalue resilience, and dampen investment interest.").

regulatory standards for the siting, design, and construction of critical infrastructure assets. The Obama Executive Order Flood Risk Management Standards are an example of this approach (though they were rescinded by the Trump Administration),²³⁹ but there is much more work to be done.

To be clear, federally-developed guidelines, best practices, or regulatory standards should not be imposed upon state and local governments as an unfunded mandate. Over-reliance on the financial and technical capacity of state and local governments is one of the key risks of the current system of infrastructure finance, as discussed above, and the federal government should not impose additional mandates on state or local governments without allocating additional grant funding or providing low cost financing, or both.

Furthermore, federally-developed best practices or standards should not preclude or devalue local input. While the state of U.S. infrastructure is an issue of national concern, specific projects require insights from local stakeholders. This is true of infrastructure generally (like deciding where to build a road or if a new school is needed), and also with respect to infrastructure issues specifically involving climate change (such as determining if a sea wall if necessary due to coastal flooding). Heatwaves, droughts, floods, storms, and other climate changefueled impacts affect localities in different ways. Whereas coastal communities in the United States may experience sea level rise or storm surges associated with extreme weather events, midwestern communities may experience flooding due to rivers overflowing their banks. Changing temperature and precipitation patterns mean that some communities may experience increased risk of droughts or extreme heat, whereas other communities may experience wetter and colder weather extremes. Urban communities may need to strengthen public transportation systems in the face of climate change-fueled extreme weather events, whereas rural communities may be focused on addressing threats to water supplies associated with changing weather patterns.

In responding to these locally-felt needs and impacts, local stakeholders are likely to have insights that higher levels of government may not. Moreover, ideals and norms of democratic self-governance mean that local stakeholders should be able to weigh in before financial commitments are made in their name. And, as a political matter, getting residents' input is a prudent, fiscally responsible way to reduce the risk that local stakeholders will balk at financial commitments down the road.

Existing voting rights and other mechanisms for taxpayer input and oversight are not perfect. Not every municipal bond offering is subject to a vote. Property and business owners cannot easily sell their homes or businesses, or exit the

^{239.} See WHITEHOUSE.GOV, supra note 139 (calling for federal infrastructure projects and disaster rebuilding investments to take rising sea levels and other consequences of climate change into account); see also EXEC. OFF. OF THE PRESIDENT OF THE U.S., supra note 230, at 12–16 (discussing resilience-based building codes standards and programs).

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municipal enterprise, if they disagree with a bond vote or with local economic policy or development plans.²⁴⁰ Moreover, as Puerto Rico's experience under PROMESA and Flint, Michigan's experience under the control of an emergency manager reflect, municipal financial distress and insolvency regimes raise substantial and troubling concerns about the role of democratic self-governance in local financial affairs.²⁴¹ Even so, the opportunity to vote on certain bond offerings and in local elections, such as elections for school budgets and for local officials, means that residents will, in most circumstances, have at least some say over commitments for public infrastructure made in their name under the current system. While best practices and regulatory requirements are good ways of establishing a climate risk-sensitive "floor" in the siting, design, and construction of public infrastructure, such standards should include opportunities for local educational outreach and input.

3. The Federal Government as a Source of Capital or Credit Assistance for High Risk Issuers and Projects

A third potential role for the federal government is to serve as an alternative source of capital or credit assistance, or as credit backstop, especially in situations where private credit markets deem an issuer or a project to be too great a credit risk. The federal government could accomplish this by increasing grant funding for infrastructure-related climate change adaption and resiliency planning projects outright. Without more federal money, the financial burdens of infrastructure and climate change adaption, and resiliency planning will continue to fall most heavily upon state and local governments, with all of the attendant consequences and risks described above.

a. Insurance

Short of additional grant funding, there are still ways for the federal government to help state and local governments deal with the financial consequences of climate change. For example, the federal government could establish an insurance program that that encourages and rewards state and local governments for engaging in climate change adaption and resiliency planning efforts. The National Flood Insurance Program (NFIP) offers a starting point for how this might work. The NFIP is a federal program that seeks to reduce the impact of

^{240.} See, e.g., Chung, supra note 60, at 809.

^{241.} See, e.g., Dean Delasalas, La Promesa Cumplida [The Promise Fulfilled]: How the U.S. Constitution Has Enabled Colonialism, 67 CATH. U. L. REV. 761, 762–63, 778–80 (2018); Emily LeBlanc, What Happens When an Island Starts to Drown Under Its Own Weight? The Debt Crisis of Puerto Rico, 20 OR. REV. INT'L L. 305, 317–22 (2018); Victoria Zorovich, The Perfect Storm: Weathering Puerto Rico's Fiscal Crisis in the Wake of Hurricane Maria, 46 HOFSTRA L. REV. 1067, 1075–76 (2018); See also NAOMI KLEIN, THE BATTLE FOR PARADISE 43–53 (2018); Naomi Klein, There Is Nothing Natural About Puerto Rico's Disaster, THE INTERCEPT (Sept. 21, 2018), https://perma.cc/2TZL-QMDQ.

flooding on private and public structures by providing insurance to property owners, renters, and businesses in areas where private insurance may be unavailable or prohibitively expensive.²⁴² To participate in the NFIP, eligible communities must (i) complete an application; (ii) adopt a resolution of intent to participate and cooperate with FEMA (the Federal Emergency Management Agency); and (iii) adopt and submit a floodplain management plan that meets or exceeds minimum NFIP criteria.²⁴³ Once a community is accepted into the program, homeowners, renters, businesses, and community centers can purchase flood insurance through their NFIP-participating community.²⁴⁴

To encourage and reward community floodplain management activities, the NFIP allows communities to earn points through the NFIP Community Rating System (CRS).²⁴⁵ The CRS is a voluntary, incentive-based program developed by FEMA that provides incentives and rewards for community floodplain management activities that exceed minimum NFIP requirements, for example, communities that exceed minimum requirements are eligible for discounted premium rates.²⁴⁶ Reductions in premium costs have the potential to save residents thousands of dollars a year.²⁴⁷ In some coastal areas where few, if any, private insurers

243. See Participation in the National Flood Insurance Program, FED. EMERGENY MGMT. AGENCY, https://perma.cc/XM6M-2HSQ (last visited Jan. 13, 2020) ("Participation in the National Flood Insurance Program (NFIP) is voluntary. To join, the community must: Complete an application; Adopt a resolution of intent to participate and cooperate with FEMA; Adopt and submit a floodplain management ordinance that meets or exceeds the minimum NFIP criteria. The floodplain management ordinance must also adopt any FIRM or FHBM for the community."); see also 44 C.F.R. §§ 59.2, 60.1 (2019).

244. See, e.g., 44 C.F.R. §§ 59.2(b), 60.1 (2019).

245. See Fed. Emergeny MGMT. AGENCY, NATIONAL FLOOD INSURANCE PROGRAM COMMUNITY RATING SYSTEM, A LOCAL OFFICIAL'S GUIDE TO SAVING LIVES, PREVENTING PROPERTY DAMAGE AND REDUCING THE COST OF FLOOD INSURANCE 2 (2018), https://perma.cc/7SK7-LEYW.

246. Id.

247. See, e.g., CITY OF VA. BEACH, VIRGINIA BEACH SEA LEVEL RISE POLICY ADAPTION REPORT 19 (Jan. 14, 2019) (Draft working document), https://perma.cc/27TR-5RB5. One notable aspect of this draft report is that it never uses the words climate change. Instead, it refers to flood impacts, sea level rise, changing participation patters, and increasingly recurrent tidal, storm surge, and inland flooding events. See, e.g., id. at 12. In choosing not to include references to climate change, the drafters may have hoped to avoid political battles that surround climate science and climate change in the United States.

^{242.} See, e.g., National Flood Insurance Act of 1968, Pub. L. No. 90-448, § 1303(c), 82 Stat. 572, 573, codified as 42 U.S.C. § 4001(a) (2019) ("The Congress finds that (1) from time to time flood disasters have created personal hardships and economic distress which have required unforeseen disaster relief measures and have placed an increasing burden on the Nation's resources; (2) despite the installation of preventive and protective works and the adoption of other public programs designed to reduce losses caused by flood damage, these methods have not been sufficient to protect adequately against growing exposure to future flood losses; (3) as a matter of national policy, a reasonable method of sharing the risk of flood losses is through a program of flood insurance which can complement and encourage preventive and protective measures; and (4) if such a program is initiated and carried out gradually, it can be expanded as knowledge is gained and experience is appraised, thus eventually making flood insurance coverage available on reasonable terms and conditions to persons who have need for such protection."); FED. EMERGENY MGMT. AGENCY, *The National Flood Insurance Program*, https://perma.cc/3EKP-PAXM (last visited Jan. 13, 2020); *See also* U.S. GOV'T ACCOUNTABILITY OFF., 5 GAO-16-611, FLOOD INSURANCE—POTENTIAL BARRIERS CITED TO INCREASED USE of PRIVATE INSURANCE 1, 5 (2016).

are in the market due to perceived risk, the NFIP "underlies and backstops development and the municipal tax base."²⁴⁸

The NFIP model is not perfect. Commentators have questioned whether the NFIP has encouraged, or at least facilitated, development in areas that are inevitably in harm's way.²⁴⁹ In addition, the program's finances have proven to be challenging. The NFIP found itself in debt after Hurricane Katrina, and Congress has had to increase the program's borrowing authority on several occasions to meet financial obligations.²⁵⁰ Flood plain maps may be out of date or inaccurate.²⁵¹ Furthermore, the NFIP has not yet been able to meet the goal of moving away from government-subsidized insurance to insurance premiums that are risk-based.²⁵²

Just because the NFIP is not perfect does not mean that leaders should entirely dismiss the concept of a federal insurance program designed to help spread and manage climate change risks or costs. To reduce the risk of moral hazard, a climate change risk insurance program for public infrastructure should be available for critical public infrastructure projects only, not for private developers or private projects. After all, the goal of this program is not to encourage private development in sensitive areas; it is to help at-risk municipalities manage risks and costs associated with their obligation to provide critical infrastructure in the face of climate change. Also, to encourage and reward prudent resource management, this program should be available only for those projects that meet or exceed stated regulatory requirements. Those requirements should be state-of-the-art, grounded in science, and updated as new data are obtained. The requirements also should be fashioned with an eye towards avoiding the risk of regulatory capture—specifically, the risk that private developers will press rule-makers to allow (and press municipalities to build and pay for) the construction of infrastructure in vulnerable locations to support private development.²⁵³ With these limitations and requirements in place,

^{248.} See also John A. Miller, supra note 230; U.S. GOV'T ACCOUNTABILITY OFF., supra note 242, at 31–32.

^{249.} See, e.g., Logan Strother, The National Flood Insurance Program: A Case Study in Policy Failure, Reform, and Retrenchment, 46 THE POL'Y STUD. J. 452, 459 (2016); See also Scott Gabriel Knowles & Howard C. Kunreuther, Troubled Waters: The National Flood Insurance Program in Historical Perspective 26 J. POL'Y. HIST. 327, 328 (2014).

^{250.} See Knowles & Kunreuther, supra note 249, at 328.

^{251.} RAWLE O. KING, CONG. RESEARCH SERV., R40650, NATIONAL FLOOD INSURANCE PROGRAM: BACKGROUND, CHALLENGES AND FINANCIAL STATUS 11 (2011) (discussing efforts to modernize FEMA's flood hazard assessment processes, including efforts to modernize flood insurance maps).

^{252.} Id.

^{253.} Regulatory capture refers to the idea that regulation is "acquired by the industry and is designed and operated primarily for its benefit." *See* George Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 3, 36 (1971). Regulatory capture has been cited as a contributing factor in many crises and catastrophes in recent years, including the 2007 financial crises, the Deepwater Horizon oil spill, and the Fukushima Daiichi nuclear power plan disaster in Japan. *See* Christopher Carrigan & Cary Coglianese, *Oversight in Hindsight: Assessing the U.S. Regulatory System in the Wake of Calamity, in* REGULATORY BREAKDOWN: THE CRISIS OF CONFIDENCE IN U.S. REGULATION 1–20 (Cary Coglianese ed., 2012).

providing financial incentives in the form of competitively-priced insurance for state and local governments to consider climate risk when siting, designing, and building infrastructure has the potential to reduce risk of loss, strengthen adaption and resiliency planning efforts, and encourage a comprehensive approach to climate risk management across infrastructure categories.²⁵⁴

b. Expand Access to Reasonably Priced Capital and Provide Credit Assistance

i. Federal Adaption and Resiliency Planning Bank

It also would be worth exploring the development of a public benefit-style corporation, a climate risk adaption and resiliency planning bank, or an entity similar to the U.S. Export-Import Bank but focused on climate change adaption and resiliency planning, as an alternative source of capital or credit assistance for public infrastructure projects. The Export-Import Bank of the United States ("EXIM") describes itself as the "official export credit agency of the United States. . .with a mission of. . .facilitating the export of U.S. goods and services."²⁵⁵ To this end, EXIM steps in "when private sector lenders are unable or unwilling to provide financing" by providing U.S. businesses with financing tools necessary to compete for sales.²⁵⁶ Because EXIM is backed by the full faith and credit of the United States, "EXIM assumes credit and country risks that the private sector is unable or unwilling to accept."²⁵⁷

A similar entity focused on climate change adaption and resiliency planning projects could serve a a source of low-cost funding, financing, or credit assistance for state and local governments seeking to prepare infrastructure and related public assets for the effects of climate change. Ideally, such an entity could serve as a comprehensive clearinghouse for these sorts of projects, leveraging existing programs and expertise that exist across the federal government.²⁵⁸ This would help state and local government issuers who are either shut out from capital or credit markets entirely, or who cannot access capital markets (or insurance products) in a timely manner or on reasonable terms, due

^{254.} See EXEC. OFF. OF THE PRESIDENT OF THE U.S., *supra* note 230, at 6 ("There is a strong analytical basis to conclude that resilience investments reduce disaster costs."); *see also id.* at 8 ("Investments in resilience can pay dividends in the form of savings on insurance costs, which can enhance community insurability by making insurance more available and affordable.").

^{255.} About Us, EXPORT-IMPORT BANK OF THE U.S., https://perma.cc/8FD6-3L26 (last visited Jan. 13, 2020).

^{256.} Id.

^{257.} Id.

^{258.} To be sure, the federal government has developed a number of programs and initiatives over the years to provide loans, credit assistance and other types of financing to support adaptation and resiliency planning. For a partial list of these initiatives, see EXEC. OFF. OF THE PRESIDENT OF THE U.S., *supra* note 230. While leveraging the domain expertise of various federal agencies and programs is important—and something I would want to keep going forward—an Export-Import-style bank could serve as both a clearing house for such programs and a means of identifying systemic risks associated with infrastructure and climate change.

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to perceived climate risk. This has the potential to facilitate needed projects, while reducing issuers' risks and costs.

It is important to note that there are several government programs already on the books that provide funding, financing, or credit assistance for infrastructure projects. For example, the Water Quality Act of 1987 ("WQA")²⁵⁹ established a program whereby the federal government, with the EPA as program administrator, provides seed money grants to the states to endow state-administered revolving loan funds ("SRF"). Once established, SRFs issue bonds to raise capital, and use bond proceeds to make loans to individual municipalities for water and wastewater projects. Repaid loans go back into the SRF for future lending. A similar model exists in the transportation context:²⁶⁰ The federal government allocates seed money to state infrastructure banks ("SIB"), which then create revolving funds to provide credit assistance (loans, loan guarantees, lines of credit) for local transportation projects. Repaid loans go back into the fund for future lending.

There have been a number of proposals for a federal infrastructure bank over the years. In 2007, for example, Senators Christopher Dodd and Chuck Hagel proposed the creation of a National Infrastructure Reinvestment Bank; this entity would have established a federal infrastructure bank to make loans for transportation, mass transit, water, and housing infrastructure.²⁶¹ Shortly thereafter, Representative Rosa DeLauro and several co-sponsors introduced the National Infrastructure Development Act of 2007. This bill would have created something similar to a national infrastructure bank, as well.²⁶² Although President Obama championed an infrastructure bank (and other similar entities/programs designed to increase access to capital for infrastructure projects), these initiatives never came to fruition during his presidency for a variety of reasons, including loss of Democratic control of Congress. While President Trump has spoken of an infrastructure bank, not much is known about how things would work. Some commentators have expressed concerns about the Administration's plans to privatize certain infrastructure projects²⁶³ and the Administration's proposed allocation of

^{259.} Water Quality Act of 1987, Pub. L. No. 100-4, 101 Stat. 7 (1987).

^{260.} There are four different acts that have allowed the creation of SIBs in the transportation space: (i) The National Highway Safety Act 1995 (pilot program); TEA-21 in 1998 (pilot program); (3) SAFETEA-LU in 2005 (permanent Title 23 program); and (iv) FAST Act (permanent program). Specific SIBs must comply with the rules and requirements set forth in the relevant authorizing act. For a brief summary of relevant rules and standards, *see* Kevin McDonald & Fredrick Werner, *State Infrastructure Banks* (*SIBs*) 101 (2016) https://perma.cc/J4VH-4HLR.

^{261.} National Infrastructure Bank Act of 2007, S.1926, 110th Cong. (2007); *See* Everett Ehrlich & Felix G. Rohatyn, *A New Bank to Save Our Infrastructure*, N.Y. REV. OF BOOKS (Oct. 9, 2018), https://perma.cc/L5B6-JM36.

^{262.} National Infrastructure Development Act of 2007, H.R. 3896, 110th Cong. (2007).

^{263.} See, e.g., Paul Krugman, Build, He Won't, N.Y. TIMES (Nov. 21, 2016), https://perma.cc/77LH-4YCD.

financial responsibility as between the federal government and the states.²⁶⁴

A national infrastructure bank—even one tailored to climate risk adaptation and resiliency planning projects—is not a perfect solution for all types of infrastructure projects. First, as it typically is envisioned, a national infrastructure bank would provide loans or loan guarantees—not grant funding—for approved projects. To repay the loans, projects financed through the bank would have to dedicate tolls, taxes, or other revenues streams for repayment. But many adaption and resiliency planning projects do not generate revenues. Moreover, there is always a risk that lending criteria or credit determinations would be subject to industry capture or politicization. Still, for appropriate projects, and with clear criteria in place, the opportunity to obtain funding, financing, or credit assistance for climate change adaption or resiliency planning projects without having to go directly to public markets could result in cost savings and improve resiliency planning.

ii. Technical Amendments in Support of Tax Exemptions

The federal government also could enact technical legislative and regulatory reforms focused on expanding access to capital for infrastructure projects via the tax code. These initiatives do not make structural changes to the existing infrastructure finance system; instead, they rely upon technical amendments to the existing regime to enhance borrowing capacity or shore up or expand access to the tax exemption for municipal bonds. For example, on July 25, 2019, U.S. Representative Terri Sewell and Tom Reed introduced the Municipal Bond Market Support Act of 2019 ("MBSA").²⁶⁵ This legislation is aimed at helping local governments, non-profits, schools, hospitals, universities, and other entities reduce costs associated with infrastructure and development projects. Among other proposed reforms, the MBSA would amend the Internal Revenue Code to expand access to low-cost capital for municipalities and non-profits by increasing the annual limit for municipal bank qualified bond borrowing from \$10 million to \$30 million. Also, on May 15, 2019, Representatives Dutch Ruppersberger and Steve Stivers, co-chairs of the Municipal Finance Caucus, introduced the Investing in Our Communities Act to restore the tax exemption for advance refunding municipal bonds. ²⁶⁶ The 2017 Tax Cuts and Jobs Act eliminated this exemption, making it more difficult for state and local governments to reduce costs by refinancing debt when interest rates are more favorable.²⁶⁷

^{264.} See, e.g., Lori Mack, Trump's Infrastructure Plan Puts Most Of The Financing On States And Cities, CONN. PUB. RADIO (Feb. 21, 2018), https://perma.cc/WRW6-BZY9.

^{265.} Municipal Bond Support Act of 2019, H.R. 3967, 116th Cong. (2019–2020).

^{266.} Investing in Our Communities Act, H.R.2772, 116th Cong. (2019–2020).

^{267.} See *Infrastructure Financing*, NAT'L ASS'N OF ST. TREASURERS 1 (2019), https://perma.cc/ V2WW-BVVR, for a discussion of the advance refunding exemption and its effect upon infrastructure investment.

c. Debt Resolution Strategies: Purchase Municipal Bonds, Establish TARP-style Program

Finally, the federal government should examine ways to support debt resolution mechanisms for state and local governments experiencing financial strain due to climate change. When municipalities experience financial distress, there are two main approaches to debt relief—(i) municipal bankruptcy (where available, with the risks and potential consequences described above) and (ii) state law-authorized financial oversight authorities, including financial control boards or commissions, emergency managers, or other coordinators or overseers of troubled local government units.²⁶⁸ Chapter 9 expert James Spiotto has argued that oversight authorities should be empowered to refinance existing debt, and to authorize the collection of new revenue sources that are isolated from bankruptcy and other legal risks facing creditors.²⁶⁹ Spiotto argues that such an authority would have financial credibility and thus would be able to access borrowing in public markets when needed and on more favorable terms than would be available to the local government debtor.²⁷⁰ This is the strategy in Puerto Rico under PROMESA: PROMESA's fiscal oversight board has broad powers over Puerto Rico's finances, and the board has used its authority to impose an austerity budget upon the island, restructure debt, and interface with the municipal bond market.

There are no easy answers, but the PROMESA example raises serious concerns about the consequences of using financial exigency to impose austerity budgets, and to supplant elected, local decision-makers with an unelected individual or group. Using grants or low-cost loans from the federal (and potentially the state) government to fund the work of a control board—rather than going to the municipal bond market for funding—could help mitigate some of these concerns. In this way, the federal or state government could provide access to capital for needed mitigation, adaption or resiliency planning at times and on terms that would not be available to the debtor dependent on public markets.

Another potential option would be to allocate federal funds for the purchase of municipal securities issued by financially stressed local governments—a kind of Troubled Asset Relief Program ("TARP") for municipal debt. This has the potential to reduce the pressure of debt service that fiscally stressed local governments now face by taking securities out of the hands of vulture investors or investors who might press for repayment despite costs to local public health and welfare. This, in turn, could help fiscally stressed issuers free up funding for essential infrastructure and services, while still giving the

^{268.} For a discussion of state intervention regimes generally, see PEW CHARITABLE TRS., THE STATE ROLE, *supra* note 117.

^{269.} CHAPMAN AND CUTLER LLP, MUNICIPALITIES IN DISTRESS?: HOW STATES AND INVESTORS DEAL WITH LOCAL GOVERNMENT FINANCIAL EMERGENCIES 35 (2012).

^{270.} Id.

municipality breathing room to work out a sustainable plan for returning to fiscal health.

C. STATES AND LOCAL GOVERNMENTS SHOULD CONTINUE TO COMBINE FORCES AND INNOVATE

Even if the federal governments take on a leadership role with respect to infrastructure and climate change, there is still room—and a need—for formal and informal mechanisms at the state and local level to help governments and communities deal with climate change.

1. States and Sophisticated Local Governments Also Can Serve as Clearinghouse for Climate Science and Best Practices

First, as with the federal government, state and larger, more sophisticated local governments should continue to explore ways in which they can serve as a clearinghouse for climate science and adaption and resiliency planning best practices. As noted above, a number of state and local governments have already embraced a leadership role with respect to climate change. The New York City Mayor's Office of Resiliency and Recovery has published a set of Climate Resiliency Designed Guidelines so that forward-looking climate change data can be incorporated in the design of all New York City capital projects.²⁷¹ The City of Virginia Beach also has done impressive work around climate change, as well.²⁷² There are, of course, gaps—smaller, local governments are far less likely to have the sources or personnel needed to do this sort of work. But, state and local governments should continue to innovate and experiment in the face of climate change.

2. Alternative Sources of Capital, Backstop for Smaller Issuers, Comparatively Riskier Projects

State governments also should continue to explore ways to help smaller municipalities to raise capital for infrastructure on competitive terms. New York's Environmental Facilities Corporation ("EFC") offers one potential model. EFC is a public benefit corporation that was established to provide low-cost capital and technical assistance for environmental projects in New York State.²⁷³ Together with the New York State Department of Environmental Conservation, EFC administers the Clean Water State Revolving Fund ("CWSRF"), which provides low interest rate financing to municipalities for water quality protection projects such as sewers and wastewater treatment facilities. EFC raises capital for these

^{271.} N.Y.C. MAYOR'S OFF. OF RECOVERY & RESILIENCY, CLIMATE RESILIENCY DESIGN GUIDELINES 5 (2019), https://perma.cc/3DTY-7F9Q.

^{272.} CITY OF VA. BEACH, supra note 247, at 9.

^{273.} About EFC, ENVTL. FACILITIES CORP., https://perma.cc/J686-9KE5 (last visited Jan. 13, 2020).

projects by issuing municipal securities, then lending the proceeds of its offerings to municipalities to fund specific projects. In so doing, EFC is able to spread risks associated with any one specific projects and help smaller issuers benefit from EFC's economies of scale. A similar entity focused broadly upon climate risk, adaption, and resiliency planning projects that could help state and, especially smaller, local governments raise capital in a timely fashion and at a reasonable cost, thereby reducing risks and costs for issuers and investors alike. Augmenting EFC's work with federal grant funding would help, as well.²⁷⁴

D. MUNICIPAL FINANCIAL DISTRESS REGIMES

There also is room to consider risks and costs associated with climate change in connection with municipal financial distress and debt resolution regimes such as municipal bankruptcy, receivership, or fiscal oversight or control boards. There are, however, some potential doctrinal challenges—at least with respect to municipal bankruptcy. As it stands today, the inhabitants of insolvent municipalities generally do not have a clear statutory right to be heard in chapter 9 bankruptcy proceedings prior to the plan confirmation stage.²⁷⁵ This means that taxpayer voices—the voices of people who are living with the risks and consequences of deteriorating infrastructure and climate risk everyday—are not front and center prior to plan confirmation; instead, they must rely upon elected officials or appointed financial managers to be heard at the pre-confirmation stage.

In the Detroit bankruptcy court, Judge Stephen Rhodes suggested a way for for taxpayers to be heard prior to plan confirmation through the doctrinal requirement of insolvency, and specifically, through the concept of service delivery insolvency.²⁷⁶ To be eligible for Chapter 9 relief, a municipality must demonstrate that it is insolvent.²⁷⁷ 11 U.S.C. § 101(32)(C) defines insolvency as: "(i) generally not paying debts as they become due unless such debts are the subject of a bona fide dispute; or (ii) unable to pay debts as they become due."²⁷⁸ With respect to the second test—unable to pay debts when they become due—Judge Rhodes cited

^{274.} Note that there are challenges and limitations involved in funding certain types of projects using CSWRF Funding. *See* U.S. EPA, 830B17003, FINANCING OPTIONS FOR NONTRADITIONAL ELIGIBILITIES IN THE CLEAN WATER STATE REVOLVING FUND PROGRAMS 1 (1987), https://perma.cc/9R34-MELU.

^{275.} Prior to the plan confirmation stage of a municipal bankruptcy, the inhabitants of a municipality seeking bankruptcy protection may not qualify as parties-in-interest under 11 U.S.C. § 1109(b); thus, they may not have a statutory right to be heard. Christine Sgarlata Chung, *Municipal Bankruptcy*, *Municipal Services, and Taxpayers' Voice*, 24 WIDENER L. REV. 43, 62–67 (2015) (citations omitted). Permissive intervention may not be available, either. *Id.* at 64–66. Instead, the interests of a municipality's inhabitants may be filtered (if at all) through parties with standing prior to plan confirmation—for example, through elected officials or appointed oversight authorities (e.g., emergency managers appointed under state law).

^{276.} In re City of Detroit, 504 B.R. 97, 112, 119–21, 129 (Bankr. E.D. Mich. 2013) (No. 13-53846) (Eligibility Opinion).

^{277.} Eligibility Opinion, 504 B.R. at 168 (citations omitted); *See also* 11 U.S.C. § 101(32)(C)(i)–(ii) (2012).

^{278. 11} U.S.C. § 101(32)(C) (2012).

the collapse of the Detroit's infrastructure and public health and safety services as evidence of insolvency.

By characterizing Detroit as insolvent due to its inability to provide basic health and safety services, and by treating the city's inhabitants as creditors of a sort, owed a debt of at least minimally acceptable services, Judge Rhodes opened the door to consideration of taxpayer interests at the eligibility stage,²⁷⁹ even though taxpayers likely would not have standing as parties-in-interest or rights of intervention at this stage of the proceedings under previously-articulated tests.²⁸⁰ Where municipal bankruptcy is available, the concept of service delivery insolvency might help local stakeholders raise concerns about infrastructure, essential services, and climate risk prior to plan confirmation. In situations where bankruptcy is not an option, but state law provides for fiscal oversight (an emergency manager or financial control board), there is room, as a matter of best practices, to urge financial decision-makers to consider climate change risks and impacts as well.

E. STRATEGIES MUST INCLUDE ATTENTION TO JUSTICE, RECOGNIZE POLITICAL, ECONOMIC, SOCIAL INEQUALITIES

Finally, any reforms to the current system should include attention to issues of environmental justice. There is a rich and growing body of work that speaks to the unequal social, political, and economic consequences of pollution, municipal financial distress regimes, climate change, and disaster relief. For example, many studies have shown that polluters and pollution are disproportionately located and found in communities of color.²⁸¹

Natural disasters and disaster recovery play out in different ways in different communities as well. In one recent study, for example, public health researchers determined that flooding caused by Hurricane Harvey was "significantly greater in neighborhoods with a higher proportion of non-Hispanic Black and

^{279.} *Id.* The concept of service delivery insolvency was first set forth in the landmark 2013 municipal bankruptcy case involving the city of Stockton, California. *See In re* City of Stockton, Cal., 493 B.R. 772, 789 (Bankr. E.D. Cal. 2013).

^{280.} In re Addison Comm. Hosp. Auth., 175 B.R. 646, 651 (Bankr. E.D.Mich.1994); see also Christine Sgarlata Chung, Government Budgets as the Hunger Games: The Brutal Competition for State and Local Government Resources Given Municipal Securities Debt, Pension and OBEP Obligations, and Taxpayer Needs, 33 REV. BANKING & FIN. L. 663, 666–68, n.8–15 (2013-2014) (discussing poverty and economic headwinds in Detroit).

^{281.} See, e.g., Adam F. Benson, Thomas J. Luben, Ihab Mikati, Jennifer Richmond-Bryant, & Jason D. Sacks, *Disparities in Distribution of Particulate Matter Emission Sources by Race and Poverty Status* 108 AM. J. PUB. HEALTH 480, 480 (2018) (finding that people in poverty are exposed to more fine particulate matter than people living above poverty, and that non-white individuals tend to be burdened); Rebecca Anthopolos, Michelle L. Bell, Mercedes A. Bravo, & Marie Lynn Miranda, *Racial Isolation and Exposure to Airborne Particulate Matter and Ozone in Understudied US Populations: Environmental Justice Applications of Downscaled Numerical Model Output, 92–93 ENVTL. INT'L 247, 247 (2016).*

socioeconomically deprived residents."²⁸² These findings "highlight[ed] the need to prepare for and address the unequal social consequences of climate changerelated disasters, which are expected to increase in frequency and severity."²⁸³ Researchers have also examined environmental justice issues arising in the wake of Hurricane Katrina.²⁸⁴ And, with respect to disaster relief, NPR reporting found that, "across the country, white Americans and those with more wealth often receive more federal dollars after a disaster than do minorities and those with less wealth."²⁸⁵ This reporting also found that, "federal disaster spending appears to exacerbate that wealth inequality."²⁸⁶

The politics of municipal financial distress also raise issues of justice, race, and economic inequality. In testimony before the Michigan Civil Rights Commission concerning Flint's water crisis, for example, Professor Peter J. Hammer observed that although Flint's financial crisis was due to structural financial problems associated with population decline and the loss of most of the city's manufacturing base, the state's response to that crisis—a 61% decline in revenue sharing between fiscal year 2006 and 2012—precipitated the financial distress that the state used to justify the appointment of the (unelected) emergency managers. The city's emergency managers laid off city workers, implemented austerity budget policies, and championed the switch in the city's water supply that led to the water crisis.²⁸⁷

An approach to municipal finance and climate change adaption and resiliency planning informed by environmental justice would target vulnerable communities for grant funding, low-cost loans, and technical advice with respect to the siting, design, and construction of public infrastructure. Such an approach also would require tracking and reporting so that program sponsors could protect against impacts and outcomes that disproportionately burden—or, at least, fail to benefit—disadvantaged or vulnerable communities.

CONCLUSION

For almost fifty years, we have relied upon state and local governments to pay for the public infrastructure that we need to keep our communities healthy,

^{282.} Jayagit Chakraborty, Timothy W. Collins, & Sara Grinseki, *Exploring the Environmental Justice Implications of Hurricane Harvey Flooding in Greater Houston, Texas*, 109 A AM. J. PUB. HEALTH 244, 244 (2019).

^{283.} Id.

^{284.} Reilly Morse, Joint Ctr. for Pol. and Econ. Studies Health Pol'y Inst., Environmental Justice Through the Eye of Hurricane Katrina 1 (2008).

^{285.} Rebecca Hersher, *How Federal Disaster Money Favors the Rich*, NAT'L PUB. RADIO (Mar. 5, 2019), https://perma.cc/AMJ5-36V5.

^{286.} Id.

^{287.} Hammer, *supra* note 40, at 7–11.

prosperous, and safe. Climate change threatens to upend this system, straining state and local government budgets to the breaking point. There are no easy answers. Stakeholders—taxpayers, bondholders, public workers, and others involved in the state or municipal enterprise—all have compelling, but competing, claims on public resources. To meet the challenge of climate risk, we need to rethink systems and incentives so that we can identify and ultimately reduce risks and costs. Because climate risk does not discriminate, and we are all, ultimately, on the same ship.