From Surviving to Thriving: Equity in Disaster Planning and Recovery

With contributions from Rebecca Bratspies, Maxine Burkett, John Echeverria, Daniel Farber, Victor Flatt, David Flores, Alyson Flournoy, Alice Kaswan, Christine Klein, Evan Isaacson, Sarah Lamdan, Joel Mintz, Sidney Shapiro, Karen Sokol, Joseph Tomain, Katie Tracy, and Rob Verchick

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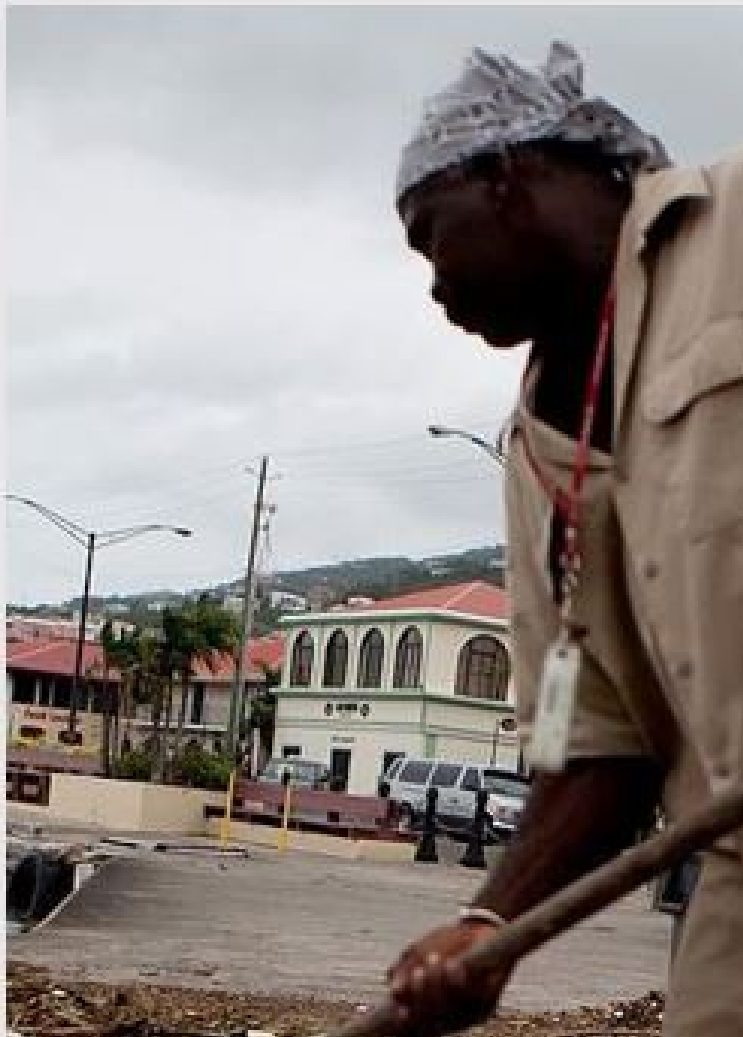

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Preface: An Ounce of Prevention

by Sidney Shapiro

The story is now familiar. An area of the United States is battered by a superstorm, hurricane, or other climate disaster, resulting in a calamity for the people who live and work there. The Federal Emergency Management Agency (FEMA) offers emergency assistance, but since it is not enough to address the harms that occurred, Congress acts to provide hundreds of millions of dollars of additional assistance.

But imagine a counter-narrative, with a significantly better outcome. In that story, we would have paid attention — before disaster ensued — to how environmental protection and planning can prevent and minimize the harm that disasters cause to people, their housing, and the infrastructure of our cities, states, and territories. Steps to inform the public about risks, to adopt protective measures, and to enforce health, safety and environmental standards could have minimized the human suffering and loss and minimized the economic costs associated with recovery.

One reason for our oversight is that we tend to think about the varied functions of government as distinct. Agencies that protect us from health, safety and environmental risks are separate and operate under different laws than do agencies that address human needs, education, and other forms of our collective welfare. So we tend to overlook the role that these protections play in minimizing the impact of disaster. But viewed through a wider lens, all of these agencies' work ideally serves the same goal: promoting social resilience. People and their neighbors are socially resilient when they have the capacity to survive, adapt, and grow in the face of misfortune and change.

These two types of government activities are mutually supportive. As this report details, investments in health, safety, and environmental protection on the front end can reduce the need for financial or other assistance for human needs after disaster strikes. Environmental protection measures cannot prevent all of the harms that will occur in the wake of weather disasters. Nor can social support

services and disaster relief alleviate all the loss and suffering in the wake of disasters. By partnering to promote social resilience, these agencies can use their resources more effectively and better achieve their shared goals.

Although the term "social resilience" is relatively new — it gained prominence slightly more than a decade ago in the field of disaster studies — the idea that government can and should help people protect themselves against unexpected events outside of their control is not new. This commitment dates back to the founding of the country and has been a consistent commitment of our country ever since. Since 1776, Congress has passed numerous laws that protect us from economic, social, health and safety risks.

When we fail to prevent and minimize preventable harms, we ignore Ben Franklin's sage advice, "An ounce of prevention is worth a pound of cure." A recent study by the National Institute of Building Sciences highlights the accuracy of that maxim in the context of disaster response. The study recommends measures that governments and property owners can take to reduce the impact of disaster events that would prevent 600 deaths, 1 million nonfatal injuries, 4,000 cases of post-traumatic stress disorder (PTSD, and that would save $6 for every $1 spent on these protections funded through select federal agencies.

When we fail to prevent and minimize preventable harms, we ignore Ben Franklin's sage advice, "An ounce of prevention is worth a pound of cure."

We also ignore the reality that our most vulnerable citizens are the ones who suffer the most in violent storms and other disasters. Many people share the heartache of losing a house, valuable keepsakes, and other property. But while these harms are shared among many, the most vulnerable residents are often the people least able to manage the temporary and permanent consequences imposed on them by weather disasters.

Weather Disasters and Social Resilience

Social resilience is about the capacity of people and their communities to withstand, recover from, and prosper after disruption. In the case of climate and other weather disasters, measures that promote resilience include natural and human systems that reduce the force of storms or the likelihood of other disasters, preparedness plans that protect people when disaster occurs, and health, safety, and environmental protection measures that focus on anticipating and preparing for weather-related events in ways that prevent (or minimize) harm to people and their property. Resilience is also enhanced by strong social networks, access to information to make sound choices, and

policies that recognize and account for the varied needs and capacities of different communities and populations. It is about ensuring people have access to health care, education, and training they need to accommodate the dislocation that occurs when disasters wreak havoc on the communities in which they live.

Social vulnerability is the opposite of social resilience. If left unaddressed, social vulnerability will prevent people and communities from withstanding and recovering from weather related disruption. We can measure social vulnerability by assessing whether a community (or area) has the necessary infrastructure that assists people in times of emergency and whether the people who live in an area have the health, education, and training to bounce back when disaster strikes. Researchers have found that a person's wealth, race, ethnicity, age, gender, and occupation are important predictors of social vulnerability. Areas of the country that have larger populations of minorities, poor persons, older residents, among other attributes, are also the most social vulnerable populations. A study of flood losses in Texas after Hurricane Harvey, for example, revealed that counties with a higher level of social vulnerability had much higher rates of death and injury than counties that had social resilience.

A Historical Commitment

Government involvement in building social resilience dates back to the founding of the country. The framers broke away from England because they wanted a government that pursued the public interest as defined by its citizens. From the start, the federal government was involved in creating an infrastructure that promoted economic growth and prosperity, including the establishment of a national bank to manage the economy.

This is evident from Thomas Jefferson's assertion in the Declaration of Independence that "all men are … endowed by their Creator with certain unalienable Rights, that among these are Life, Liberty and the pursuit of Happiness." Because Great Britain's administration of the colonies was "destructive of these ends," Jefferson declared it was the right of the people to establish their own government, one that seemed "most likely to effect their Safety and Happiness."

Abraham Lincoln spoke of this function of government as promoting the "right to rise" and of bringing "economic opportunity to the widest possible circle of hardworking Americans." For President Lincoln, it was a "leading object" of

government "to elevate the condition of men; to lift artificial weights from all shoulders; to clear the paths of laudable pursuit for all; to afford all an unfettered start and a fair chance in the race of life." Under President Lincoln, the federal government made millions of acres of western land available to homesteaders at almost no cost to the settlers, for example, and it set aside thousands of acres of land to support land-grant universities to educate a state's residents. More significantly, President Lincoln opposed the South's secession because it was an effort to establish an independent nation based on the denial of opportunity.

In the depth of the Great Depression, Franklin Roosevelt made the same connection between the role of government and fair opportunity:

> The basic things expected by our people of their political and economic systems are simple. They are: Equality of opportunity for youth and for others. Jobs for those who can work. Security for those who need it.

To this end, the federal government engaged in extensive efforts to rebuild the economy and it established regulatory protections that were intended to prevent the behavior in private markets that led to the financial collapse.

In the 1960s, Lyndon Johnson challenged the country to move "upward to the Great Society," a place where there is "an end to poverty and racial injustice" and where "every child can find knowledge to enrich his mind and to enlarge his talents." In support of this mission, the federal government substantially expanded its commitment to human needs assistance. At the same time, it established new agencies, including EPA, to prevent the environmental, health and safety risks that injured and killed people, hampering and preventing them from their pursuit of happiness.

So it is not surprising that Barack Obama, like presidents Lincoln and Roosevelt, spoke about the government's involvement in promoting social resilience:

> What makes us exceptional — what makes us American — is our allegiance to an idea articulated in a declaration made more than two centuries ago: "We hold these truths to be self-evident, that all men are … endowed by their Creator with certain unalienable rights; that among these are life, liberty, and the pursuit of happiness." … [H]istory tells us that while these truths may be self-evident, they've never been self-executing … Together, we resolved that a great nation must care

for the vulnerable, and protect its people from life's worst hazards and misfortune.

Building Social Resilience

When individuals lack opportunity through no fault of their own, they do not have meaningful choice or the capacity to exercise it. When government removes obstacles, as for example by reducing the cost of education or training for those who cannot afford it despite their best efforts, government builds social resilience. Similarly, when environmental protections help people to stay healthy by reducing exposure to toxic chemicals, it builds social resilience.

The financial and related assistance that the government provides in the aftermath of a storm is intended to help people get back on their feet. Even though such assistance is expensive, the nation has always rallied to help those in need after superstorms have struck. While such aid is valuable to those in need, and necessary to promote their recovery, the fact remains that it arrives only after the devastation has occurred. The aid arrives after people's housing has been destroyed, after they have lost their cars and trucks, after they have lost many or even all of their possessions, including valuable keepsakes, such as pictures. And the aid arrives after some of our fellow citizens have died or suffered serious injuries as a result of the storm.

The following chapters of this report explain how we have failed to use the full range of available protections to minimize the amount of damage to people and their property that occurred in recent disasters, drawing particularly on examples from the 2017 Atlantic Hurricane season, when Harvey, Irma, and Maria hit Texas, Florida, Puerto Rico and the Caribbean with floods and brutal wind. Prevention can often be achieved at a reasonable price — one that is usually considerably less than the cost of after-the-disaster aid.

Environmental protection and planning for resilience, however, are about more than saving money. They reflect a commitment to reduce social vulnerability because of its devastating impact on the lives of our fellow citizens, when we have at hand the means to do so at a reasonable cost. It is, in short, the right thing to do. And while the failure to protect in advance of disaster harms everyone in the path of a superstorm, it falls most heavily on the least fortunate among us.

The lack of preventive measures and planning for resilience signals a failure in our basic commitment as a nation to ensure a fair chance in the race of life and the right to rise. We can do better, and this report indicates how we should start.

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Executive Summary

By any definition, Hurricanes Harvey, Irma, and Maria, the trifecta of storms that pummeled Texas, Florida, Puerto Rico, and the Virgin Islands in the summer and fall of 2017, were historic disasters. But they were not disasters beyond human imagining. Indeed, given the increase in record weather events driven by climate change, we must be prepared for disaster on this scale and worse. Because such weather events and the carnage they cause are foreseeable, it's vital to anticipate them, not just in our disaster planning, but in the way we build our communities, transportation networks, power grids, and more — all so that when disasters strike, we can prevent or mitigate the worst effects, saving lives and protecting property.

In 2017, we failed. Power outages in Florida claimed lives after Irma. Massive flooding did the same in Houston in Harvey's wake, and large-scale emissions of toxic chemicals from plants and hazardous waste sites built in floodplains turned Harvey's floodwaters into a toxic brew. And the collapse of Puerto Rico's power grid caused the lion's share of the more than 1,400 deaths officially acknowledged as resulting from Maria. The weather catastrophes were compounded by human disaster — the failure to plan and prepare and the inadequacy of our existing health, safety, and environmental safeguards.

Unsurprisingly, those hit hardest by the storms and their aftermath were among our society's most vulnerable. As co-author Rob Verchick writes, "Catastrophe is bad for everyone. But it is especially bad for the weak and disenfranchised." Wealthier neighborhoods tend to be on higher ground than poorer ones. Industrial plants rarely abut million-dollar homes, but they are commonly built adjacent to low-income neighborhoods. The wealthy have better access to evacuation methods and routes, and to health care in the wake of the storm, if they need it. In these and many other ways, the social inequities that imperil the health and safety of low-income Americans are magnified and exacerbated in an emergency.

Catastrophe is bad for everyone. But it is especially bad for the weak and disenfranchised.

In this report, the Center for Progressive Reform has brought together more than a dozen of the nation's leading legal scholars to address different aspects

of the nation's disaster planning and its environmental, health, and safety standards, with a particular view to mitigating the social inequities laid bare by last year's storms. The policy solutions they propose will not stop hurricanes or other disasters from occurring. But they could make their impact far less severe by taking toxic chemicals and other dangerous hazards out of the path of storms so that they would not poison those who come into contact with floodwaters; they could make the power grid more agile and adaptable to power shortages and outages; they could reduce the incentives to build in flood zones; they could better protect the health and safety of recovery workers; they could improve disaster response so that it serves all Americans, not just those in wealthier neighborhoods; and they could future-proof vital infrastructure — roads, bridges, pipes, wires — against the creeping effects of climate change that exacerbate the impact and increase the frequency of major storms.

One theme emerges repeatedly in the scholars' examination of the issues: the need for better planning before storms strike. Indeed, many of the authors draw on the adage that an ounce of prevention is worth a pound of cure. Better planning, wiser allocation of resources, smarter growth, a clear-eyed reading of science, a commitment to equity — all these factors would improve our preparation before and our response after disasters, helping people and communities survive disasters and go on to thrive in their wake.

What Should Be Done?

The scholars offer a number of key recommendations, touching on many aspects of disaster preparedness and recovery, and holding the promise of significant positive impact. Among the proposals:

- **Resilience and adaptation should be mainstreamed,** part of the mission of every local, state, and federal agency whose work affects climate change and disaster planning and recovery, from public works departments to waste disposal to public information. Similarly, **social equity concerns should be accounted for in planning and recovery,** and resources made available when needed to address inequities. That effort should also include a focus on modes of participation and communication so that communities are not shut out of discussions about their future. (Alice Kaswan, Alyson Flournoy, Rob Verchick)

The scholars offer several recommendations related to disaster preparedness and response, including:

- Disaster response should be a partnership between federal, state, and local governments. But the **Federal Emergency Management Agency (FEMA) should consider the resources and capacity of its partners in its planning**. Wealthy states like Texas, California, and Florida are better positioned than poorer states and territories, like Louisiana, Mississippi, and Puerto Rico. Also, the **federal government needs to increase its surge capacity**, which was overwhelmed by the trio of storms that hit in 2017. Multiple storms could be more common in the future because of climate change. In addition, **FEMA's flood maps are badly out of date, and on their accuracy much depends. They need revision**, perhaps in phases, to account for sea-level rise, changes in topography, and better modeling. (Daniel Farber)

FEMA's flood maps are badly out of date, and on their accuracy much depends. They need revision, perhaps in phases, to account for sea-level rise, changes in topography, and better modeling.

- A recently adopted law on levee safety has made little headway, apparently because FEMA and the Army Corps of Engineers lack the resources to conduct the studies required and have yet to issue even voluntary federal safety guidelines. **Congress should provide FEMA and the Corps the resources they need to do a better job protecting the nation's levees**. To buttress the nation's dams, **the president should reinstate his predecessor's flood safety executive order**, or Congress should do so by legislative means. The order established flood safety requirements and has since been repealed by President Trump. In addition, **FEMA needs to be more explicit about the uncertainties in its flood modeling and conduct research to improve it**. (Daniel Farber)

- It is past time to reform the National Flood Insurance Program so that it does not incentivize construction in flood zones. **Congress should phase out federal subsidies for NFIP while providing premium support to low-income homeowners that reduces their risk of loss**. In addition, Congress should review and strengthen incentives for local governments to adopt **limits on new development in floodplains** and insist that the flood maps on which so much hinges are updated to reflect true risks. In addition, state legislatures should **require disclosure of true flood risk to property buyers** in flood zones. (Christine Klein, Alyson Flournoy)

- Local governments play a key role in mitigating the potential damage from disasters, and **state governments should support local planning efforts, making resources available and helping steer them toward valuable information and strategies.** States should also **insist that local planners adequately consider the disaster risks in all aspects of their planning** by,

for example, considering sea-level rise and future flood risk in their comprehensive planning processes. In addition, states and the federal government should provide **funding to provide protection for low-income communities** or the means for them to retreat when necessitated by climate change. (Alice Kaswan, Alyson Flournoy, Rob Verchick)

- With climate change already beginning to force community relocation and migration, and more of the same on the way, **it is vital for federal and state governments to support various local strategies, including land acquisition and planning processes**. Nonprofit organizations will play a special role in relocation and migration planning, as well, providing ***pro bono* legal assistance to support land acquisition** and offering technical assistance to help **empower and amplify local voices** in the planning process. In addition, while there is little hope that the Trump administration will reassert a federal role in the planning process, eventually, the federal government will need to return to the task of supporting planning efforts. (Maxine Burkett, David Flores)

- The nation's power grid delivers electricity that is vital to daily life and sorely missed in disasters. The grid has aged and needs modernization. **Regulators must find ways to accommodate "prosumers"** — consumers that produce their own power and thus contribute to the grid — and **accommodate renewables as they become more cost-competitive**. More broadly, **subsidization of large central power stations should stop; utilities, with a nudge from appropriate regulations, should invest in a smart grid** that can manage clean and variable energy resources such as solar and wind; and utilities must **continue to invest in and explore options for power storage**. (Joseph P. Tomain)

Subsidization of large central power stations should stop; utilities, with a nudge from appropriate regulations, should invest in a smart grid.

Health and safety measures take on added importance in the wake of disasters. The scholars offer several recommendations in this area, including:

- **Local governments should increase their use of green infrastructure, which can provide additional protection from flooding** by allowing stormwater to find permeable surfaces. **The federal government should prod local governments** to adopt more green infrastructure best practices. (Evan Isaacson)

- Protection for first responders and disaster recovery workers from on-the-job hazards is often given short shrift. **The Occupational Safety and Health Administration (OSHA) is badly underfunded, hobbling its ability to develop safeguards for emerging hazards and its enforcement of existing hazards**. Congress should act. **OSHA should move to develop safety standards for workers covering heat stress, ergonomics, and infectious diseases**, particular problems in storm recovery, and it should **enforce its standards during recovery operations**, rather than routinely suspending them. (Katie Tracy)

- As storms approach, it is common for governors to declare states of emergency, which, among other things, allow for the suspension of specific rules and regulations protecting health, safety, and the environment. In Texas after Harvey, many of these rules remained suspended eight months after the storm, even though they posed no meaningful impediment to disaster recovery. One result was more than 100 releases of toxic emissions that polluted land, water, and air. **EPA should require facilities covered by key environmental laws to plan for control of emissions during and after disasters**. EPA should also **require that adequate records of emissions are kept and made available to the public,** and it should **ensure that state suspensions of federal environmental reviews will sunset after two weeks and be subject to federal review.** (Victor Flatt)

EPA should require that records of emissions are kept and made public, and should ensure that state suspensions of federal environmental reviews sunset after two weeks.

- One particularly dangerous hazard during flood events is emissions from Superfund sites. Better methods of remediating sites are necessary to prevent such releases during storms. **EPA should issue a rule or guidance making clear that simply "capping" hazardous wastes will rarely be sufficient for a final cleanup**, and it should be certain **local communities are made aware of proposals to cap**. EPA should **require sites with permits for hazardous waste to develop emergency and disaster plans**. In addition, EPA should develop a **rule on chemical spills** from plants discharging into the waters of the United States. (Victor Flatt, Joel Mintz)

Public information plays a vital role in protecting communities before, during, and after disasters. The scholars offer several recommendations in this area, including:

- The National Environmental Policy Act (NEPA) requires environmental impact assessments of federal actions that significantly affect the environment. But the requirement is often ignored, particularly by the

current administration. As the effects of climate change begin to cascade, the failure to observe the requirement is all the more harmful. **EPA should enforce NEPA's assessment requirements**. In addition, **the Council on Environmental Quality (CEQ) should require all agencies to incorporate climate change analysis into environmental impact statements**. (Joel Mintz)

- The Emergency Planning and Community Right-to-Know Act requires companies that store or handle toxic chemicals to make information about toxic releases and their emergency plans available to the public. Such information is invaluable to first responders and the public at large in times of emergency. But the law is weakly and sporadically enforced, leaving responders and residents in the dark about deadly hazards. **EPA should effectively enforce EPCRA, granting waivers sparingly**. The agency would do well to **follow the model of the FDA's risk-communication system**, built around plain-language circulars and direct-to-consumer messaging. (Rebecca Bratspies, Sarah Lamdan, Victor Flatt)

Although the courts' role in mitigating the impacts of disaster are not as plain to the eye as that of legislators, governors, and presidents, their decisions can powerfully affect the extent to which people and communities are exposed to risk in disasters. The report concludes with discussions of specific constitutional and common law issues affecting disaster planning and recovery. Among the scholars' observations:

- The **Supreme Court's current view of "takings" has had a chilling effect on coastal regulators**, hampering efforts to control development in areas vulnerable to storms. Over time, the overwhelming evidence of sea-level rise could spur the Court to overturn or narrow its reading of the lead case in this area, *Lucas v. South Carolina Coastal Council*. On the other hand, **the Court's eminent domain jurisprudence offers an important tool that could be used in the future to spur community relocation** in the face of sea-level rise. (John Echeverria)

- Efforts to press companies to hold polluters accountable via tort law have been hampered by rulings that federal common law preempts state tort law. Ideally, **the Supreme Court should create a clear standard for preemption of state common law by federal common law that accounts for the importance of state law in the U.S. system.** (Karen Sokol)

Introduction: Adaptation Planning and Resilience: All Hands on Deck

by Alice Kaswan, Alyson Flournoy, and Rob Verchick

By the end of the 2017 hurricane season, the American people were reeling from the impacts of Hurricanes Harvey, Irma, and Maria. The press documented the familiar cycle of compassion, frustration, and anger. As people suffered for days, weeks, and months in communities that were flooded, without power, and in need of food and other basic supplies, the Federal Emergency Management Agency (FEMA), the White House, and other agencies once again emerged in the role of villain for their failure to respond with adequate speed or resources, a failure with particularly deadly consequences in decimated Puerto Rico.

Assigning blame and holding the federal government to account for these victims' suffering is an important step in learning from past mistakes. But alone, it is not enough. We also need to look at the institutions, laws, and policies that could better prepare our communities to withstand the inevitable storms of the future.

The toxic releases that followed Harvey, the 12 nursing home residents who died from stifling heat in Florida after Irma, and the thousands of deaths and second-largest blackout in world history that Puerto Rico suffered in the wake of Maria all illustrate how developing real resilience requires that agencies outside the resilience/adaptation silo take climate and disaster risk seriously as part of their missions. In addition to improving traditional methods of disaster response, we need to plan ahead of time. Through preparation and adaptation, we can achieve *resilience.*

This chapter introduces the topics covered in chapters that follow and explains how the policies, activities, and recommendations they highlight can help promote equitable resilience by improving our planning and disaster preparedness, better protecting health and safety, and promoting social equity.

We need to think more systemically about the role of federal, state, and local governments, and of agencies not typically considered relevant to disaster preparedness.

All Hands on Deck — Before Disaster Strikes

We need to think more systemically — not just about the federal government, but about the role of state and local governments as well, and of agencies not typically considered relevant to disaster preparedness. Employing this wider lens, it is clear that there are important roles for all levels of government in developing and implementing policies that promote resilience in advance of the

increasingly intense storms that climate disruption is causing. These roles fall to a broad array of different agencies — not just the usual suspects to whom we look post-disaster.

Disaster preparedness and planning

The federal government obviously plays a key role in building and maintaining levees and dams and in setting standards for rebuilding in the wake of disaster. The National Flood Insurance Program has enormous impact on decisions about development and rebuilding along vulnerable areas of our coasts. But there are less visible requirements that play an equally important role, like the standards and impact analysis required for all infrastructure built with federal funding under past executive orders, agency-specific policies, and the National Environmental Policy Act. And the federal government provides essential funding and information about climate change impacts, weather, facilities with hazardous chemicals, and strategies for adapting and responding to new threats. The reliability of the electricity grid and its resilience to disaster is determined by laws, policies and, decisions made before disaster strikes.

State and local governments, too, play a significant role in shaping communities in ways that determine their vulnerability to hurricanes and other disasters. Local governments bear responsibility for local stormwater infrastructure and for ensuring that it can function in the face of rising sea levels. Land use planning by local governments, often under the umbrella of state comprehensive planning mandates, determines whether new development and rebuilding is permitted in vulnerable areas and what types of activities are allowed in areas subject to storm surges or frequent flooding. Public information offices play a key role in helping to spread information and educate residents in advance of disasters. In turn, these functions help protect residents and responders not only from flooding and other more visible harms from storms, but from exposure to toxins from flooded industrial sites.

The legal system can also shape our ability to prepare. Holding emitters accountable under common law torts could provide funds for necessary adaptation measures. And interpretations of the Constitution's takings clause, which requires compensation if government takes or drastically impacts property, could affect the degree to which local and state governments can control development of vulnerable areas.

Public health and safety measures

The most obvious impacts caused by storms like Harvey, Irma, and Maria are the immediate loss of life and harm to property from wind and flooding. But a storm's longer-term impacts can be equally devastating, if not as dramatic. Lack of access to medical care, food shortages, exposure to sewage and other toxins in floodwaters, and the mental health impacts of the experience can leave a community and its residents scarred in ways less likely to grab the headlines. Hurricane Maria's thousands of deaths did not all occur from the storm itself; they occurred as the ongoing lack of electricity and access to food and medical care led to otherwise preventable deaths. Remedying these effects and avoiding them in future storms may require resources and agencies outside the usual disaster preparedness and response chain of command and visionary thinking that looks beyond business as usual, toward a better life for all.

Less visible resources — like social capital within a community — can also affect outcomes and determine a community's resilience. Where neighbors have a strong sense of community before a storm hits, residents tend to help each other, sharing resources and information to benefit all.

Social equity

As Rob Verchick, one of this chapter's authors, states elsewhere: "Catastrophe is bad for everyone. But it is especially bad for the weak and disenfranchised." We know that vulnerability to disasters is strongly affected not just by the strength of the storm, but by the resources of those it strikes. Hurricane Maria provided a poster child for the disparities: Puerto Rico's run-down electricity grid was unable to withstand Hurricane Maria. Hurricane Katrina highlighted disparities on the mainland: Some New Orleans residents without the means to flee found themselves rescued from rooftops and housed in the Louisiana Superdome while others drowned in the floodwaters.

Catastrophe is bad for everyone. But it is especially bad for the weak and disenfranchised.

Avoiding such disparities in disasters means addressing economic and environmental disparities before disasters strike. Yet, guidelines or building codes requiring expensive flood-proofing measures, like elevating homes, installing shutters, or other steps, could be beyond the reach of low-income households. The ultimate adaptation measure — retreat from vulnerable areas — could prove particularly challenging for poorer residents in search of scarce affordable housing. And, because poor and of-color communities are disproportionately located close to industry, hazardous waste sites, and sewage treatment plants, they face heightened risks when these sites are damaged by

disasters. We cannot achieve our goal of sound disaster preparedness if we ignore social equity.

What Should Be Done?

Mainstreaming resilience and adaptation

Improving communities' resilience to hurricanes and other disasters requires that accounting for climate and other disaster risk become part of every agency's mission, whether federal, state, or local. It can't be only FEMA or, at the local level, the public works department, that assesses climate risks as part of every decision. Agencies whose missions include public information, solid and hazardous waste disposal, public health, land use planning, and social services all must improve their abilities to factor in the realities of climate and disaster when executing their missions.

Mainstreaming equity concerns

Achieving equitable adaptation will require that agencies also mainstream social equity. When government entities impose new requirements to improve resilience, they should consider equity impacts and provide resources to comply. Programs providing community resources for disaster preparation should prioritize resources for low-income communities that would otherwise lack the resources to prepare. And mainstreaming equity is not only about financial resources; it includes modes of participation and communication. Adaptation planning should include historically marginalized communities, and information about risks and preparation should be communicated to and through community-based organizations by the people and in the languages most trusted and heard within local communities.

Adopting a multi-level governance approach

Mainstreaming adaptation and equity is not an exclusively federal, state, or local responsibility: We need all hands on deck. Many of the relevant programs already function on multiple levels, with federal agencies imposing requirements and dispensing funds to state and local entities, which in turn have discretion to shape their own programs. The players at each of these levels have the opportunity to mainstream adaptation, disaster resilience, and equity. To the extent that some communities might resist adaptation planning or fail to account for social equity, federal and state requirements to incorporate these parameters may be necessary. Moreover, many state and local governments are likely to lack the resources to adequately prepare for future climate impacts. Federal and state resources, both expertise and financial, will be essential.

Federal Resilience Standards

by Daniel Farber

On August 15, 2017, President Trump issued an executive order to expedite federal infrastructure-related decisions by allowing only 90 days for permit decisions and cutting back on flood safety requirements. Enthusiastic Republicans hailed the step. For instance, Rep. Ralph Abraham (R-LA) said he was "thrilled by Mr. Trump's decision." He dismissed catastrophic flooding in Louisiana the previous year as an "isolated event," saying that the "bigger threat … is from costly regulations." Ten days later, Hurricane Harvey hit Texas and western Louisiana.

An ounce of prevention is worth a pound of cure, or so goes the maxim. It could hardly be more apt than in the case of flood mitigation projects, since investments in resilience pay for themselves many times over when natural disasters strike. For instance, according to a recent report:

> Recent studies have indicated that every dollar spent building or improving buildings to comply with the newer codes saves four dollars in damages…. [T]he return on investment in building to the upgraded codes parallels similar investment in efforts to create a more resilient infrastructure. Studies have indicated that it's possible to receive a 6:1 rate of return on federal grants that have been provided for in mitigation efforts, including enhancing the infrastructure.

Investments in resilience pay for themselves many times over when natural disasters strike.

Current federal requirements for resilience in buildings and infrastructure are spotty and in need of an overhaul.

Current Resilience Requirements

Levees and seawalls

More than 100,000 miles of levees stretch along the waterways of the United States, including about a fifth of all U.S. counties, many of which are owned or operated by states, localities, or private entities. Earthen levees are constructed from compacted soil that is typically covered with grass, gravel, stone, asphalt, or concrete to help prevent erosion. Floodwalls, which are generally found in urban areas, are made of concrete. Levees require active maintenance such as removing trees or other vegetation, repairing concrete damage, or filling in animal burrows.

The Government Accountability Office (GAO) reported that the federal government does not have a program that oversees all levees across the nation, and no national standards for levee safety. Instead, the Army Corps of Engineers (the Corps) attempts to oversee only the 15,000 miles of levees involving federal construction, maintenance, or rehabilitation. Under a 2014 law, the Federal Emergency Management Agency (FEMA) and the Corps were also supposed to establish voluntary federal safety guidelines and a hazard classification system based solely on the potential consequences associated with a levee's failure, as opposed to the likelihood or probability of a levee failure.

As of mid-2016, the agencies had made little progress on some tasks and no progress on others required by the statute, which they attributed to lack of resources. Apart from some work on incorporating FEMA information into an Army Corps database, the situation was bleak:

> The agencies have taken no action on the remaining key national levee-safety-related activities for which they were responsible and have missed several statutory deadlines for developing guidelines and reports. For example, the agencies took no action on ... the voluntary national levee-safety guidelines, due June 10, 2015; or a report, due June 10, 2015, that was to include, among other things, recommendations for legislation and other congressional actions necessary to ensure national levee safety. Additionally, according to agency officials we interviewed, the agencies have no current plan for implementing the remaining activities.

Other federal infrastructure

In 2015, President Obama issued an executive order requiring greater flood precautions for federally funded infrastructure, especially such critical facilities as hospitals. Although leaving room for some alternatives, the Obama order authorized three main approaches to flood risk management for federal infrastructure:

> (i) the elevation and flood hazard area that result from using a climate-informed science approach that uses the best-available, actionable hydrologic and hydraulic data and methods that integrate current and future changes in flooding based on climate science.... ;

(ii) the elevation and flood hazard area that result from using the freeboard value reached by adding an additional 2 feet to the base flood elevation for non-critical actions and by adding an additional 3 feet to the base flood elevation for critical actions;

(iii) the area subject to flooding by the 0.2 percent annual chance flood.

Just days before Hurricane Harvey, Trump repealed the order, thrilling Representative Abraham and restoring a previous standard dating from the Carter administration. Section 6 of Executive 13801 states, "Executive Order 13690 of January 30, 2015 (Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input), is revoked."

The Obama order seems to have had three fatal flaws from Trump's perspective: It made construction more expensive, it was issued by Obama, and it mentioned climate change. In the long run, American taxpayers will find themselves paying out more in disaster relief for buildings they helped pay for in the first place because the government failed to require proper flood precautions.

In February 2018, the U.S. Department of Housing and Urban Development (HUD) quietly reinstated some of the Obama requirements for post-hurricane housing funding. Chapter VI(B), § 32(e) of the Notice setting forth requirements for disaster recovery community development block grantees provides:

> All structures … designed principally for residential use and located in the 100-year (or 1 percent annual chance) floodplain that receive assistance for new construction, repair of substantial damage, or substantial improvement … must be elevated with the lowest floor, including the basement, at least two feet above the base flood elevation. Mixed-use structures with no dwelling units and no residents below two feet above base flood elevation, must be elevated or floodproofed, in accordance with FEMA floodproofing standards at 44 CFR 60.3(c)(3)(ii) or successor standard, up to at least two feet above base flood elevation…. All Critical Actions … within the 500-year (or 0.2 percent annual chance) floodplain must be elevated or floodproofed (in accordance with the FEMA standards) to the higher of the 500-year floodplain elevation or three feet above the 100-year

> floodplain elevation. If the 500-year floodplain is unavailable, and the Critical Action is in the 100-year floodplain, then the structure must be elevated or floodproofed at least three feet above the 100-year floodplain elevation.

HUD also included a directive for grantees to take "continued sea level rise" into account. Chapter VI(A) § 7 requires grantees to:

> Promote sound, sustainable long-term recovery planning informed by a post-disaster evaluation of hazard risk, especially construction standards and land-use decisions that reflect responsible floodplain and wetland management and take into account *continued sea level rise*, if applicable; and coordinate with other local and regional planning efforts to ensure consistency. This information should be based on the history of FEMA flood mitigation efforts and *take into account projected increase in sea level (if applicable) and the frequency and intensity of precipitation events.* (emphasis added).

However, other federal infrastructure spending remains subject only to the Carter-era rules.

The hurricane season of 2017 should be a wake-up call. We need to get serious about flood risks and infrastructure.

The hurricane season of 2017 should be a wake-up call. We need to get serious about flood risks and infrastructure. Those risks are only going to increase as sea level rises and extreme weather becomes more common.

Dam safety

In February 2017, the Oroville Dam in California faced a risk of failure after heavy rains, leading to the evacuation of 188,000 people. The dam's emergency spillway came near to collapse. As reported in the *Sacramento Bee*:

> One day after water started running over the emergency structure, the hillside had eroded so badly that dam officials feared the lip of the emergency spillway would crumble, releasing a "wall of water" on communities below the dam. That necessitated the evacuation. Faced with imminent disaster, dam operators then dramatically ramped up water releases over the main spillway, which lowered lake levels to the point that water stopped flowing over the emergency spillway.

In April 2017, after the near-collapse of the Oroville Dam, Democratic House members asked the GAO for a thorough review of the Federal Energy Regulatory Commission's (FERC) safety efforts, since FERC licenses hydroelectric dams. An independent forensic review found that the crisis resulted from systemic failures and concluded:

> Although the practice of dam safety has certainly improved since the 1970s, the fact that this incident happened to the owner of the tallest dam in the United States, under regulation of a federal agency, with repeated evaluation by reputable outside consultants, in a state with a leading dam safety regulatory program, is a wake-up call for everyone involved in dam safety.... Challenging current assumptions on what constitutes "best practice" in our industry is overdue.

The federal government regulates the safety of only a small proportion of dams in the United States. According to the American Society of Civil Engineers, in 2015, there were more than 15,000 dams classified as "high-hazard potential," a number that had increased by a third since 2005. The federal government owns less than 5 percent of the nation's dams; the remainder are generally regulated by state governments. The federal government issues dam safety guidelines, but they are not mandatory. The national flood safety program is established by 33 U.S. Code § 467f and includes provisions for training and other support of state programs. According to FEMA, nine states (Alabama, California, Florida, Georgia, Indiana, Iowa, Kentucky, Vermont, and Wyoming) lack the power to require owners of high-hazard dams to prepare emergency action plans covering evacuation and other responses. Clearly, more needs to be done to ensure the safety of our country's dams.

Estimating maximum flows

Even putting aside the impacts of climate change and land use change, there are a lot of uncertainties about the designation of 100-year or 500-year floods, which are key to planning for important infrastructure such as dams and levees and also for flood maps. For inland flooding, estimates are based on hydrological gauges in streams. (Hurricanes, on the other hand, are fairly rare events, so the database for them is inherently limited.) There may be a limited number of gauges in some areas, or they may not have been in operation very long. Also, gauges may be inaccurate, particularly in periods of high flow. Efforts

are made to adjust for some of these issues, for example with comparisons to gauges in nearby areas. But this involves judgment calls.

In addition, we don't have a theoretical basis for predicting the statistical distribution of river flows over time. The federal government did a study and found that, of the standard distributions used by statisticians, one called the Pearson Type III distribution with log transformation worked the best for fitting the data on high stream flows (i.e., floods). (This is basically a normal "bell curve" that has been stretched in one direction, or "skewed.") But this is an approximation since we don't know the true shape of the probability distribution. So the statistical method being used is only approximately right to begin with.

By definition, increasingly rare events are increasingly unlikely to be found in the record of the time period for which we have data. That means that there's going to be a lot of uncertainty about high-end estimates, which involve rare events like 500-year floods. For example, in a situation studied by the National Research Council in 2000, the expected discharge for the 100-year flood was 4,310 cubic feet of water per second (cfs), the upper confidence limit was 6,176 cfs, and the lower limit was 3,008 cfs. So basically, what we know is that there's a 90 percent chance that the 100-year flow would involve somewhere between 3,008 cfs and 6,176 cfs, a difference of a factor of two.

What Should Be Done?

Congress needs to fully fund the levee safety program

Trump needs to reinstate Obama's infrastructure flood safety executive order
If President Trump does not revive the Obama order, Congress needs to enact legislation to do so.

The dam safety program needs to be revamped
FERC needs to assume responsibility for regulating and inspecting the subset of non-federal dams with the highest hazard levels.

FEMA needs to be more explicit about uncertainties in flood modeling and work toward improvements
FEMA should prioritize research on improved modeling techniques that incorporate climate change and landscape changes that increase flood risk. FEMA and other agencies should also take a precautionary approach to federal infrastructure planning, using a margin of safety to account for uncertainties.

FEMA and Disaster Resilience

by Daniel Farber

"No power, no water, no transport, roads were closed, many streets broken, houses destroyed and people crying."

Those were the words of Maria Meléndez, the mayor of Ponce, the largest city in southern Puerto Rico, after Hurricane Maria devastated Puerto Rico and the Virgin Islands. She had good reason to complain. As pointed out in the *Economist*, "[e]ven the most attentive government would have struggled with Maria." But the federal government's response fell far short of attentive: "Instead of strong leadership, to cut through the difficulties, Donald Trump provided little help."

"No power, no water, no transport, roads were closed, many streets broken, houses destroyed and people crying."

The United States needs to do better than that. In this chapter, I explain the many roles of the Federal Emergency Management Agency (FEMA), the lead agency in disaster response, in creating resilience — from its leadership during disasters like Hurricane Maria to setting standards for rebuilding and issuing flood maps — and highlight the ways in which it has failed in those roles. I then make a series of recommendations to remedy these failures and ensure that the federal government does better next time a life-threatening hurricane or other disaster hits Puerto Rico or any other part of the United States.

FEMA's Roles and Failures

Disaster response

When people think of FEMA, they likely envision rescuers finding victims and taking them to safety. FEMA does provide emergency assistance, temporary housing, and other services. But its main job is to coordinate the response of many parts of the federal government. And normally, the federal government's role itself is mostly supportive, with the main job of emergency response falling on state and local governments.

President Jimmy Carter created FEMA in 1978 by combining the functions of several different government agencies. [1] Today, its work is governed by the Post-Katrina Emergency Management Reform Act of 2006. The law charges FEMA with assisting the president in carrying out his functions under the core federal disaster law, the Stafford Act. According to 6 U.S.C. 313(b)(1):

> The primary mission of the Agency is to reduce the loss of life and property and protect the Nation from all hazards, including natural disasters, acts of terrorism, and other man-made disasters, by leading and supporting the Nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation.

FEMA follows a national response framework that it issued in 2013. The framework emphasizes that disaster response requires "layered, mutually supporting capabilities of individuals, communities, the private sector, NGOs [non-governmental organizations], and governments at all levels." Efforts are coordinated through the Incident Command System, including multiple agencies. No fewer than 14 agencies can be involved in post-disaster response.

First responders are rarely federal; instead, they are state and local personnel who are already on the scene. When the National Guard is deployed to the scene, it, too, is often under state control. Private entities, including utility companies, also play a key role in restoring power, water, and communications in the aftermath of a disaster. [2] Nevertheless, FEMA's work is essential after a major disaster.

Not since Katrina had FEMA faced a challenge like the summer of 2017, with Hurricanes Harvey, Irma, and Maria hitting the U.S. mainland and island territories, even as major wildfires raged in California. FEMA has greatly improved since the days when President Bush told "Brownie" he'd done "a heck of a job," just before things really fell apart. By the time of Hurricane Sandy, the agency had learned from Katrina the importance of pre-positioning assets before the storm actually struck and having an early presidential declaration of national emergency. Those lessons were also followed with Harvey and Irma, but they proved not to be enough to cope with Maria.

FEMA's post-mortem after Sandy indicated areas of strength and weakness. That was also the U.S. Government Accountability Office's (GAO) conclusion. In particular, GAO questioned whether FEMA had addressed gaps in the response capabilities of some agencies or had sufficiently improved logistics, such as its ability to track the location of supplies. FEMA also had room for improvement in several areas, including coordination of federal senior leadership, implementing the incident-management system, and connecting planning efforts with operational decision making.

Even given these shortfalls, however, there is little doubt that the federal response to Sandy was far superior to the response to Katrina. Unfortunately, the response to Hurricane Maria was a throwback to Katrina, with major response delays compared to Hurricane Harvey, which occurred just beforehand. The following table summarizes the differences between the responses in Texas and Puerto Rico, including data from later in the response effort. There is an unmistakable — and striking — disparity.

Table 1: Comparison of Texas and Puerto Rico Hurricane Responses

Government Action	Hurricane Harvey (Texas)	Hurricane Maria (Puerto Rico)
Helicopter deployment	73 helicopters within a week	70+ helicopters after 3 weeks
Immediate FEMA funding (nine days post-storm)	$141.8 million	$6.2 million
Meals delivered in first 9 days	5.1 million	1.6 million
Personnel deployed after first 9 days	30,000	10,000
FEMA payments approved in first nine days	$142 million	$6 million
Time after storm to approve permanent disaster work	10 days	43 days
Percent of relief applications approved as of day 80	39%	28%

An additional factor in the slow response was the inability to mobilize half of the Puerto Rico National Guard in the days after the disaster. Addressing criticism that FEMA's response to Hurricane Maria was delayed and gave fewer resources to Puerto Rico than to the mainland, FEMA Administrator Brock Long stated that was "completely false." He said "that in the first six months since Maria hit, FEMA invested $10 billion in Puerto Rico, in contrast to the $6 billion invested in

the six months after Hurricane Katrina." Long added that "[r]ecovery never moves as fast as people want it to" and that "in this case, moving faster can be detrimental from the standpoint of putting this money to work in a manner that truly makes Puerto Rico stronger and more resilient." He attributed the slow progress of recovery to the difficulty of obtaining power poles and construction equipment given the slew of natural disasters that had struck the United States in the previous year.

There is no reason to doubt FEMA's good faith or that the government ultimately devoted similar resources to response to Hurricane Maria as it did to other hurricanes. Response agencies were already stretched thin by the earlier major hurricanes of the season, the wildfires in California, and the logistic problems of aiding an island at some distance from the mainland. As the *Economist* put it, "Even the most attentive government would have struggled with Maria. FEMA was overstretched in Texas, Florida and California. Puerto Rico, unlike Houston, is rugged, 180 [kilometers] long, and has worn-out infrastructure and weak institutions." Thus, equal resources would inevitably have led to unequal results. Indeed, this is likely always to be true when considering the needs of vulnerable populations, who are likely to need greater assistance than peers who have greater resources and fewer needs.

But even if FEMA devoted equivalent effort to the two disasters, equal effort was not necessarily the right standard, given the different levels of harm in Texas and Puerto Rico. Consider the following table:

Table 2: Comparison of Impacts (Texas vs. Puerto Rico)

	Texas	Puerto Rico
Housing units destroyed or significantly damaged	42,000 (Greater Houston area, destroyed or significantly damaged)	400,000 (destroyed or significantly damaged)
Number of deaths	88	500-4,500
Number without power	280,000	1,000,000
Number without Drinking Water	45 systems in smaller communities shut down, Houston unaffected.	One half of population (approx. 1.7 million) left without potable water
Number without phone, cell, or Internet service	180,000 homes	91% of island left without cell phone coverage

As bad as things were in Houston, they were much worse in Puerto Rico. Despite the massive destruction of infrastructure and housing in Puerto Rico, the government chose not to give it higher priority. Given the massive capabilities of the federal government, it seems likely that it could have overcome resource and logistic challenges if a more strenuous effort had been made. [3] As FEMA's after-action report concedes, FEMA was unprepared for the disaster and its response effort fell far short of what was needed.

One cause of the delayed response was misguided advance planning. FEMA's plan placed too much reliance on local institutions that already had serious problems of their own. Besides planning for a smaller hurricane, FEMA's advance plan for Puerto Rico ignored the special issues handicapping the island's resilience. According to *Politico*, which obtained a copy of the advance plan and shared it with experts:

> FEMA did not anticipate having to take on a lead role in the aftermath of the disaster, despite clear signs that the island's government and critical infrastructure would be overwhelmed in

> the face of such a storm. Instead, the document largely relied on local Puerto Rico entities to restore the island's power and telecommunications systems. It didn't mention the financial instability of the Puerto Rican government and Puerto Rican electrical utility, factors that significantly complicated the immediate response to Maria.

Rebuilding requirements

FEMA also plays an important role in disaster recovery through its role in the federal flood insurance program. This program, as currently designed, provides subsidies to many property owners to develop or maintain structures in unsafe areas. This problem is discussed in a previous chapter of this report. But FEMA also plays an important role in rebuilding, through requirements imposed on local governments and property owners in return for disaster funding.

In reauthorizing FEMA until July 31, 2018, Congress made an effort to improve resilience of local public infrastructure. For instance, in Puerto Rico and the U.S. Virgin Islands, FEMA's Public Assistance (PA) program will pay for public facility and infrastructure repairs up to current nationally accepted codes and standards regardless of local codes at the time of the storm. Also, the Stafford Act will now increase the federal share of disaster funding from 75 percent to 85 percent if communities take steps to plan for and mitigate against future disasters.

Flood mapping

Flood mapping defines the boundaries of flood zones, setting the parameters for flood insurance requirements and for community land-use planning. Unfortunately, there are significant issues regarding the validity of existing flood maps. Flood maps are variable in quality and age, with some now approaching 40 years in age. Updating these maps is important for several reasons. Land use patterns have changed, affecting the amount and speed of run-off. Land in some areas has subsided. And climate change will also impact precipitation patterns and sea levels.

As the Congressional Research Service noted in a report on the National Flood Insurance Program, there does not seem to be a clear policy on updating flood maps:

> There is no consistent, definitive timetable for when a particular community will have their maps revised and updated. FEMA uses a process called the Coordinated Needs Management Strategy to

> prioritize, identify, and track the lifecycle of mapping needs.....Generally, flood maps may require updating when there have been significant new building developments in or near the flood zone, changes to flood protection systems (e.g., levees and sand dunes), and environmental changes in the community. Because of the variability in how and when a FIRM is updated, for example, one community may be undergoing the process of updating its map while a neighboring community is not, and one community may have had its map last updated in 2016 while a neighboring community had its last revised in 2005, etc. [4]

Communities and affected individuals have many opportunities for input, which is good in the abstract, but it can lead to lengthy delays due to resistance by individuals who fear new maps will result in changes in insurance requirements or trigger the need for more stringent land-use controls. As a result, the "FEMA mapping process, and some National Flood Insurance Program (NFIP) maps, have been criticized for being out of date, using poor quality data or methods, or not taking account of changed conditions. [5]

In the past, FEMA has passed the cost of mapping on to flood insurance policy holders. Pending legislation would allow states and localities to develop their own flood maps subject to federal oversight and would require private insurers to contribute to funding the mapping program.

The mapping system is badly in need of reform. The Congressional Research Service observes that:

> A 2013 report on the impact of climate change and population growth on the NFIP concluded that by 2100, the 1% annual-chance fluvial floodplain area is projected to grow nationally by about 45% .... In the populated areas of most interest to the NFIP, about 30% of these increases may be attributed to increased runoff caused by the increase in impermeable land surfaces caused by population growth and development, while the remaining 70% represents the influence of climate change.

What Should Be Done?

FEMA's planning must include realistic assessments of local resiliency

The disaster response system works best with strong local partners. Some states — notably Texas, Florida, and California — are prone to disaster events.

But they also have substantial public and private resources to bring to bear. Poorer jurisdictions such as Louisiana, Mississippi, or Puerto Rico are much less well positioned to respond to disaster. To assume they will play a leading or even equal role in the aftermath is unrealistic and a recipe for failure.

The federal government needs greater surge capacity

The likelihood of massive harm from natural disasters is only likely to increase due to climate change and the increasing population in vulnerable areas. This will necessarily increase the likelihood of two or more such events occurring in close succession. Thus, FEMA needs to plan for multiple major events, just as the Pentagon plans for the possibility of more than one simultaneous war.

High-level support from the presidential administration is indispensable

FEMA's role requires it to summon and coordinate the efforts of agencies that are larger and much more powerful, pulling them away from their normal activities. In the event of a catastrophic event, this must happen quickly. Without strong support from the top, FEMA has limited ability to do this.

FEMA must update flood maps

Current flood maps are outdated. It might be helpful to issue maps in phases, beginning with a version including changes in flood frequency (due to sea-level rise or improved modeling) and topography (such as subsidence). The next phase would factor in landscape changes. The final map would also take into account existing flood protection. Phasing would allow useful information to be made available more quickly and would hopefully limit political disputes until all three stages were complete and a formal map was released.

The National Flood Insurance Program: Back to the Future

by Christine Klein and Alyson Flournoy

In the wake of Hurricane Harvey, Eileen and Jeff Swanson faced the unthinkable. They had just paid off the last of the mortgage on their $225,000 home in the Canyon Gate neighborhood of Houston, where they lived with two sons, one of whom is severely developmentally disabled. During the storm, a foot of water inundated their home, and in its wake, they faced $60,000 in costs to repair the damage. Like many Houston residents, the Swansons had no flood insurance.

The lesson one might be tempted to draw is the one Federal Emergency Management Agency (FEMA) Administrator Brock Long promoted in a recent congressional hearing: that reform of the National Flood Insurance Program (NFIP) should focus on ensuring that those at risk have flood insurance to speed up their recovery. While this is a desirable goal, it fails to address more fundamental structural problems with the NFIP that the Swansons' predicament reveals. Ensuring everyone at risk is covered will help people to recover after disaster strikes but at a high cost in suffering and dollars. Reform must also enlist the NFIP as a tool to help avoid predictable flooding of people's homes, businesses, and communities.

That requires that we look at several root causes of the Swansons' problem: that the local government allowed construction in an area intended — not just expected, but intended — to flood in extreme storms, and no federal, state, or local law required either special measures to reduce the risk to homes or disclosure of this risk to prospective buyers. (The Barker Reservoir, built by the Army Corps of Engineers in the 1940s, was not an obvious source of risk to the Swansons or other purchasers. In dry weather, it is a park with trails and sports fields.)

How can we enhance the resilience of communities through an ounce of prevention, instead of simply paying for a pound of cure over and over after each new flood? The path to achieving exactly this was blazed when the NFIP was first enacted. To find the way forward requires that we look back to the program's history.

An Ounce of Prevention

The National Flood Insurance Program celebrated its 50th anniversary in 2018. At middle age, it is not in good shape. The program is some $20.5 billion in debt to the federal treasury as of February 2018 (even after the Treasury Department canceled an additional $16 billion of debt after Hurricanes Harvey, Irma, and Maria). At the same time, the cost and severity of flood damage have not diminished. What could account for the NFIP's widely acknowledged failings?

As the program has been implemented by the federal government and amended by Congress over the past half century, it has strayed far from the original goals of the 1968 Congress that enacted the underlying legislation. Today, many probably believe that Congress intended to permanently subsidize federal insurance to protect property constructed in flood-prone areas. Nothing could be further from the truth.

Third time is the charm? Beyond levees and disaster relief

Congress did not turn to federal flood insurance until two other federal efforts to minimize flood damage had fallen short.

Congress did not turn to federal flood insurance until two other federal efforts to minimize flood damage had fallen short. Early in the 20th century, flood prevention and recovery had been the responsibility of state and local governments. When they proved unequal to the challenge, the federal government, primarily through the Army Corps of Engineers, gradually began to offer assistance. At first, the Corps followed a "levees only" policy, relying solely upon the construction of levees to contain floodwaters. Despite those early efforts, the Great Mississippi River Flood of 1927 caused about 500 deaths and left at least 700,000 people homeless. In response, Congress passed the Flood Control Act of 1928, through which the federal government took on a broader role in engineered flood control, authorizing the construction of more federal levees, but also spillways, floodways, reservoirs, and other structures to protect floodplain development.

As flood damage continued to accrue, Congress began to experiment with a second important response to flooding: disaster relief. Through the Disaster Relief Act of 1950, Congress authorized post-flood financial assistance from the federal government. But such relief, funded by taxpayers, also proved to be inadequate. This lesson hit home after Hurricane Betsy of 1965, a Category 3 storm, made landfall in Florida and Louisiana, killing 75 people and submerging tens of thousands of homes, some up to their rooftops. Betsy was the nation's first "billion-dollar hurricane" in terms of flood damage (about $7.9 billion, adjusted for inflation).

Just three years later, Congress tried yet a third approach: flood insurance. When it passed the National Flood Insurance Act of 1968, Congress intended to defray the expense of after-the-fact disaster relief by encouraging floodplain occupants to pay insurance premiums into an insurance pool before disaster struck. As the House of Representatives explained in its report on the pending legislation, disaster relief from the federal government and voluntary relief agencies had proved inadequate, thereby "underlin[ing] the need for a program which will make insurance against flood damage available, *encourage persons to become aware of the risk of occupying the flood plains*, and *reduce the mounting Federal expenditures for disaster relief assistance*." [6] Congress was well aware that any insurance program — especially one with federal subsidies — could actually "aggravate rather than ameliorate" flood danger by giving floodplain occupants a false sense of security and creating what the insurance industry calls "moral hazard" — the propensity for excessive risk-taking by those who do not bear the full cost of risky actions such as floodplain development. To avoid such hazard, Congress incorporated three critical components into the National Flood Insurance Program.

Temporary federal subsidies

The task force report that gave rise to the NFIP in 1968 originally estimated that federal subsidization of the cost of flood premiums for existing high-risk properties would be required for a limited period of time only — approximately 25 years. As the House Report asserted, "Any Federal 'subsidy' which will accrue under the insurance program to the benefit of property owners now occupying the flood plain is defensible only as part of an interim solution to long-range readjustments in land use...." Existing floodplain structures were grandfathered in and their insurance premiums available at federally subsidized rates, but the House Report explained that such a temporary partial subsidy for *new* properties "is not at all valid." Instead, Congress assumed that after existing floodplain structures completed their useful lives, the program would be turned over to the private insurance industry, which would charge full actuarial rates that reflected the full measure of risk assumed by those who chose to build new structures within areas at high risk of flooding. At that time, the task force report explained, "private insurers would take over the bulk of the program, charging full, risk-based actuarial premiums, and the federal government would have no liability, except with possible reinsurance against catastrophic losses." [7]

State and local land use regulation

How would private insurers be able to provide economical insurance at some future date? The key lies in the state and local land use regulations that Congress envisioned as the centerpiece of the NFIP. In the statute's statement of purpose in Section 1302(c), Congress found that "a program of flood insurance can promote the public interest by providing appropriate protection against the perils of flood losses and encouraging sound land use by minimizing exposure of property to flood losses...." In fact, under Section 1305(c), federal insurance would be available only to participating communities that provided satisfactory assurances that they were adopting permanent land use and control measures, with effective enforcement mechanisms, in conformity with federal criteria to be developed by the Secretary of the Department of Housing and Urban Development. Further, the law made federal disaster assistance unavailable for losses covered by the flood insurance program, or that could have been so covered by landowners in participating communities, with exceptions for low-income individuals.

The path forward calls for a return to the principles articulated in the National Flood Insurance Act of 1968 — providing only temporary subsidies, ensuring enactment of sound land use regulation, encouraging partial retreat, and advancing social equity.

Partial floodplain retreat

Thus, state and local land use regulation was an essential cornerstone of the National Flood Insurance Program. Such regulation would perform at least two critical functions, as stated in the NFIP's declaration of purpose. First, it would "constrict the development of land which is exposed to flood damage and minimize damage caused by flood losses." Second, regulation would "guide the development of proposed future construction, where practicable, away from locations which are threatened by flood hazards." If fully implemented, these "constrict" and "guide away" principles could have done much to protect lives and property from the ravages of floodwaters, as well as insulate the federal fisc from unsustainable costs. Instead, regulatory efforts were thwarted by many factors, including a growing antipathy toward regulation and the rise of the regulatory takings doctrine, as further explained elsewhere in this report.

What Should Be Done?

The path forward calls for a return to the principles articulated in the National Flood Insurance Act of 1968 — providing only temporary subsidies, ensuring enactment of sound land use regulation, encouraging partial retreat, and advancing social equity. The repeatedly postponed reauthorization of the NFIP provides an ideal opportunity for Congress to focus on these goals. A February 2018 Public Opinion Strategies poll commissioned by the Pew Charitable Trusts shows strong public support across political parties for policies that more fairly

allocate the costs of flood insurance and emphasize prevention, rather than just recovery, by incorporating sensible mitigation measures.

Phase out federal subsidies

An important concern of the 1968 legislators was to "encourage persons to become aware of the risk of occupying the flood plains." Appropriate pricing of flood insurance is a critical way of accomplishing this goal. The Biggert-Waters Flood Insurance Reform Act of 2012 tried to phase out subsidies rapidly but was met with a severe backlash. The subsequent Homeowner Flood Insurance Affordability Act of 2014 also included a phase-out of subsidies, albeit on a more gradual schedule. Importantly, the 2014 legislation also called for measures to enhance affordability, hearkening back to an original component of the flood insurance program.

In some cases, the rich are able to remain in the floodplain and to elevate their structures so as to qualify for federal flood insurance, or to buy property without a federally backed mortgage and therefore escape the need for federal flood insurance. Care needs to be taken in subsidizing insurance policies — even for low-income individuals and families — because it may only work to keep people in harm's way. Premium support must be coupled with steps that reduce the risk to vulnerable populations.

The Trump administration is proposing a funding mechanism that appears to be a bad idea: transfer NFIP risk to the capital markets. This partial privatization is superficially appealing and seemingly consistent with the original NFIP goal of moving from federal subsidies to private insurance. However, such reforms could easily end up allowing private insurers to "cherry pick" the properties with the lowest risk — similar to letting private health insurers take on only healthy people, leaving the government to pay for the rest.

Reinvigorate state and local land use regulation

It is time to live up to one of Congress's original purposes in enacting the flood insurance program: to encourage strong state and local land use regulation. This may require action at the federal, state, and local levels, and by the judicial as well as legislative branches.

Congress should review and strengthen the incentives for local governments to adopt tough limits on new development in floodplains and areas subject to flooding in extreme events. In April 2018, Houston adopted building standards that, according to one report, "could have spared 84 percent of the buildings

flooded by Hurricane Harvey." The standards increased the elevation required for new buildings from one foot to two feet of elevation above the 500-year floodplain. The incentives provided by the NFIP to local governments were clearly inadequate to achieve the program's goals. Allowing local governments to wait until after flooding strikes shifts the losses from developers — who are better able to assess and factor costs into their decisions — to residents and the public at large — who generally lack both the expertise and the basic facts to enable them to accurately assess their risks.

Congress should also strengthen the requirements of the NFIP to insist that flood maps on which the federal insurance program, local communities, and residents rely are updated to reflect the true risk presented in an era of climate change, as noted elsewhere in this report.

Federal judicial decisions also play a significant role in deterring local governments from adopting needed land use restrictions. Local officials fear they will incur liability for a regulatory taking if they adopt the minimum standards needed to protect the public's health, safety and property. The U.S. Supreme Court should mitigate this as it elaborates how the takings clause applies in future cases where local governments are seeking to address the slow-moving emergency of flood risk. Other creative ideas like insurance for regulatory takings claims could also take the chill off needed local regulation.

It is important to encourage the removal of more buildings from the floodplain altogether through voluntary buy-out programs.

Encourage partial floodplain retreat

Beyond phasing out subsidies for insurance premiums, it is important to encourage the removal of more buildings from the floodplain altogether through voluntary buy-out programs. This would help to solve the well-documented "repetitive loss" problem, under which a small number of high-risk properties take up a disproportionately large proportion of insurance payouts. Section 1323 of the National Flood Insurance Act, added in 2004, provides a repetitive flood claims grant program to mitigate structures, which includes acquisition or relocation of at-risk structures. Even before the most recent rounds of hurricanes, for example, Harris County, Texas, bought out more than 3,000 flood-prone properties between 1985 and 2015, using federal and local loans and funds. This amounted to a purchase of more than 1,000 acres that were restored as natural floodplains, which the county estimated saved at least 1,500 homes from flooding during one storm alone (the so-called "Tax Day Flood" in April 2015). This program could be expanded, perhaps partially funded

through premium increases over time, emphasizing buyouts and retreats over the incomplete solution offered by elevation of structures.

Provide better signaling

There are many sources that document how inaccurate FEMA's floodplain maps are, how they fail to take advantage of the best available data, and how they fail to take into account the reality of climate change. The 2014 Act requires the mapping program to use "the most accurate topography and elevation data available," which would appear to require incorporation of the best available climate change projections where these affect elevation. In Houston, for example, many homeowners, like the Swansons, did not realize they were within identified "flood pools" where stored flood waters could be released periodically. This represents a failure of signaling, as well as an abdication of responsibility by local government by allowing homes to be built within the known flood pool.

Requiring disclosure of a property's location within a flood zone or flood pool, as some states require, is only meaningful if the flood zones reflect risk accurately. Sellers may already be required to disclose past flooding under state statutory or common law standards, but this can be difficult and costly for a misled buyer to enforce. State legislatures should update their disclosure statutes to account for this.

Enhance equity

Since its enactment, the NFIP has included a focus on supporting the most vulnerable in our communities. Reforms of all aspects of the NFIP should incorporate needs-based distinctions that provide relief to those who need it most. With the growing deficit in the NFIP and the prospect of ever more extreme storms, subsidizing those with adequate resources may not be a sustainable strategy. In addition, greater transparency by FEMA in reporting on the types of assistance provided, income levels of those receiving assistance, and overall cost could help ensure that support is directed where it is needed most.

State and Local Planning

by Alice Kaswan, Alyson Flournoy, and Rob Verchick

Three months before Hurricane Irma hit Florida, the state relaxed what many had considered to be one of the best building codes in the country. That wasn't an anomaly. A report by the Insurance Institute for Business & Home Safety found that many states along the Atlantic and Gulf coasts either lack building codes or have relaxed them in recent years.

When jurisdictions fail to plan, or plan too little, they squander the opportunity to avoid or mitigate significant problems. Houston and surrounding Harris County, have seen massive in-migration and development in the last 20 years on some of the least absorbent soils in the nation, but has not developed adequate stormwater infrastructure. Behind Orleans and Jefferson parishes in Louisiana, Harris County ranks third in the nation for the amount paid out by the National Flood Insurance Program over the last 40 years.

Hurricane Maria revealed Puerto Rico's underlying vulnerability and poor resilience capacity, including its decrepit power system and lack of on-island basic necessities and services. That vulnerability was rooted in the island's poverty. Looking ahead, the tragedy highlights the significant challenges facing low-income communities and states lacking adequate resources to reduce vulnerability and achieve greater resilience.

An Ounce of Prevention ...

Although climate change is a global problem with global impacts, those impacts are manifested at the local level. Global emissions may cause climate change, but when sea levels rise and hurricanes drive storm surge into New York City's subways or into homes along the Gulf Coast, the experience is decidedly local. Accordingly, adaptation and resilience planning at the state and local level is essential. State and local governments control many critical levers. They have the capacity to plan the location and structural integrity of essential infrastructure, such as transportation, power, and water supply and treatment. And they have the authority to control how land is used and how structures are built. States and their municipalities decide whether the floodplain gets developed, how close homes and schools can be to contaminated areas, and how strong the roofs must be.

Critical features of planning

Certain features are critical to good planning. Communities often lack the will to devote the resources needed to plan for uncertain disasters. And after a disaster, it may be some time before they have the resources to devote to planning processes. If planning is to be effective, local governments need to understand vulnerabilities; to be efficient, solutions need to focus on strategies that yield multiple benefits. For example, green infrastructure parks being developed in New Orleans will not only help protect communities from flooding, but also provide recreation for residents and support tourism.

To achieve equitable adaptation, planners must identify and assess the risks faced by physically vulnerable or socially marginalized groups, like the elderly, disabled, and poor. A failure to focus on the risks to these groups virtually ensures that they will suffer disproportionate harm, as occurred when a nursing home failed to plan for post-hurricane power outages, leading to the preventable deaths of some residents in the sweltering summer heat after Hurricane Irma.

To achieve equitable adaptation, planners must identify and assess the risks faced by physically vulnerable or socially marginalized groups, like the elderly, disabled, and poor.

Building strong partnerships by engaging local stakeholders and facilitating collaboration will produce better decisions and a more engaged and prepared community. And decision-makers must incorporate sound science, acknowledging uncertainties without becoming paralyzed by them. Tools like multiple-scenario planning and low-regrets strategies can help local governments manage risk. And decision-making is an ongoing process that requires monitoring and re-evaluation of strategies over time. Measurable goals and metrics — both qualitative and quantitative — are key to ensuring that outcomes can be assessed systematically.

The challenges for sound land use planning

Critical as it is to resilience, local land use planning for adaptation and resilience presents special challenges due to the political forces facing local governments. New building codes, limitations on rebuilding, land use restrictions to preserve wetlands as a storm buffer, or other local planning measures will entail costs that citizens are likely to resist and that can be hard for local politicians to support without political cost. Restrictions on new development could also deter new investment in a community, harming the powerful real estate community and depriving local governments of hoped-for tax revenue. The ultimate local adaptation measure — retreat — is likely to be extremely controversial for local officials who advocate it. Analysts extolling the virtues of local land use planning

must be cognizant of the political forces at play, and strategies for achieving resilience must overcome the political impediments to local action.

What Should Be Done?

Local governments should leverage state and regional power

Local governments may require new tools in order to address the threats they face from disasters in an era of climate change and sea-level rise. Florida offers two examples of how state and regional efforts can help support local government adaptation efforts. The Southeast Florida Regional Climate Compact, forged by four Florida counties and numerous municipalities and partners, has provided a key information clearinghouse, an incubator for adaptation and resilience policies, and a coalition for seeking legislative reform and funding. The Compact's leadership led the state to adopt a new statute that authorized local governments to incorporate Adaptation Action Areas (AAAs) into the coastal element of their comprehensive plans. These AAAs help local governments designate areas that require special adaptation measures to deal with sea-level rise and related impacts. They also help local governments prioritize and tailor their funding and planning. Valuable resources like the Adaptation Clearinghouse help local government officials and staff research best practices to identify strategies that suit their particular situations.

State governments should ensure local planners consider disaster risk

State legislatures should use their power not only to give local planners tools, but to ensure that they adequately consider disaster risk in all aspects of their planning. In 2015, Florida adopted SB 1094, "An act relating to the peril of flood." The law included several requirements to ensure that local governments take account of the future flood risk from storm surge and sea-level rise in their comprehensive planning process. Among other things, state law now explicitly includes sea-level rise as one of the sources of flood risk that local governments must address in the redevelopment portion of their comprehensive plans (in Fla. Stat. 163.3178(2)(f)(1)). The law also requires local governments to develop principles, strategies and engineering solutions to reduce the flood risk from storm surge, as well as high-tide events and related impacts of sea-level rise. It also encourages use of best practices to reduce losses due to flooding and requires local building codes to be at least as stringent as the state flood-resistant construction standards.

On the other end of the continent, California has likewise required local governments to address adaptation and resilience when they next revise their

hazard mitigation or general plans. The law (in Government Code § 65302(g)(4)) requires a vulnerability assessment that addresses hazards, population sensitivity and ability to cope, as well as the agencies responsible for protecting health and safety. Local governments must then formulate objectives to resolve the identified vulnerabilities and specify feasible implementation measures. Florida and California's requirements for local planning provide a critical mechanism to induce local jurisdictions to face the difficult challenges ahead.

State and federal governments should provide funding for poorer communities

Given how far climate change has progressed, adaptation will not come cheap. Poor residents could well be unable to afford new building requirements, and poorer municipalities are unlikely to be able to help their residents or take expensive measures to protect their infrastructure. State and federal funding will be essential. Federal funding for pre-disaster hazard mitigation grants provided by FEMA is critical, and Congress should be praised for having included generous funding for these in the 2018 budget. Without state and federal support specifically targeted for low-income communities, however, existing disparities in vulnerability and impacts will only worsen. California has set aside funds — 35 percent of the revenue from its carbon cap-and-trade program — to benefit disadvantaged communities, and adaptation measures are among the purposes to which the funds can be devoted. As climate risks become increasingly evident, funding to provide low-income communities with protection or the means to retreat will be essential.

Relocation and Migration

by Maxine Burkett and David Flores

The 2017 hurricane season demonstrated the "second disaster" phenomenon. Climate-fueled storms are the first, named disaster. The second disaster is the tragedy that results from the lack of preparedness of decision-makers — at all levels — who have failed to plan in a manner consistent with the risks presented.

Perhaps few phenomena underscore that more than the post-disaster displacement and long-term relocation that climate change is increasingly inducing. While there is an infrastructure to manage post-disaster displacement and support displaced persons, its ability to effectively and equitably support individuals and communities has been lacking.

For planned, long-term relocation, the circumstances are more concerning. The United States has no coherent and coordinated regulatory approach to address the core questions facing communities that will need to relocate: *Who* is vulnerable to a crumbling coastline? *What* are the parameters for determining that a community is no longer habitable? *Where* will they go to ensure a viable relocation? And *when* are these determinations made — before or after the next devastating flood event or storm?

The absence of adequate safeguards and planning are at their most apparent in the context of displacement and relocation induced by sudden and long-term climate change-related disasters. During the closing days of the Obama administration, the White House Council on Environmental Quality attempted to coordinate several federal agencies to address larger-scale, permanent displacement and relocation of Americans — from the deltas of Louisiana to the coastal tundra of Alaska. That effort quietly died with the change in administrations in 2017. The fierce storms in the months that followed, however, are a harbinger of things to come, raising the question of whether the United States will improve its ability to withstand the first disaster and thereby avoid the second.

The Current Law and Policy Vacuum

Defining terms and context

A baseline problem for those concerned with the impact of climate change on human mobility is the absence of any law or policy framework addressing the issues. Even the terminology used can mask this problem. While the media

widely deploys the term "climate refugee," the term "refugee" has a specific legal definition that doesn't cover those migrants whose displacement might be linked to a climate-fueled disaster. These individuals have no recognized legal identity or framework to address their movement under domestic or international law.

For the most part, government officials, researchers, and community members are simply working to understand exactly how climate change will induce or influence human displacement, migration, and relocation of communities in present-day and future circumstances. While often used interchangeably, each term describes relatively distinct phenomenon.

- *Displacement* is the forced movement of people from a location due to one or several factors. These factors include climate-related and other disasters, political or armed conflict, and development.

- Human *migration* is the movement of people from one location to another for the purpose of seasonal settlement or permanent resettlement, often to obtain more desirable living conditions.

- *Relocation* is the planned process of leaving a fixed settlement for another permanent settlement, which one or several factors, including the impacts of climate change, may induce.

Each term reflects the varying triggers for movement that are either sudden-onset, including climate-related disasters such as intense hurricanes or wildfires, or slow-onset events or gradual environmental degradation such as droughts that produce water scarcity or prolonged, stifling heat. The United States is not immune to these disasters, as evidenced by communities that are currently grappling with them, from Alaska to Puerto Rico. Further, the country will have to balance the needs of internal movement of residents with those of international migrants, similarly displaced by regional and global climate disasters.

Climate-related disasters and disparate displacement

The climate signal in Hurricane Harvey was surprisingly strong, leading researchers to determine that climate change had roughly tripled the odds of a Harvey-type storm. The result was that in just over 36 hours, 9 trillion gallons of rainwater deluged the Gulf Coast of Texas, including Houston, and displaced tens of thousands.

Communities of color and low-income communities are particularly vulnerable to disaster-induced displacement. New Orleans' experience of post-Katrina displacement, unevenly experienced, is an important historical analogue. Those in vulnerable communities suffered disproportionately. More likely to rent than own their dwellings, people of color and low-income residents were vulnerable to sudden involuntary displacement via mass "blindsiding" evictions. Many New Orleanians did not even receive notice of eviction, but instead found out that their homes and housing complexes were to be shuttered, and they were to be homeless through broadcast television announcements.

Low-income residents and people of color are also more likely to suffer displacement both before and after disasters due to high levels of background pollution. In 2017, families in Port Arthur, Texas, a Gulf Coast city about 90 miles east of Houston, were already familiar with the experience of voluntary displacement, having requested removal and relocation because of air pollution from oil refineries and petrochemical plants that saturate their communities. These industrial facilities are often located within yards of homes, schools, and playgrounds. Harvey flooded neighborhoods saddled with toxic Superfund sites, overflowing sewers, garbage, and landfills that accompany the region's outsized petrochemical footprint, forcing further displacement.

Harvey flooded neighborhoods saddled with toxic Superfund sites, overflowing sewers, garbage, and landfills that accompany the region's outsized petrochemical footprint.

The impacts on people of color were and continue to be disproportionately negative. The root causes of these impacts are deep and persistent — from the discriminatory policies that funneled or redlined African Americans and Latinos, for example, into marginal conditions to the disparate effects of the rebuilding process on these communities.

In Houston, the absence of zoning restrictions helped to concentrate pollution in the communities with the highest concentration of Latino and African American families. Years before Harvey made landfall, environmental justice scholars Robert Bullard and Beverly Wright noted: "[t]his no-zoning policy has allowed for a somewhat erratic land-use pattern in the city... Houston's black neighborhoods were unofficially 'zoned' for garbage."

Additionally, the infrastructure for stormwater and flood management itself is aged and dilapidated, thus deepening the racially divided exposure to climate risks and increased likelihood of displacement. And storm damage is not limited to infrastructure but can also introduce loss of employment, as well as the further devastating losses of friends, family, community, and culture.

Any systematic effort to address the problem of climate displacement must begin with strengthening planning and environmental, health and safety protections, to enhance community resilience while also enhancing social equity. This is particularly important during rebuilding and recovery, when cities like Houston run the risk of "rebuilding gentrification," in which the "greening up" of a city for resilience results in permanent displacement for those who have lived in neighborhoods for generations. [8]

The Stafford Act and post-disaster displacement

As noted above, we lack adequate regulatory tools or a systematic approach to the challenges presented by climate-induced migration and planned relocation. [9] There are *ad hoc* efforts in Alaska and Louisiana currently underway; however, a coherent and comprehensive interagency, multi-scalar, and cross-sectoral approach is lacking. The primary federal responses to pre- and post-disaster displacement are grounded in the Robert T. Stafford Disaster Relief and Emergency Assistance Act (the "Stafford Act") and the National Flood Insurance Program — specifically the latter's buyout programs for repetitive loss properties.

In order to improve coordination and responsiveness of disaster preparedness and relief efforts, Congress enacted the Stafford Act . The act aims to "provide an orderly and continuing means of assistance by the Federal Government to State and local governments in carrying out their responsibilities to alleviate the suffering and damage which result from such disasters." In order to initiate federal support, the president must make a major disaster declaration. A "major disaster" is

> [a]ny natural catastrophe (including any hurricane, tornado, storm, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, or drought), or, regardless of cause, any fire, flood, or explosion, in any part of the United States, which in the determination of the President causes damage of sufficient severity and magnitude to warrant major disaster assistance under this chapter to supplement the efforts and available resources of States, local governments, and disaster relief organizations in alleviating the damage, loss, hardship, or suffering caused thereby.

A major disaster declaration is made only when "response is beyond the capabilities of the State and the affected local governments and that Federal assistance is necessary."

Once the president has issued a major disaster declaration, the Federal Emergency Management Agency (FEMA) can provide federal assistance to state recovery efforts from its Disaster Relief Fund. The Stafford Act also authorizes FEMA to grant money to individuals and households through its Individuals and Households Program (IHP). Under Section 408, the agency can provide "financial assistance, and if necessary, direct services, to individuals and households in the State who, as a direct result of a major disaster, have necessary expenses and serious needs" they are otherwise unable to meet. The types of assistance provided include funds for temporary housing, repair of a primary residence, replacement of a residence and permanent or semi-permanent housing, and financial assistance for other needs, such as medical care and personal property. While the Stafford Act relief and grant programs can support temporarily displaced people and recovery efforts for homeowners and renters, the homeless, undocumented residents, certain aliens, and other displaced people are ineligible for these programs or otherwise face insurmountable barriers to successfully navigating the grant process.

There are aspects of the construction and execution of the Stafford Act that hamper its ability to adequately assist those displaced by disaster. After Hurricane Sandy, the law's prohibition against duplication of benefits had the effect of "punishing" homeowners who proactively rebuilt their homes. Administrative errors disadvantaged recipients of support through FEMA's IHP, [10] resulting in thousands of claims stuck in the review process years after the storm. The failings of the disaster recovery system — from the Stafford Act generally and FEMA's IHP to the NFIP program — resulted in Sandy homeowners "selling their homes back to the State, losing their homes to foreclosure or short sale, leaving their 'nest egg' or draining every bank and retirement account with the hopes of rebuilding what is now a distant memory." [11]

Lawmakers from both parties, the insurance industry, planning experts, and advocates have critiqued the kinds of massive, though still inadequate, congressional aid packages passed in the wake of disasters as socializing flood risks in ways that encourage people to live in flood-prone areas. There is, however, skepticism that reform measures will meaningfully reduce

congressional willingness to fund post-disaster, despite the signals it sends regarding the dangers of living along the ever-more-risky coasts.

Resisting relocation

While there is no comprehensive federal approach for planned relocation — and seemingly none forthcoming — a range of legal mechanisms to support retreat from the coastlines are available, including local governments' "downzoning" flood-prone areas, creating setbacks or buffers, and securing easements from developers in exchange for necessary permits. In addition, the federal Coastal Zone Management Act affirmatively encourages states to develop comprehensive coastal management programs in order to access federal funds. The Disaster Mitigation Act (DMA) provides a similar carrot. They are generally unsuccessful, however, evinced by the fact that the population of coastal counties is still growing.

In a few instances, however, municipal governments have taken advantage of federal grant and loan programs that permit acquisition of new property for relocations. FEMA and the Department of Housing and Urban Development's Community Development Block Grants (CDBG) aid rebuilding by providing grants to state and local governments for post-disaster buyout programs. Buyouts target homes and buildings affected by disasters, especially floods, and provide owners with payments that are greater than what they could obtain in the real estate market.

Such buyout programs may be a viable strategy for coordinated relocation of communities. In order to facilitate successful community relocations, buyout programs can adopt strategies and policies that encourage owners to sell properties in groups and also purchase new homes and businesses in areas designated for relocation. However, the strategy has significant limitations. The municipality must match federal funding through the Flood Mitigation and Community Development Block Grant programs. Furthermore, funds available *before* serious disasters are limited, blunting proactive, preventative relocation efforts. In addition, many communities, including some threatened Alaska Native villages facing relocation, are ineligible for these funds because they lack incorporated municipal governments.

Even if viable, buyout for relocation would likely be met with significant resistance. After Katrina, New Orleans weathered a political firestorm on the issue of permanent displacement (effectively post-disaster relocation) that would result from city government plans to prevent rebuilding. Storm and flood

victims' reactions to disasters are typically characterized by an intense and unwavering desire to rebuild. Alexander B. Lemann described this emotion as "one of the key obstacles standing in the way of the road to more resilient housing patterns, and yet it typically is ignored by the community of scholars who study disaster law and policy." This is particularly significant for low-income and of-color communities that shoulder a disproportionate concentration of disaster risk. Lemann explains:

> For many of its victims, Hurricane Katrina demonstrated that the government regarded them as not worthy of protection. Although rebuilding in these cases might be a way of countering this message, a prohibition on rebuilding only makes that message stronger. By trying to enforce retreat in the wake of floods that have disparate impacts, governments appear to signal their desire to rid themselves of particular groups entirely. Rebuilding thus becomes an act of political resistance, a way of avoiding being erased and getting even with wealthier, drier communities.

Following Katrina, 75 percent of respondents said that low-lying areas of the city destroyed by the hurricane should be rebuilt, 95 percent said that the region's levee system should be rebuilt and strengthened and 86 percent of respondents said they were planning to remain in the area. This heavy support for rebuilding reflects a deeper critique of the post-disaster planning. Residents accused the mayor of "taking part in a 'Katrina cleansing"' and attacked the plan for trying to "turn 'black people's neighborhoods into white people's parks.'" Lemann also describes the "long history of tension arising over post-disaster efforts to increase resiliency that are perceived as thinly veiled forms of social engineering."

Rebuilding, in many respects, may be "an act of defiance against an unfair and discriminatory system." Resettlement, or moving communities as a whole rather than individuals piecemeal, is one way in which the value of a community may be respected while advancing the protection needs at the coasts. However, resettlement is fraught with many difficulties and may not be scalable given the sheer number of vulnerable coastal residents. As the examples of resettlement multiply, it is crucial that we learn from the experiences so they can be improved upon and serve as one of a basket of responses.

Learning from Success: The Martín Peña Canal Case Study

Many efforts to respond to flooding are led by some combination of local, state, and federal governments, and, as a result, residents feel disempowered. Opportunities and resources to mitigate exposure through structural practices or by migrating from flood-prone areas through buyouts, for example, are largely dependent on government funded and managed programs. However, in Puerto Rico, a unique experiment in community-led governance and land ownership shows promise for promoting equitable adaptation to flooding risks by empowering communities to implement management of retreat and migration of their own design.

In 1932, the San Ciprian hurricane devastated portions of Puerto Rico. Masses of impoverished, rural Puerto Ricans, already induced to migrate from growing economic depression, moved to the marginal and unimproved low-lying mangrove forests on the outskirts of urban San Juan. Over time, eight distinct enclaves formed around the Martín Peña Canal. These migrants built their homes in areas lacking public infrastructure, especially sewage systems, and on land they did not own. To the dismay of government planners and private developers, the Martín Peña Canal residents have persevered in one of Puerto Rico's most severely impoverished, flood-vulnerable, and polluted communities, owing to the strength of the community, its grassroots leadership, and the necessity and resulting expertise of responding to and recovering from recurring disasters.

Government and public pressure to remediate flooding and pollution has grown steadily in the past 20 years. A dredging project first proposed in 2002 to remedy the situation called for displacing some 2,300 households. In response to this proposal, the organized Martín Peña Canal communities advocated for a comprehensive development and land use plan that would provide equitable and community-led relocation of impacted households. In accordance with the demands of community members and their allies, the Legislative Assembly of Puerto Rico passed the Martín Peña Canal Special Planning District Integrated Development Act (Puerto Rico Law 489) in 2004.

In part, the law chartered the Martín Peña Canal Community Land Trust to hold title to some 200 acres of previously public land on which new affordable housing would be built to relocate flood-prone households away from the impact of the dredging project. The land trust would also secure the tenancy of hundreds of existing homes. The land trust would generate revenue from

affordable rental fees with which to finance construction of additional homes. To date, the Land Trust has used this land to relocate 600 households away from flood-prone areas into quality, affordable housing. However, additional investment and construction of homes is necessary to successfully relocate all of the households that are flood-prone and will be potentially displaced by the dredging project.

Eighty-five years after San Ciprian, Hurricane Maria tore a similar path across the island. In Martín Peña Canal, some 1,000 homes were damaged or destroyed and 100 households were left homeless. Unlike the hundreds of thousands of Puerto Ricans who have left the island in the months following Maria, the low-income or elderly residents of Martín Peña are more typical of those immobilized, rather than displaced, by disaster. However, the residents of Martin Pena Canal have been lauded for their disaster resilience, built through years of hard fought and community-led revitalization and adaptation.

Due to earlier government investments in community development and self-organization, community-based organizations and grassroots networks were already prepared for and familiar with flood relief and recovery and able to both operate without federal resources and coordinate with state and federal agencies. The Land Trust and other community-led organizations have demonstrated an ability to fundraise, implement, and coordinate recovery projects, including replacement of damaged roofs. As a collective for land ownership and housing management, the Land Trust is also suited to represent the interests of residents and advocate on their behalf to access federal funding to support housing recovery. In response to damage from Maria, the community organizations have established sophisticated partnerships with professional organizations in engineering and architecture to develop storm-resistant housing designs to weather future storms.

What Should Be Done?

State and local governments need to fill the climate change adaptation and disaster resilience vacuum left by the current presidential administration

With the federal government largely ignoring climate change and thereby contributing to the second disaster, it is more important than ever for states, counties, and tribes to take action. The post-Sandy recovery effort revealed and underscored the necessity of integrated services to assist with recovery. Though the federal government must be a partner for long-term success in disaster resilience and recovery efforts, the current administration cannot be relied upon

to provide leadership in this area. In fact, proposed deregulation and budget cuts will further limit the already constrained opportunities to support community resilience in general and for the most vulnerable specifically.

State governments also have a vital role to play in supporting land acquisition and governance strategies for relocation. With access to public lands and detailed land use data, states can work with their communities to help identify opportunities to acquire land for relocations. States also have the authority to create or adapt laws, policies, and programs for land use that can serve the land acquisition and governance needs of relocation communities. States can budget their agency resources to provide communities with technical assistance for site feasibility studies and development. And while federal funding opportunities may support only one portion of the community relocation process, states can direct sustaining support to communities to ensure the long-term success of resettlement.

Nonprofit organizations can connect individuals and communities with the resources they need to adapt, relocate, and proactively plan for future disasters

Nonprofit organizations play a special role in supporting relocating communities with assistance in land acquisition and governance. Nonprofit partners are uniquely situated to provide *pro bono* legal and technical assistance to exclusively serve the best interests of communities. Nonprofits can assist by providing unbiased legal and technical interpretation of options for land acquisition and governance for relocation. Nonprofit organizations also provide critical support in building capacity within communities and in empowering and amplifying the voices of community leaders to advocate for access to public and private resources for relocation.

Over the long-term, the federal government must reclaim its leadership role in climate change adaptation and proactive resiliency efforts

The relocation opportunities presented by the federal government must be enhanced over the long term. Adequate funding for and forward-looking design of federal technical assistance and grant- and loan-making programs will greatly assist communities challenged by climate-related displacement and relocation. The federal government needs to provide adequately funded and procedurally appropriate opportunities to acquire and manage land for relocation.

Energy Infrastructure: Beyond Repair

by Joseph P. Tomain

We have seen the pictures before. A man and his dog, both wet and disheveled, gliding down the middle of a residential street in a rowboat past downed power lines. As they drift, they pass the tops of cars parked at the curb, immobile. As they drift further, they see a woman and child standing on the roof of a darkened house, dazed. Is the child missing a toy or maybe a pet? Is the woman missing a spouse or maybe a child?

Now consider sitting at home watching the game or a movie or the news when the TV flickers and then goes out, along with all the other lights and electrical appliances in your home. After a minute or two your concern rises as you reach for your cell phone and call the power company. Your local utility responds that they are aware of the problem and that repairs will be made within the hour.

Now consider the fate of the island of Puerto Rico after Hurricane Maria. Six months after the hurricane, people are still without power. Maria initially left 3.4 million U.S. citizens without electricity, and it became known as the *apagón,* or super blackout. As a result of the *apagón*, schools, homes, and businesses were damaged or destroyed; safe water was hard to come by; unreliable and dangerous diesel fuel generators were called into use; food and money were in short supply; and a risky, and sometimes fatal, strain was placed on the health care system. The death toll for the disaster has been estimated at over 4,600 fatalities, even though the official government death toll still stood at just 64 nearly a year later.

There is something additionally disturbing about these pictures. Not only do they cover a range of risks to health and life, not to mention ordinary creature comforts, they are occurring faster and with more devastating consequences than we have experienced in the past. Consider some recent facts:

- In August 2003, tree branches caused the largest power blackout in North America, affecting 50 million people at a cost estimated upwards of $10 billion. [12]

- In August 2005, Hurricane Katrina hit the Gulf of Mexico and devastated 400 miles of coastline, destroyed the electric grid, and caused more than 1,500 fatalities and more than $40 billion of insured losses.

- In August 2011, Hurricane Irene left 9 million customers on the East Coast without power and caused approximately 48 deaths and more than $15 billion in losses.

- In June 2012, a powerful windstorm in the Midwest and mid-Atlantic left 4 million people without electricity. Some were without power for several days, others for several weeks.

- In October 2012, Superstorm Sandy left more than 10 million customers in 24 East Coast states without power, causing losses of more than $50 billion.

- In August 2017, Hurricane Harvey struck the Gulf Coast, causing $125 billion in damages, impacting 13 million people, and causing at least 88 deaths.

These varied stories and statistics share one commonality: The electric grid failed. The consequences — ranging from inconvenience to the loss of life — underscore the importance of this product. Electricity is not a convenience; it is a necessity. Electricity is not simply an input to economic growth; it is essential to daily life.

In the face of power outages, what do we do and what *should* we do?

What We Do

In the face of a power outage, consumers all do as noted above: We call the power company and hope for a quick fix. The power company, in turn and in fact, prepares for that call. Utilities regularly plan for such emergencies and conduct exercises and drills in anticipation of such outages. Indeed, utility websites assure customers that they continually plan and are prepared for such events. Of course, power outages, particularly those due to extreme weather events, do not fall exclusively within any single utility's territory. Consequently, regional responses are necessary to address grid failures.

Prior to Superstorm Sandy, and recognizing the need for regional cooperation, the Edison Electric Institute (EEI), a trade association representing investor-owned utilities, helped facilitate Regional Mutual Assistance Groups (RMAGs), a voluntary program among electric companies in a region to coordinate emergency responses. The RMAGs were organized expressly for the purpose of responding to outages by coordinating logistics and personnel in order to restore the grid. RMAGs were tasked with identifying the necessary skills, equipment, and materials needed to rebuild powerlines, replace damaged poles, and restore power to customers.

Sandy was a catalyzing disaster. Its geographic scope, its magnitude, the millions of customers affected, and its multibillion-dollar costs alerted utilities and their trade associations that existing regional responses were insufficient to address a national response event (NRE). Thus, after the storm, EEI reorganized the RMAG program by (1) consolidating some of the smaller programs; (2) enhancing and formalizing commitments in anticipation of national outages; (3) and developing guidelines for responding to NREs.

Recently, another study regarding responses to national-level events that produce outages made additional recommendations including the following: (1) Utilities should have contracts or memoranda of understanding in place with manufacturers for essential personnel and materials; (2) Memoranda of understanding should be in place among federal, state, and local governments as well as law enforcement agents, outlining responsibilities prior to, during, and after such events; (3) Utilities and government response coordinators should share their response plans; and (4) The public and private sectors should work to develop better forecasting tools and more accurate data.

The electric grid, one of the greatest engineering achievements of the 20th century, has aged and is in need of a multi-trillion dollar investment.

Assuming, for the moment, that each of these responses, including those of the federal government, are successful, notice that all respond to one challenge — repair the grid. This fix addresses the immediate problem. However, the better question for us to address is whether grid repair is enough, or must we go beyond it?

The Grid

The electric grid, sometimes referred to as the most complicated machine ever invented or one of the greatest engineering achievements of the 20th century, is essential for the delivery of electricity. Nevertheless, the grid has aged, and there is a strong consensus that it is in need of a multi-trillion dollar investment. The question, however, is: Will upgrades and improvements be enough?

Grid modernization is insufficient to protect all consumers, and particularly low-income consumers who suffer from energy poverty. Energy poverty is defined as "the inability of households to afford energy services for adequate heating and cooling resulting in uncomfortable indoor temperatures, material deprivation, and accumulated utility debt." If catastrophic losses are occasioned by catastrophic events and by the fact that millions of Americans are connected to the grid, then another response that goes beyond grid repair is needed. In part, that broader response is to transform the grid by making it "smarter" and

by requiring it to deliver different energy products and services. And, moving beyond the smart grid, the entire electric system — from production through delivery and consumption — must be reimagined and designed for an ongoing transition to a clean energy future.

The grid can be made "smarter" through technological improvements that provide two-way communications among various producers and customers; that make greater use of information and communication technologies to send more accurate price signals and set more accurate rates; that can balance inputs from variable energy sources such as solar and wind; and, perhaps most importantly, can manage an array of distributed energy resources (DER) such as rooftop solar power, wind power, and microgrids.

More notably, as the electricity landscape changes and as new technologies come onto the market, customers can generate all or some of their own power; they can then disconnect from the grid in whole or in part; and energy markets can be decentralized. The smart grid, then, becomes not only emblematic of a changing electricity industry, it is emblematic of a major transformation of our energy economy from a centralized, traditional, fossil-fuel reliant economy to a decentralized clean energy economy.

During the Obama administration, federal efforts to modernize the energy sector included planning for a clean energy transition. The government acknowledged the direct connection between energy production, distribution, consumption, and disposal, and the environmental consequences at each of those stages of the fuel cycle. Additionally, growing awareness of the dangers and risks of climate change became part of federal energy planning through such initiatives as signing the Paris Climate Agreement; enacting the Clean Power Plan; developing a Climate Action Plan; and funding clean energy research and development through the American Recovery and Reinvestment Act (the 2009 stimulus bill), among other activities. The Trump administration has reversed each of these initiatives.

Despite President Trump's animus toward clean energy in favor of traditional fossil fuels, there are positive signs. When enacting the 2018 omnibus budget bill, Congress rejected many of the administration's most drastic proposed cuts to environmental and clean energy programming and, in several instances, added money to those programs. Additionally, over the last four decades, a strong policy consensus has formed in favor of a clean energy transition and,

although federal leadership would be welcomed, the transition proceeds apace as state, regional, and local levels of government pick up the slack. [13]

Traditionally, U.S. energy policy has been large-scale, capital-intensive, and highly centralized. The current electric grid fits neatly into that model. Further, the traditional model has heavily relied on fossil fuels and nuclear power. Until a decade ago, those resources constituted over 95 percent of our energy production, with renewable resources accounting for the rest. Within the last decade, renewable resources and energy efficiency account for approximately 10 percent of our energy profile, as the cost of generating electricity from wind and solar decline and approach grid parity.

A clean energy economy is structured differently from the traditional model. A clean energy economy reduces the scale of energy production and distribution and brings energy services and products closer to the consumer. In short, the energy economy becomes more decentralized, more labor-intensive, and relies increasingly on a more aggressive use of clean renewable energy resources and, perhaps more importantly, an increased use of energy efficiencies. Significantly, this new decentralized energy paradigm should reduce the damages and injuries caused by major power outages by restricting the scope of harm.

As the country moves to a clean energy future, there are three essential components for a successful transition: technological innovation, aligned business practices, and supportive government regulations must be coordinated for the transition to succeed. Sound clean energy policy reveals a coordination among these elements, thus promising a dramatic change in the fundamental model of U.S. energy policy.

What Should Be Done?

Technological innovation

Currently, the generation and distribution of electricity is a one-way system and depends on an interstate infrastructure, as well as complicated regional energy markets. Large central power stations generate electricity and sell that electricity to markets for delivery to consumers who then pay their electricity bills. Because electricity cannot be stored in large amounts, supply and demand must be balanced; otherwise, the grid risks collapse. The balancing is done through complex computer programming on regional and statewide bases.

Today, however, new technologies such as rooftop solar, microgrids, smart meters, advanced metering infrastructure, electric vehicles, and improved

electric storage are dramatic alternatives to the model of large-scale power plants. These technologies enable consumers to exercise greater control over their energy use and, simultaneously, alert power producers to the need for them to pay more attention to consumer demand.

As a result of innovative communications and information technologies, the electricity system of the future will be a two-way system in which improved information about energy prices and energy services flows between producers and consumers. As consumers have the increasing ability to generate their own electricity, to the extent that they generate more electricity than they use, they then become electricity producers themselves. Furthermore, to the extent that customers are able to store electricity, such as through electric vehicle batteries, they also provide storage and balancing services to the utility. In short, utility customers now become "prosumers"; not only do they buy electricity from the utility, they can also sell their own electricity to that utility as well as provide the utility with other valuable services, including increased reliability and improved cybersecurity.

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The utility of the future

In addition to technological innovation, privately owned utilities are facing significant challenges. Not only are consumers exercising more control over their energy choices, demand for electricity has flattened notably. Consequently, the traditional "grand bargain" between utilities and their regulators must be, and is being, re-examined. Traditionally, utilities were encouraged to invest as much capital as possible in generation and equipment because they were rewarded based upon the amount of electricity they sold. The problem with such a model is that once demand has been satisfied, then additional capital investment necessarily raises the price of electricity. High electricity prices, in fact, resulted when the electric industry reached a technological plateau over 40 years ago.

The market was not unaware of increasing electric prices, and it responded by revealing the fact that cheaper, non-utility electricity was available. Aided by the federal Public Utility Regulatory Policies Act, small power producers were able to generate electricity cheaper than that produced by large central power stations and they needed that power to get to market. Additionally, consumers became self-generators. Consequently, as the demand for large central power plant electricity flattened, traditional utilities' revenue was at risk unless they developed new business models.

The utility of the future will no longer exist only to sell as much electricity as possible. Nor will such a utility depend on volumetric rates as their only source of revenue. Instead, the traditional electric utility will become an energy provider that, in addition to selling electricity, will sell other energy services, including demand-reducing efficiency measures. The utility of the future, for example, will set prices according to time of use, provide energy audits to encourage energy efficiency, develop new business lines with innovative energy technologies, and play more of a coordinating role between traditional utilities and an array of non-utility energy providers, ranging from individual rooftop solar owners to large-scale non-utility wind farms.

Regulatory innovation

The electricity industry was regulated for most of the 20th century based on the idea that electricity was a product in the public interest and that it should be universally available at reasonable prices. For the first two-thirds of the century, utilities were able to realize economies of scale, which meant that they could produce larger amounts of electricity at either flat or declining prices. Consequently, producers were happy because profits were reliable; consumers were happy because their energy bills were stable and often falling; and regulators were happy because there were few conflicts between consumers and producers.

In the mid-1960s, however, the utility industry had to respond to increasing electricity costs caused by economic factors such as rising energy prices and the costly, mistaken investment in nuclear power. Since that time, federal and state regulators have undertaken a number of experiments under various headings such as deregulation, restructuring, and, in some instances, reregulation. All of these experiments were driven by changes in the electric industry and the reality that traditionally structured utilities are no longer the only game in town. Instead, the electric industry is becoming more competitive as new actors, new technologies, and new industry arrangements challenge the old model. The old electric industry is becoming cleaner and more environmentally sensitive. The industry is also becoming more decentralized and more competitive.

Consequently, regulators must design a regulatory environment that can accommodate changes in the industry as it undergoes a clean energy transition. In short, regulators must:

- Rethink the regulatory compact that rewarded traditional utilities for building more plants and selling more electricity;
- Accommodate new sources of electricity from solar and wind providers as they become more cost-competitive;
- Encourage and support technological innovations;
- Promote and support energy efficiency; and
- Provide a platform for decentralized and distributed energy providers.

Currently, several states throughout the country, including California, Vermont, Hawaii, Minnesota, Maryland, and New York, are engaged in reconfiguring their electric systems. In 2015, New York launched a program known as Reforming the Energy Vision (REV), which is the most wide-ranging system reform in the country. REV was not primarily driven by environmental concerns. Instead, the New York Public Service Commission was greatly concerned about the "tidal wave of costs that will arise in the not too distant future, as aging infrastructure reaches obsolescence and will simply need replacing (at great cost and with no noticeable new value to customers)." Superstorm Sandy only highlighted those vulnerabilities.

The program is based on three basic principles: First, building a smart energy distribution platform; second, aligning utility earnings with environmental outcomes; and third, engaging consumers so that they become not only buyers but market participants, as well. The primary goal of the REV is to incorporate innovative technologies that can be used to support greater grid flexibility, paying particular attention to adopting expanded use of intermittent technologies such as wind power, solar power, and other DERs.

REV, then, is a multi-year process with several moving parts, including redesigning the regulatory scheme for electricity regulation, encouraging the development of new business models; performing requisite cost-benefit analyses, and reconfiguring how electric utility revenue is generated. The hope is that a redesigned electricity system will deliver new business opportunities for producers and consumers, as well as create a low-carbon economy that can reliably deliver electricity to disadvantaged populations

Realigned energy distribution

The current paradigm of electricity distribution reliant on a centralized grid means that severe weather that damages the grid will have wide ranging consequences. Thus, to the extent that customers can reconfigure local electricity markets, they can reduce the scope of harm caused by such an event. Ideally, an individual building or home might rely on its own backup generation in the event of a power outage. Such a fix, however, can be prohibitively expensive for most families. Another response, then, is for a consumer to become part of a smaller energy system, such as a microgrid or a community choice aggregation program.

A microgrid has been defined as "an integrated energy system consisting of distributed energy generating resources, both conventional ... and renewable generation such as solar roof panels ... and energy storage, operating as a single, autonomous grid either in parallel to or islanded from the existing power grid." The definition is noteworthy for two reasons. First, a microgrid is a small-scale system of electricity distribution and storage. Second, microgrids are a form of distributed generation (DG) or DER. The small-scale nature of such resources can be used to generate electricity at a local level rather than depend upon large-scale interstate generation and distribution. Microgrids can be used by neighborhoods, universities, shopping centers, military installations, and any other array of consumers. [14] Thus, in the event of a natural disaster, harm can be localized and reduced.

Another form of decentralization is known as community choice aggregation. Through such a program, cities, counties, and other government entities can aggregate individual electricity consumers within a defined area for the purpose of providing electricity and other related services. Several states, including California, Illinois, Ohio, Massachusetts, and New York, allow local governments to procure their own electricity supplies through this device. In most instances, incumbent electric utilities continue to operate in those areas, at least for backup purposes.

Advocates for community choice argue that it is more democratic because it provides more local control. They also argue that community aggregation increases consumer choice and also provides local economic development benefits. To the extent that such aggregation relies on renewable resources and energy efficiency, aggregation is also more environmentally friendly. Further, to the extent that reduced energy consumption is a goal of such aggregation,

consumers should enjoy greater rate stability and lower prices. Additionally, local control might also be more sensitive to low-income users.

The municipal electric utility

As a final example, many cities in the United States are considering the municipalization of their electric utilities. Today, privately owned utilities account for approximately 70 percent of the electricity that is produced and delivered in the United States. The remainder is produced and delivered by utilities owned by the federal government such as the TVA, by rural electric cooperatives, or by municipalities. In an era of decentralization, some cities, most notably Boulder, Colorado, are reconsidering municipal ownership.

The advantages perceived for municipally owned electric utilities are: local control over prices and resources, potentially reduced prices resulting from the nonprofit status of the ownership, more responsive management services, and keeping jobs within the community. Municipally owned power can differ from community aggregation by being completely disconnected from the grid.

Since 2011, Boulder has been exploring the idea of becoming a municipal electric utility completely disconnected form the local utility, Xcel Energy. The main impetus for municipalization is to achieve a goal of 100 percent clean energy and an 80 percent reduction in carbon emissions by 2050. In other words, municipalization empowers the community to set goals, such as environmental protection and energy independence, other than the traditional utility goal of maximizing electricity sales

Before a successful transition to municipal electricity can occur, numerous steps must be taken, including the creation of a business plan, modeling and forecasting for future energy demand and reliability, and analyses of environmental and climate effects, as well as municipal financing. Approval for the separation was granted to Boulder by the Colorado Public Utility Commission in September 2017 with multiple conditions. The city estimates that it will cost approximately $110 million to separate from the grid and acquire the necessary materials. As of this writing, there is no specific date for the separation, and final voter approval is required before it goes into effect. The decision timeline is based upon the above-referenced reports, including the monetary commitment of a minimum of $16.5 million to begin to acquire and build essential assets.

Moves in this direction are important because centralization of the electricity system has resulted in higher-cost electricity, an aging infrastructure, catastrophic losses in the event of damage, and an outdated business model designed to promote consumption rather than efficiency or environmental protection. As a result, the demand for centralized electricity has decreased substantially while many non-utility providers seek to enter the market. Climate change and environmental harms add other complexities to the energy sector. Fortunately, technological, business, and regulatory trends support the transition and promise a better, cleaner energy future as the country moves beyond repairing the grid to constructing a safer and more resilient electricity sector. [15]

To facilitate this transition to a clean economy, regulators can take three steps. First, subsidization of large central power stations must come to an end. Second, utilities, with the support of appropriate regulations, must invest in a smart grid that is capable of managing clean and variable energy resources such as solar and wind. Third, and perhaps most importantly, utilities and other entrepreneurs, as well as federal and state regulators, must continue to invest in and explore options for power storage. Together, these efforts will further a much-needed energy transition.

Stormwater Infrastructure and Management: Unsafe for Human Contact

by Evan Isaacson

As millions of Americans in Houston and throughout Florida and Puerto Rico are acutely aware, the most dangerous aspect of a hurricane is the water. In Houston, the 50 inches of water that fell over the course of a few days broke records and overwhelmed the city's flood control system. In Florida, Hurricane Irma's storm surge ravaged coastal communities hundreds of miles up and down the Atlantic and Gulf coasts. And in Puerto Rico, Hurricane Maria dumped more than two feet of rain in some areas, generating floodwaters more than a dozen feet high in low-lying areas throughout the island.

The pathway of waterborne devastation was different for each of these storms. But as the winds faded and the waters receded, one thing that remained in each of these locations was hazardous and even lethal contaminants left behind by the floodwaters. Thousands of Americans returned to their homes and communities, wading through inches, even feet, of water that carried anything and everything that you would expect to find in sewers, basements, parking lots, and factory floors.

A top official at one of the several trade associations that lobby for municipal water and sewer systems told Bloomberg News in the wake of Irma that "there's no sewer system in the world that can be built that's completely leak proof." Behind this specious statement, however, lie some important questions that must be asked about the state of America's water infrastructure and our preparedness for a new and more extreme reality.

Costly Lessons

The combined severity of Hurricanes Harvey, Irma, and Maria may be unprecedented, but the type of damage caused by these storms is, of course, nothing new. Just one year prior, when Hurricanes Hermine and Matthew briefly passed over and around Florida, respectively, the storms caused more than 250 million gallons of sewage to overflow and spill into nearby communities.

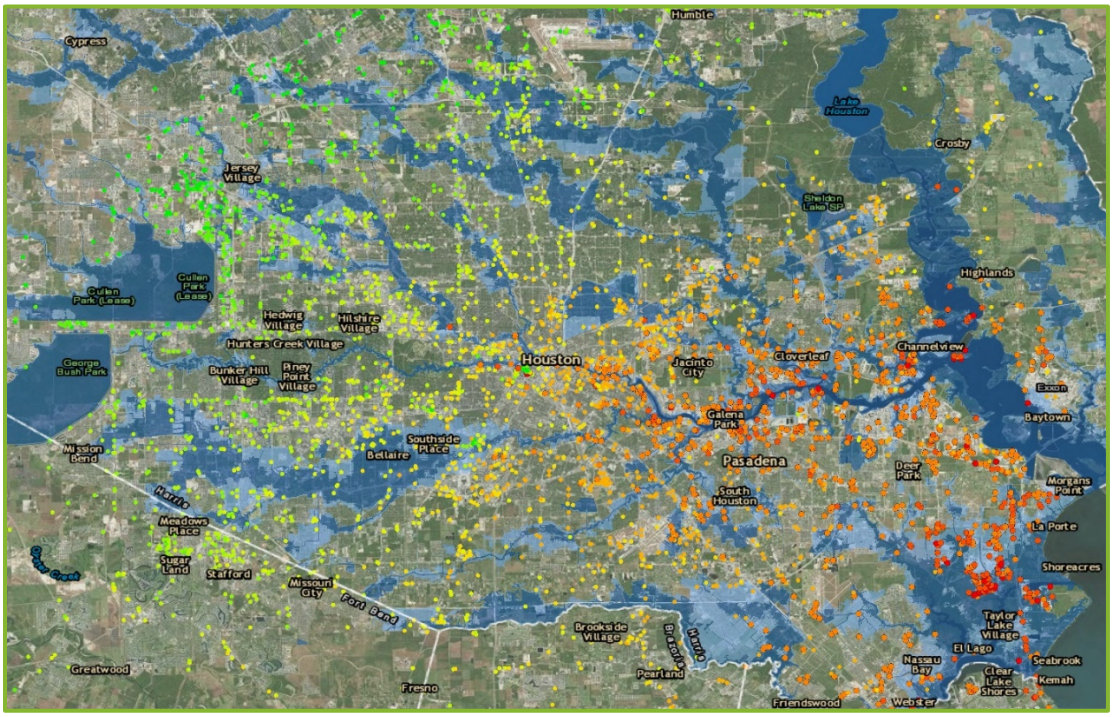
It may take some time to estimate the total volume of sewage overflows in Florida more recently caused by Irma, but more than 100 spills or releases were reported to the state by local governments across Florida in just the first several days following the storm. A geospatial analysis of EPA data combined with

federal estimates of the extent of Irma's storm surge shows that major wastewater treatment plants from Tampa to Naples on the Gulf Coast and from Miami to Daytona Beach on the Atlantic Coast may have all experienced coastal flooding during the storm.

The map on the left shows the extent of coastal inundation caused by Hurricane Irma as estimated by NOAA, while on the right is a smaller scale map of the Naples-Ft. Myers metropolitan area showing major wastewater facility dischargers, such as large sewage treatment plants. In both maps, light blue areas represent inland inundation from the storm, while darker blue areas are inundation of intertidal zones and estuarine wetlands. Light green squares on the right are all major wastewater facilities, while larger red squares are sewage treatment plants located in areas projected to have been inundated during Irma's storm surge.

While researchers and the insurance industry continue to tally up the damage from the 2017 hurricanes, it is imperative that our elected leaders and agency officials take heed of the lessons from these recent catastrophic storms. Just because a perfectly leak-proof sewage system cannot be designed does not mean we can ignore the awful condition of our nation's water and sewer infrastructure or defer action on creating more resilient urban landscapes. Nor can we afford to continue pretending that our flood zone maps accurately reflect the true nature of flood risk. If these maps had any basis in reality, then

perhaps the majority of Houston estimated to have flooded during Hurricane Harvey would have been shown to be located within the 500-year floodplain.



Many EPA-regulated industrial sites in the Houston area containing toxic pollution are located in FEMA flood zones, while many other low-lying facilities are not included in these zones drawn by government officials. These EPA-regulated sites are coded by elevation in the above map, with dots ranging from dark green at the highest elevation to red at the lowest elevation. Dark blue areas show the 100-year flood zone and light blue show the 500-year flood zone. As the map reveals, many low lying sites at risk of inundation are not in a FEMA flood zone.

Regulatory Progress on Flood Control: A Slow Drip

The history of flood control in the United States is generally a history of growing federal involvement and increasingly large engineering projects to keep water from spilling over riverbanks, reservoirs, and levees. Within cities, storm sewer systems eventually emerged as an engineering solution to channel the ever greater volumes of rainwater down the drains and into the nearest waterway, as quickly as possible.

For obvious reasons, this practice of using urban streams and rivers as an extension of the local sewer system implicated the Clean Water Act. One of the

most consequential and underappreciated points in America's history of flood mitigation is the 1987 amendments to the Clean Water Act. The Environmental Protection Agency was required by that law to establish a new permitting program for municipal separate storm sewer systems ("MS4s") to reduce the impact of discharges from urban outfalls into the waterways around which most Americans lived and from which many draw their drinking water.

We are now more than 45 years from the enactment of the Clean Water Act and more than 30 years from the 1987 amendments, but, with some exceptions, our storm sewers look much the same today as they did in the middle of the twentieth century. There are three primary reasons for this stagnant pace of regulatory development.

More than 45 years since the enactment of the Clean Water Act, our storm sewers look much the same today as they did in the middle of the twentieth century.

The first reason is that EPA and the state permit writers have largely dragged their heels in developing new permits and moving cities, counties, and other municipal MS4 permit holders from one five-year permit cycle to the next. A second and closely related reason is that our cities and counties have been successful in marshalling their considerable political clout to lobby permit writers to maintain this sluggish pace, thereby delaying or avoiding costs associated with the modernization of MS4 permits and incorporation of the latest technologies into local permit implementation plans. Finally, in fairness to cities, states, and EPA, the menu of options for addressing pollution carried by rainwater has historically been much more limited and slower to develop than the "end of pipe" technologies that have long existed for most wastewater dischargers regulated under the Clean Water Act.

But over the last decade, the range of technological options for improving the quality of polluted urban runoff and reducing the quantity of storm and flood waters has improved substantially. The evolution of this technological progress and increasing availability of new solutions is reflected in a series of guidance documents developed primarily by EPA's Office of Water.

Initially, EPA gave cities and states a pass when it came to addressing the pervasive problem of stormwater pollution through stormwater permits. But throughout the first and second terms of the Obama administration, EPA's guidance evolved in a way that pushed state and local governments to consider addressing the problems caused by the impervious surfaces that drain to the MS4 system. EPA accomplished this by drawing a clear and direct link between stormwater permit pollution limits and the pollution reductions called for in watershed restoration plans required by the Clean Water Act, known as Total

Maximum Daily Load (TMDL) requirements. This shift occurred largely because the development of "green infrastructure" techniques and technologies had expanded dramatically, opening new opportunities for MS4 permit holders to help meet water quality goals.

The problem, however, is that technological innovation and EPA's evolving expectations for the way in which cities should be controlling polluted runoff and floodwaters have both outpaced the enforceable standards and pollution limits that state permit writers have actually placed in the MS4 permits. If permit writers made sure that each MS4 permit was renewed on schedule every five years, they could ensure that each and every new permit reflected the latest technologies and their ever-decreasing costs. That is how the 1987 Clean Water Act amendments were supposed to work in order to ensure cities and counties were protecting their communities to the "maximum extent practicable" from urban runoff.

Pointing Fingers Rather than Taking Action

Unfortunately, many state and local governments and water utilities, and the variety of associations that represent them, have employed the same tactics as any private sector or industrial trade group to combat regulatory progress. Local governments and utilities have sued, lobbied, and advocated to halt the modernization of permits and regulations. Accelerating water infrastructure upgrades to protect water quality and public health, it seems, is a far less important goal for many local leaders than paring back municipal budgets. This fiscally conservative, if shortsighted, strategy to deal with environmental, public health, and flood control challenges is typically the one most appealing to local officials, at least until catastrophe — generally foreseeable — strikes.

In the weeks after Harvey hit, Houston Mayor Sylvester Turner publicly feuded with Texas Governor Greg Abbott over the need for Texas to open up its "Rainy Day" fund to help rebuild the city after yet another major weather event hit the city. Turner also urged the state to begin investing in a series of multi-billion-dollar projects to hurricane-proof the city and the area's oil and gas infrastructure. The mayor rightly pointed out that the $12 billion cost to build this new system of dikes, levees, and a massive storm gate would be a tiny fraction of the cost to rebuild the areas of Houston that would be devastated again and again after each new hurricane.

But it's hard to propose an utterly sensible investment like this, or even to point the finger at the state, when you don't have clean hands yourself. Houston's famous resistance to city planning and its permissive stance toward development and the vast resulting expanses of pavement have been important contributors in causing repeated and regular flooding in the city, amplifying the impact of hurricanes. Being one of the most vulnerable cities in the nation to tropical storms and recurrent flooding should be reason enough to switch to smarter growth policies or to join other cities investing in green infrastructure and more climate-resilient urban landscapes.

The Storms' Toxic Legacy

In one of the most important postmortems of Hurricane Katrina, the National Academy of Engineering published an article examining the toxic contaminants stirred up by the hurricane. The authors noted that the greatest threat of exposure to hazardous substances came not from the obvious stew of chemicals seen swirling in the floodwaters, but from what evaporated or settled out from those floodwaters.

Long after a hurricane passes, the sediments it unearths and disseminates are left coating the ground in and around homes and businesses in the affected area. And these toxic sediments also settle between the cracks of our regulatory system, with no obvious regulatory tools for controlling their impact.

These chemicals may have been regulated at one point under our pesticide, insecticide, or solid waste disposal laws, or they may have seeped through the ground of a regulated hazardous waste site. The substances may have been deemed pollutants of concern as part of an impaired waterway restoration plan under the Clean Water Act. Or perhaps the sediments blew from a stockpile or site that had failed to properly undertake dust control or good housekeeping practices required under one of several environmental laws.

Regardless of their journey through the regulatory process, once toxin-laden sediments are mobilized in a storm they simply become part of the ambient environment ready to imperil the health of local communities, wildlife, or ecosystems the next time the wind blows or water runs its course. Clearly, current regulatory standards are lacking and insufficient to protect storm-ravaged communities from the storm's long-lasting impacts.

What Should Be Done?

Local Jurisdictions Should Invest in Green Infrastructure

The significant recent advances in technological development for controlling polluted urban runoff provide more than just a powerful new tool for MS4 permit writers looking to devise new stormwater permit conditions and meet lower pollution limits. As it turns out, this developing suite of stormwater best management practices, which collectively fall within the label of "green infrastructure," are helpful for achieving a variety of community goals beyond stormwater management.

Municipal officials around the United States are beginning to invest in green infrastructure for many different reasons. Some cities and counties are greening their urban landscapes to tackle stormwater pollution, reduce sewer overflows, improve urban air quality, reduce energy use, beautify streetscapes, increase property values, or provide recreational amenities for residents, all while providing a boost to the local economy with construction and engineering jobs that cannot be exported.

Going forward, jurisdictions will likely continue to invest heavily in green infrastructure for a powerful new benefit: resilience in the face of a changing climate. Because many green infrastructure projects are designed to soak up rainfall, they end up converting the city's impermeable layer of pavement into a spongier landscape. Bioswales, green roofs, and sidewalk trees allow urban neighborhoods to handle the more frequent and intense storms that are now battering communities around the United States. In conjunction with coastline protection projects and large-scale "gray infrastructure" approaches to controlling runoff, green infrastructure programs have become an important tool in the climate adaptation toolbox for progressive urban jurisdictions.

Of course, cash-strapped cities are often reluctant to commit substantial resources in their capital budgets to address pollution from stormwater or sewer overflows, or to adapt to a slowly changing climate. Any one of the benefits afforded by green infrastructure alone may not be enough to convince elected officials to make the politically difficult choice of raising or diverting public funds from other pressing needs. In fact, all of these reasons together may not even be enough motivation to convince some short-sighted elected officials either.

The federal government should prod local government on green infrastructure

However, the important point is that these jurisdictions should not really have much of a choice in this matter. Congress made the decision three decades ago that the Clean Water Act necessitates a local response to water quality concerns from polluted urban runoff. Local programs to control stormwater became a federal concern (and a state concern due to delegations of permitting authority) through the MS4 permit requirement. Thus, as stormwater control technologies advance, state and federal permit writers should be nudging local governments towards greening their urban environment and infrastructure as permit renewals continuously modernize the MS4 permit.

Some large urban jurisdictions have been subject to federal consent decrees to eliminate sewer overflows under Long Term Control Plans. As green infrastructure projects have become an accepted method for reducing sewer system infiltration, these Long Term Control Plans provide another regulatory or enforcement tool to push urban jurisdictions to unlock the myriad benefits of greening urban areas.

Thus, EPA and state environment agencies play an important role in moving local governments and utilities forward in creating a more resilient urban environment. We need EPA to hold states accountable for modernizing MS4 permits through timely renewals and strict oversight of permit conditions. An active and vigorous EPA can and should push urban jurisdictions to commit to investing in green infrastructure. Cities and counties that do so will fare better in handling future hurricanes than Houston, Jacksonville, or San Juan did in 2017.

Worker Health and Disaster

by Katie Tracy

Lachlan Brain, a 22-year-old electrical lineman from Tennessee, traveled to Houston following Hurricane Harvey to help with the relief effort, working for T&D Solutions, a company that specializes in maintaining and repairing power lines and related equipment. While working inside a bucket truck on August 25, 2017, Brain leaned across an electrical line, came into contact with a live wire, and was electrocuted. Line personnel and first responders attempted to revive him unsuccessfully, and Brain died.

According to reports, Brain had been eager to travel to Texas for the relief effort. He had become an electrical lineman just a year before, after attending training courses at the Southeast Lineman Training Center in Trenton, Georgia. He felt that working as an electrical lineman was his true calling, according to his step grandfather Philip J. Lorenz III, a staff writer for the *Herald Chronicle*. At the time of Brain's death, Lorenz was reporting on the relief effort after Harvey, never expecting he would be covering the death of his grandson.

The federal Occupational Safety and Health Administration (OSHA) conducted an inspection of T&D Solutions following Brain's death and cited the company for three serious violations: failing to properly train employees on safety hazards related to their job, allowing an untrained person to operate an aerial lift, and failing to protect workers from incidental exposure to energized wires. The agency proposed a fine of $38,302 for the violations. T&D Solutions appealed, and the case formally settled. In the settlement, OSHA agreed to downgrade the original citations to one serious and one other-than-serious violation and a reduced fine of $25,868.

The story of Brain's death is all too common. Workers helping to pick up the pieces after major weather disasters encounter a multitude of safety and health hazards as they begin rebuilding damaged homes and structures, restoring electricity and clean water, clearing fallen debris, cleaning up hazardous waste, repairing infrastructure, and reopening schools and public services.

In the aftermath of a major hurricane or other weather disaster, displaced residents struggle to get back to their way of life, and some never do. Residents who were working before a storm may be out of work temporarily or indefinitely, depending on whether their employer reopens. Even if they have a

job to return to or find new work with the restoration effort, they may be living in temporary housing many miles from their place of work. And public transportation for getting to and from work may be unreliable or unavailable. Parents may not have access to childcare if schools do not reopen. Because of these barriers to employment, many resident survivors have trouble securing work.

Individuals who do find work with the restoration effort often encounter severe exploitation. Contractors looking for cheap labor bring in teams of immigrant workers, some documented and some undocumented, to perform cleanup and restoration work. Although the contractors often promise to provide food and housing and pay decent wages, many workers find that when they get to the storm-ravaged towns, they are forced to live in the damaged buildings they were hired to repair or are out on the streets and are severely underpaid or not paid at all. Further, they often do not receive proper training or protective gear for dangerous tasks. Undocumented immigrants rightfully fear police and immigration raids, as local police and employers regularly threaten them with deportation if they raise health and safety concerns, report wage theft to authorities, or seek out government assistance of any kind.

Many workers, when they get to the storm-ravaged towns, are forced to live in the damaged buildings they were hired to repair or are out on the streets and are severely underpaid or not paid at all.

The following examines the way that subpar efforts to protect workers from unsafe and unhealthy working conditions effectively support, even exacerbate, the exploitative practices of companies seeking to make a quick buck off the devastation. Recommendations for protecting the health and safety of recovery workers follow.

Overview of Regulatory Framework

OSHA's organization and authority

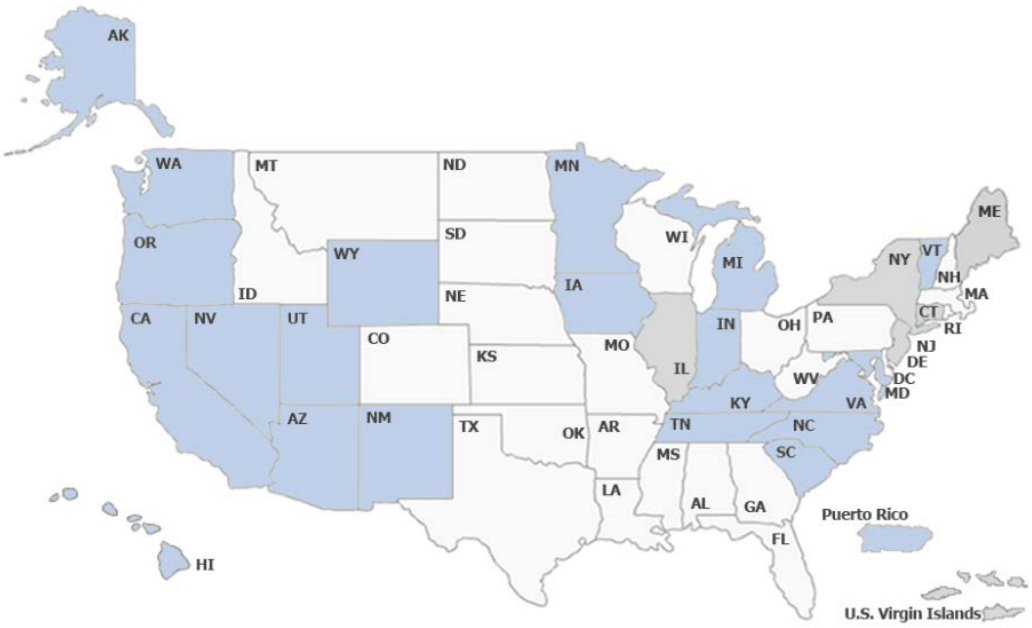
The Occupational Safety and Health Act of 1970 (OSH Act) was enacted "[t]o assure so far as possible every working man and woman in the Nation safe and healthful working conditions...." The federal Occupational Safety and Health Administration (OSHA) is the primary agency tasked with implementing the law. The Act authorizes OSHA to enforce the law by promulgating hazard-specific health and safety standards, conducting inspections, and issuing citations to employers found to be in violation of those standards.

OSHA may also issue citations to employers who violate the Act's "general duty" clause, which imposes a general duty on employers to protect workers from a recognized hazard that places them at risk of death or serious physical

injury. This authority allows OSHA to issue citations against employers even when the agency has not adopted a hazard-specific standard; however, the agency must meet a higher burden of proof for general duty clause citations.

Federal OSHA's standards serve as minimum requirements that apply to most private-sector workplaces throughout the country. Federal OSHA covers private sector workers in roughly half the states. The other states and territories have chosen to operate their own occupational safety and health programs under federally approved OSH plans in lieu of federal OSHA. At present, 22 states and one U.S. territory operate under an approved plan that covers both private and public sectors. Another five states and one U.S. territory operate under an OSH plan covering the public sector only, with federal OSHA maintaining jurisdiction over the private sector. Public sector workers in federal OSHA states are not covered by the Act.

Figure 1: State Plan State Map



Because neither Texas nor Florida operate state plans, federal OSHA was the primary cop on the beat when Hurricanes Harvey and Irma hit in 2017. Puerto Rico, on the other hand, does operate its own OSH plan, and PR OSHA is the primary worker health and safety agency in the territory. After Hurricane Maria hit Puerto Rico in 2017, PR OSHA was the primary OSH authority overseeing the recovery effort, although federal OSHA did provide some assistance with an emergency response team. In the U.S. Virgin Islands, federal OSHA maintains

jurisdiction over the private sector, and the Virgin Islands Department of Labor, Division of Occupational Safety and Health (VI DOSH) covers public sector workers through its own OSH plan.

Minimal protections from common hazards encountered during post-disaster response operations

Workers involved in cleanup activities after a major storm will face a host of hazards, including ever-present hazards (e.g., falls or electrical hazards) amplified by the storm as well as new hazards that emerge as a result of the damage (e.g., floodwaters and debris). After flood conditions have subsided, workers will likely confront mold while repairing inundated buildings. Workers also may be exposed to contaminated floodwaters and toxic chemicals while performing a variety of cleanup tasks. Workers responsible for restarting operations at oil refineries and chemical plants may be put in harm's way from uncontrolled releases of toxic chemicals during start-up. Some workers tasked with cleanup around Superfund sites will be exposed to hazardous substances. And workers may be exposed to dangerous substances like asbestos when cleaning up damaged homes and buildings.

For some of the hazards workers encounter, federal OSHA has promulgated standards that specify the protections that employers must provide in certain situations, such as when workers are restoring electrical power, handling hazardous materials, or entering into confined spaces. OSHA also maintains a website dedicated to hurricane preparedness and response, which offers a host of resources for protecting workers. Additionally, in states and territories that operate their own OSH programs, such as Puerto Rico, the state or territory may institute standards and programs that provide more protections than those of federal OSHA.

Yet workers in post-disaster areas commonly complain that employers do not provide them with even basic protective gear such as gloves, goggles, or masks to shield them from direct contact with mold, toxic chemicals, dead animals, and a host of other hazards. Many employers fail to provide their workers not only with essential safety equipment, but also with the proper training necessary to prevent injuries and illnesses. Further, employers may fire workers who get injured or sick, leaving them stranded without housing, food, and any source of income.

In the aftermath of storms, journalists and advocates frequently report on these abusive work practices. Thus, it would seem intuitive that OSHA would establish

a major presence in post-disaster areas and ramp up its enforcement to protect workers from the many widely known abuses by employers after disasters strike. Such strong enforcement is critical because it levels the playing field, prevents unscrupulous employers from exploiting workers (or worse — injuring or killing them), and sends a message to all employers that the rule of law will be upheld. But in fact, it is common in the wake of a storm for OSHA to cease its programmed enforcement actions — i.e., planned inspections of worksites focused on finding violations and correcting them *before* an injury, illness, or death occurs. After Hurricanes Katrina and Rita hit Louisiana, for example, the federal government suspended programmed enforcement in many parishes affected by the storm. Likewise, following Hurricane Harvey at the end of August 2017, OSHA did not resume programmed enforcement until October 10, 2017.

OSHA claims that suspending programmed enforcement allows it to respond faster to immediate hazards reported by workers. In theory, OSHA can transfer the resources set aside for programmed enforcement to other unprogrammed enforcement (i.e., inspections in response to imminent hazards, fatalities and catastrophes, complaints, and referrals) and compliance assistance activities. Both are particularly important in the wake of a disaster because imminent hazards, fatalities, complaints, and referrals would theoretically increase when cleanup, recovery, and rebuilding activities are underway, as the tasks associated with these activities are some of the most dangerous workers perform any time of year, even when there is much less pressure to get the work done. The pressure to work fast and cheap is much higher in the wake of a storm. Compliance assistance is also important after a storm because a Certified Safety and Health Official (CSHO) can likely conduct multiple briefings or consultations in the time it takes to do a single inspection. But inspections can have longer and broader impacts if they result in citations and penalties.

Ideally, the appropriate response to a storm for OSHA is to continue programmed enforcement while ramping up unprogrammed enforcement and compliance assistance activities. OSHA should not need to reallocate its resources at a time when workers need the agency most. Yet because of limited agency resources, as discussed more below, the agency must make tough choices on how best to fulfill its mission. At this time, OSHA's resource constraints are such that programmed inspections are already infrequent. For example, in July and August 2017, OSHA only performed 12 planned inspections of worksites located in Houston. If OSHA finds that suspending programmed

enforcement will provide it the resources it needs to increase its presence in a storm-ravaged area, then this may be the right policy decision at this time. However, OSHA needs to reevaluate this decision often, rather than suspending enforcement after a storm as a matter of practice.

Furthermore, a decision by OSHA to suspend programmed enforcement should correspond to an increase in unprogrammed enforcement and compliance assistance activities. Enforcement data in Houston after Hurricane Harvey paints a different picture, however. In September 2017, the month after Harvey during which OSHA had suspended programmed enforcement, the agency not only dropped its planned inspections, but also dropped inspections in response to worker complaints and referrals.

Figure 1: Harvey's Impact on OSHA Inspections

Month (2017)	Planned Inspections	Complaint Inspections	Referral Inspections
July	7	11	2
August	5	8	4
September	0	1	1
October	0	4	5
November	7	5	6

Source: DOL Enforcement Data, https://enforcedata.dol.gov/homePage.php (as of July 23, 2018)

Given the news accounts and individual reports of exploitative practices happening during this period, it seems likely that the agency would receive more complaints and referrals after a storm. It is possible, however, that given the length of time it takes to file a complaint, workers simply did not file them or waited to file them. Another possibility is that OSHA received complaints and referrals, but chose to respond with compliance assistance activities rather than through the complaint/referral process as it normally would. But as noted above, citations and penalties can be more effective over the longer term than compliance assistance.

In fact, even with OSHA's focus on compliance assistance after Hurricane Harvey, many workers involved in the response effort reported that their employers did not provide proper training or personal protective equipment.

According to a survey of 361 day-laborers, in the weeks following Hurricane Harvey, 85 percent of undocumented immigrants who helped with post-disaster recovery efforts reported not having received *any* training for the worksites they were entering. In the same survey, 87 percent of respondents said they were not informed about risks related to unsafe buildings; 85 percent that they had not been informed about mold risks or risks of working in contaminated water; and 83 percent that they had not received training before working with fallen trees or electrical lines.

Although some workers buy their own gloves, glasses, and masks in an attempt to protect themselves, many cannot afford to do so. Further, because of a lack of affordable housing, many do not have access to clean water for showers, and are thus forced to go days without washing off the toxic dirt and chemicals. After Hurricane Katrina, workers in New Orleans reported that they had to "clean[] toxic mud left over from the hurricane without being provided with any protective gear or safety instructions," and that they "complained about headaches and nausea" but their employers "d[id] not provide medical treatment for them."

The resulting exposures can be deadly. For example, on October 16, 2017, roughly two months after Hurricane Harvey made landfall, a 31-year-old father and carpenter, Josue Zurita, died from a flesh-eating bacterial infection known as necrotizing fasciitis. Zurita was a native of Oaxaca, Mexico but had been living in Galveston, Texas, for 12 years to work and send money home to support his wife and daughter. In the wake of Harvey, Zurita was helping repair damaged homes in Harris and Galveston counties. He went to the hospital on October 10, 2017, after a wound on his upper left arm became infected. Health officials said he most likely contracted the deadly bacterial infection when hurricane debris or floodwater came into contact with the open wound. Zurita died six days after receiving the diagnosis.

In addition to OSHA's lax enforcement of existing worker protections, the agency also has not fulfilled its mandate to ensure safe and healthful working conditions for workers by adopting new standards to address remaining hazards. The agency routinely declines to exercise its authority to promulgate standards for well-known hazards, many of which arise during post-disaster response operations, such as infectious diseases, heat stress, or ergonomic stressors. As a result, if the agency does cite violations of these well-recognized hazards, it has to do so under the General Duty Clause, which imposes a higher

In addition to lax enforcement of existing protections, OSHA has not fulfilled its mandate by adopting new standards to address remaining hazards.

burden of proof on the agency than that for citing violations of hazard-specific standards. Because of the higher burden of proof, the agency rarely cites employers for exposing workers to such hazards using its general duty clause authority.

For example, exposure to high heat and hot environments is a widely recognized occupational hazard for outdoor and indoor workers that can cause injuries and illnesses ranging from cramps to death. Heat stress is particularly relevant in post-hurricane response because many of the areas struck by hurricanes experience tropical and subtropical climates, including Houston, and because hurricanes strike during the hottest months of the year. The National Institute for Occupational Safety and Health recommended that OSHA adopt an occupational heat standard in 1972, 1986, and again in 2016, but the agency has repeatedly declined to do so. Instead, OSHA relies on the general duty clause to cite employers for failing to protect workers from heat stress. This is clearly insufficient. For example, in FY 2012, the Labor Department reported 31 worker fatalities and 4,120 heat-related injuries and illnesses, but OSHA only cited employers in 17 cases.

The problems workers face only worsen if they suffer an on-the-job injury or become ill. Workers' compensation coverage often fails to help workers recover. In OSHA's 2015 report, *Adding Inequality to Injury: The Costs of Failing to Protect Workers on the Job*, the agency found that employers regularly evade their responsibility for worker health and safety and that state workers' compensation systems do not provide injured workers the full benefits promised in exchange for giving up their right to file suit against their employers. According to figures cited in the report, "[w]orkers' compensation payments cover only a small fraction (about 21 percent) of lost wages and medical costs of work injuries and illnesses," and "workers, their families, and their private health insurance pay for nearly 63 percent of these costs, with taxpayers shouldering the remaining 16 percent."

Workers employed by companies that have "opted out" of their states' workers' compensation system — including many in Texas — may have even less chance of recovering benefits under employers' "alternative benefits plans." According to *ProPublica*, these alternative plans "provide lower and fewer payments, make it more difficult to qualify for benefits, control access to doctors and limit independent appeals of benefits decisions." When there is not workers' compensation coverage, a worker may have the option to sue their employer

directly in court, but this is not always possible since it is sometimes difficult for workers injured during recovery operations to determine the appropriate employer to sue.

Weak enforcement efforts and resource shortfalls for the long term

Even without the resource challenges inevitably created by hurricanes and other weather disasters, OSHA has limited enforcement resources. Former OSHA officials and state level advocates in regions affected by the storm agree that OSHA's limited budget is the primary obstacle to the agency's ability to conduct effective post-disaster operations. As Jordan Barab, the former deputy assistant secretary of OSHA during the Obama-era has written: "Paying for hotels, travel, per diem, etc. is expensive for an agency already strapped for resources to conduct its normal business. Additional materials have to be printed, meetings are held, training is conducted. In addition, taking enforcement and compliance assistance staff from other understaffed areas around the country leaves OSHA offices even more understaffed, leaving workers there more vulnerable."

According to the AFL-CIO's annual "Death on the Job" report, during Fiscal Year 2017, OSHA only had 1,821 inspectors (764 federal and 1,057 state) to inspect the 9 million worksites covered by the OSH Act. A mere 85 OSHA inspectors are assigned to the entire state of Texas, where there are almost 12 million workers. That is, there is only one inspector for every 138,891 workers, compared to the national average of one inspector per 77,908 workers and the International Labor Organization's recommended benchmark of one inspector per 10,000 workers. Florida is even worse, with a mere 59 inspectors to cover nearly 8.5 million workers across the state, equivalent to one inspector for every 140,836 workers.

OSHA's budget is too small for the agency to set aside funds to send officials to assist with disaster response efforts. So it has to use its normal operating budget, eating into regular enforcement.

Despite the limited number of inspectors in any particular state at a given time and the need to form a larger presence in storm-affected areas, OSHA's budget is still too small for the agency to set aside funds to send officials to assist with disaster response efforts. That means OSHA has to use its normal operating budget to respond, eating into its regular enforcement activities across the nation. Although the Federal Emergency Management Association (FEMA) can provide supplemental assistance, the state must make a formal request and contribute 25 percent of the funding, which many states are unwilling to do.

Despite the urgent, and glaringly apparent, need for additional resources, President Trump's proposed budget requests cut OSHA's budget and many critical programs. Additionally, Trump proposed to eliminate the U.S. Chemical

Safety Board, an agency that investigates explosions of chemical plants, and to eliminate the Susan Harwood Training Grant Program, which gives grants to nongovernmental organizations and worker centers that provide workers with health and safety training and assist with relief and recovery efforts in the wake of storms.

What Should Be Done?

The health, safety, and economic harms that disasters impart on individuals and the communities in which they work and live will only continue to escalate as extreme weather events and natural disasters become more frequent and severe due to climate change. Each storm brings with it lessons to be learned and applied to the next storm's response and recovery effort.

To protect workers from these unjust harms as they rebuild communities, strong and equitable protections must be in place and well enforced across all levels of government.

Provide adequate resources to OSHA

The solution begins with ensuring that agencies like the Department of Labor and OSHA have the budget and staff resources they need to adopt and enforce strong safeguards to protect workers from hazards — whether safety and health hazards or deplorable wage and hour policies that leave workers without fair pay for a hard day's work, or in some cases, with no pay at all. Congress and the President must provide funding to these agencies so they can fulfill their missions.

Develop and implement protective standards before the next crisis

OSHA must promulgate stronger standards to address known and emerging risks, such as for heat stress, ergonomics, and infectious diseases and ensure engineering controls and other measures are in place long before a disaster strikes. Standards are much more effective than relying solely on compliance assistance and spotty enforcement operations after the fact. With standards in place, employers and workers would already be familiar with the hazards and trained on prevention when the next storm hits.

Institute collaborative policies and programs with equity in mind

Federal regulatory agencies must institute policies and practices and implement strong standards with inclusion and equity in mind so that the costs of responding to weather disasters are not borne by the most vulnerable members of society. Agencies should collaborate with each other and with state and local

bodies ahead of disasters so that the response is well coordinated. Displaced residents cannot get back to work or help with the recovery effort unless they have stable temporary housing and access to clean water, food, medical care, reliable and consistent transportation, and schools for their children. Federal agencies also should exercise greater oversight of contractors and subcontractors who promise jobs and do not follow through with stable housing or work and who underpay or never pay the workers. Instead of ramping up Immigration and Customs Enforcement efforts, the federal government should ramp up efforts of agencies whose mission is to protect the workers who are rebuilding after the storm.

Enforce Standards in the wake of disaster

Instead of suspending enforcement in the immediate aftermath of a storm, OSHA should continue programmed enforcement while ramping up unplanned inspections and compliance assistance. Suspending planned inspections allows established companies to operate in violation of health and safety rules at a time workers need protections most. Although OSHA's limited budget currently requires the agency to make tough choices on where to allocate its resources, it should not suspend enforcement as a matter of practice. Rather, the agency should reevaluate its policy decisions often in light of best practices for responding to a storm, and determine the budget needs required for it to carry out those practices. Further, a decision by OSHA to suspend programmed enforcement should correspond to an increase in unprogrammed enforcement and compliance assistance activities, and that data should be made available to the public in an accessible location on the agency's website.

Target hazards common to disaster recovery operations

OSHA should also institute emphasis programs to target hazards commonly associated with response and recovery operations. For example, after Superstorm Sandy hit the northeastern U.S. in 2012, OSHA Region II implemented a local emphasis program targeting worker health and safety issues related to the response and recovery effort in all New York and New Jersey counties affected by the storm. OSHA should assess the effectiveness of this emphasis program and consider implementing similar programs in storm-affected areas in the future.

In state plan states, go beyond OSHA

At the state level and local level, there is also opportunity for progress. When federal OSHA has not adopted a standard to address a specific hazard, state

legislatures and agencies may impose their own standards. For example, a state could adopt standards to protect workers from heat stress, infectious diseases, or ergonomic risks. Even when a federal standard is in place, states and territories that operate their own OSH plans can impose stronger protections than provided by the federal minimums. Equally important, state OSH agencies must ramp up enforcement to ensure employers follow the standards. OSH agencies need to be prepared to mobilize after a storm, and must work with local worker centers, unions, and the public to ensure workers are heard and their concerns addressed.

Emergency Waiver of Health, Safety, and Environmental Rules

by Victor Flatt

On August 23, 2017, Texas Governor Greg Abbott declared a state of emergency as Hurricane Harvey approached the Texas Coast. That state of emergency was ultimately expanded to 60 counties in Texas. Emergency declarations in Texas (as in many states and for the federal government) allow the governor to unilaterally suspend specific rules and regulations if they are expected to hinder disaster recovery. The Texas Commission on Environmental Quality (TCEQ) asked Governor Abbott to suspend dozens of environmental rules on August 28, 2017, as Harvey was continuing to pummel Houston and the Texas Gulf Coast area.

The waiver request specified air quality rules related to emission "upset" events as well as monitoring and releases of unpermitted Volatile Organic Compounds. Predictably, the request indicated that it was necessary because of immediate Harvey impacts and hurricane recovery efforts. Specifically, the TCEQ's request noted that compliance with air and water pollution laws:

> may not be possible as a result of hurricane effects, such as lightning, floods, fires, wind or wind-blown damage, and power outages[;] and suspending these requirements would remove a potential impediment to disaster response.

However, these waivers were still in place months after the direct effects of the hurricane (lightning, floods, fires, wind, or wind-blown damage) had passed and electricity had been restored. Most of the Gulf Coast region, including Harris County, had dried out within four weeks, and electricity was mostly restored within days.

Abbott did not end the emergency waiver of these air and water pollution rules until April 6, 2018, more than eight months after Hurricane Harvey hit. During this time, investigators from news organizations and NGOs discovered more than 100 toxic releases. According to the *Houston Chronicle*, "In all, reporters catalogued more than 100 Harvey-related toxic releases — on land, in water and air. Most were never publicized."

While some of these incidents happened during Hurricane Harvey itself, many others may have happened afterwards. "The public will probably never know

the extent of what happened to the environment after Harvey," said Rock Owens, supervising environmental attorney for Harris County. "But the individual companies of course know."

Given that vulnerable communities bear a disproportionate burden of proximity to industrial facilities, it is virtually certain that they will bear the brunt of releases that occur as a result of such waivers during and after disasters. When a disaster such as an unprecedented flooding occurs in Houston, an industrial behemoth, the results are particularly bad. According to *Time*:

> Any mass flooding event brings with it contaminants through the water, but Houston's industrial sector — heavy on oil, gas and chemicals — has experts particularly worried that extreme flooding has created conditions that could lead to environmental disaster.

After the suspension of environmental, health, and safety requirements around Houston, many companies handled their releases internally because reporting requirements were also suspended.

After the suspension of environmental, health, and safety requirements around Houston, many companies handled their releases internally because reporting requirements were also suspended. The lesson here is that when environmental, health, and safety rules are waived during disasters, we may not only harm public health, but we may also never know the extent of that harm. The failure to report may be more problematic than the emission waivers themselves.

The experience with Harvey in Houston is by no means unique. Environmental rules have been suspended during and after other disasters. After Superstorm Sandy flooded New York City's subway system, the floodwaters were discharged into open water as quickly as possible without permitting niceties.

Government Overreach on Emergency Waivers

During a disaster, immediate actions may be necessary to preserve life and public health as well as property. In such cases, government wants to have a system in place to alleviate legal liability when actions are designed to deal with a greater harm. Most disaster waiver laws use language that seems to limit waivers to times of emergency or crisis. However, depending on the state, how an emergency is defined, and when and how the emergency waivers are lifted, and depending on how EPA accommodates state waivers, locations can technically still be in emergency situations long after the possibility has passed that enforcement of environmental and health laws might complicate rescue and recovery efforts after a disaster.

As seen in Texas after Hurricane Harvey, the disaster was exploited to suspend environmental rules and reporting far longer than it should have been.

What Should Be Done?

There must be limits to emergency suspensions of environmental, health, and safety rules. Regulated parties should have as much incentive as possible to prepare for and control emission releases during disasters, and data concerning releases should continue to be gathered to the extent possible. Especially given that such disasters are likely to continue increasing in the face of climate change, careful planning is paramount.

We suggest three regulatory alterations to the current scheme:

Require a Plan for Emergencies

The EPA should require facilities permitted under the Clean Air Act, Clean Water Act, and Resource Conservation and Recovery Act to plan for how they can best control emissions or avoid upset emissions when a disaster or emergency occurs. This could be accomplished with a new rulemaking or guidance. Because emergency exceptions to these statutes are discretionary, a rule could be created to detail how they could be limited.

The Emergency Planning and Community Right to Know Act (EPCRA) already provides a template for the parameters of such a requirement. EPCRA requires the EPA administrator to compile a list of hazardous substances and amounts which, when present at a facility, trigger the requirement to plan for an emergency. All permitted CAA, CWA, and/or RCRA sources could be required to plan for an emergency or disaster, or a subset of major sources could be so required (above a certain threshold amount of emissions). The Clean Air Act already has a definition of a major source for both conventional and hazardous air pollutants. Limiting or starting with the subset of largest sources also would make the review of such plans more manageable by the implementing agency. Each source subject to the emergency and disaster planning could be charged an amount to cover the additional personnel necessary for timely review of such plans. EPA could start a process of basic implementing regulations to determine minimum requirements for such plans.

Keep Records of Emissions and Report to the Public

While record-keeping requirements could still be included in the suspension of rules during a disaster, the EPA should promulgate a rule that specifies that to the extent possible, all permitted entities should keep records of releases during

disaster suspensions and continue to report these to their permitting agency (whether the state or the federal government). Except during the most intense phase of an emergency, when personnel may need to be evacuated or power is not available, most companies are already keeping track of their releases. There is no reason they should not be required to report what they know.

Institute Federal Review of Waivers

A new EPA regulation or guidance should clarify that a state's emergency suspension of environmental rules for federally based requirements (such as RCRA, CERCLA, the CWA, and CAA) will be subject to federal agency review, and that it should automatically sunset after two weeks. It can be reinstated, but it should go through review at that time. As noted in the example above, though the TCEQ's request for emergency waivers was purportedly based on active hurricane impacts or loss of power, the waiver continued for more than eight months after the initial danger.

Hazardous Waste and Disaster Preparation

by Victor Flatt and Joel A. Mintz

According to the *Houston Chronicle*, there were more than 100 releases releases of hazardous substances into land, air, and water during and after Hurricane Harvey. At least one dozen of the Superfund sites listed in or near Houston were flooded during the storm.

On September 3, 2017, the U.S. Environmental Protection Agency (EPA) acknowledged breaches at 13 area Superfund sites. Later in September, the EPA reported that it had recovered 517 containers of potentially toxic hazardous waste from Superfund sites that flooded during Harvey. In its first mention of these releases on September 22, 2017, the agency provided no information as to where the materials had come from, what they were, or how hazardous they were.

More than a month after the hurricane, EPA acknowledged a serious breach at the San Jacinto Waste Pit Superfund site. According to ABC News, tests found very high levels of chemicals called dioxins at the site in Channelview. "[T]esting results released by EPA found levels at 70,000 nanograms per kilogram, more than 2,000 times the recommended level of 30 ng/kg, according to an EPA press release. The toxic chemical that leaked does not dissolve in water and could continue to spread," the network reported.

Though the San Jacinto site had not undergone final remediation, the removal action of capping the hazardous waste was supposed to prevent any releases from the site. Indeed, even after the hurricane, the parties responsible for the waste pits continued to push for "capping" as a final cleanup solution, even though the waste would be left in place.

CERCLA and RCRA Hazardous Waste Containment Has Been Hollowed Out

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), better known as Superfund, was passed in 1980 to deal with the dangers of improper disposal of hazardous waste to land and water. As its name suggests, this statute makes past and present contributors to dangerous hazardous waste sites liable for the cost of cleanup of those sites. Cleanup must be to a standard that is necessary to protect public health and the environment. To ensure that hazardous waste sites are properly dealt with, cleanup plans

under CERCLA are to prefer treatments that "permanently and significantly [reduce] the volume, toxicity, or mobility of the hazardous substances, pollutants or contaminants." The most hazardous sites are listed on the National Priorities List and are to be given first priority for federal cleanup actions.

The Resource Conservation and Recovery Act (RCRA) was added to the Solid Waste Disposal Act in 1976 to provide for adequate transportation, storage, and disposal of hazardous waste upon generation. This cradle-to-grave program — to be implemented, in part, by a system of documentation known as the "manifest system" — was designed to ensure that hazardous wastes are not released into the environment in the first place. Where they are released, they are to be properly classified and safely transported and disposed of. Generators, transporters, and treatment, storage, or disposal (TSD) facilities are required to secure permits to control their management of this hazardous waste.

The permitting process is designed to prevent the release of dangerous hazardous wastes to the environment. Even if permits are followed, if there is evidence that any hazardous waste may present an "imminent and substantial endangerment to health or the environment," the EPA administrator may order immediate action to remediate the problem.

Thus, CERCLA and RCRA either prohibit or penalize the release of any hazardous waste substances that harm human health or the environment.

Though CERCLA and RCRA are designed to control hazardous waste, over time, both laws suffer from lax enforcement. In particular, under CERCLA, the government has allowed more *in situ* remediation options, such as containing toxins rather than removing them, despite CERCLA's preference for permanent solutions. The San Jacinto site in Houston, where such a containment strategy has been pursued, has continued to spill dioxins into the San Jacinto River with every major flood. The waste pits at San Jacinto have an outsized impact on poorer communities in the area, some of whom fish the Texas ship channel for food.

It is clear that the CERCLA cleanup process as implemented, and RCRA generally, are not sufficient to ensure the containment of hazardous waste during a disaster or emergency of the scope of Hurricane Harvey. This cannot continue. Allowing uncontrolled pollution that can harm health and the

environment should not be a price imposed on communities already suffering from the ravages of disaster.

What Should Be Done?

We recommend the following:

Cleanups should focus on permanent reduction of hazards

CERCLA cleanups should be re-focused on permanent reduction of toxicity and exposure, not simply containment. The National Contingency Plan requires that CERCLA cleanup decisions be made through a specific process that has been spelled out by the EPA. What method is chosen for a cleanup is determined during the remedial investigation and the feasibility study. As the impacts from hazardous waste sites faded from the public view in the 1990s, it became more common for the EPA to allow containment as a permanent solution to hazardous waste sites, even though containment does not meet the standard of a permanent solution.

CERCLA requires that remediation actions ensure protection of human health and the environment. The law's language is clear that cost-benefit calculations in determining the choice of remedy are barred unless health and the environment are absolutely protected.

Based on the demonstrated danger from the use of capping to control hazardous wastes at the San Jacinto Waste Pits in Houston, we recommend that the EPA issue a rule or guidance that specifies that capping hazardous wastes in place will rarely be sufficient for a final cleanup record of decision, and should only be used as a last resort if other options are not available. If a capping in place is proposed as a permanent solution, all citizens within a particular radius of the site or in an exposure zone should be contacted and allowed to comment at public hearings on the solution.

EPA should be transparent

The EPA must be more transparent in its information on releases after a disaster. While during a disaster it may be impossible to investigate releases from sites, the EPA should be the first to investigate all hazardous waste sites immediately after the disaster. Actions should be taken to identify leaks and take removal actions as necessary. Clear warnings of possible exposure should be given to the public, and exposure avenues should be eliminated at the expense of the responsible parties.

Require disaster plans

RCRA-permitted facilities should be required to develop an emergency and disaster plan for minimizing as much as possible the release of hazardous substances during a disaster. The EPA should by rule or guidance create a requirement that RCRA-permitted facilities have an emergency and disaster plan in place sufficient to protect against toxic releases in disasters such as Hurricane Harvey. RCRA's emergency response section 7003 provides statutory authority for just such a rule. The Emergency Planning and Community Right to Know Act (EPCRA) is already applicable to some RCRA permitted facilities and provides a template for the parameters of such a requirement. EPCRA requires the EPA administrator to compile a list of hazardous substances and amounts, which when present at a facility trigger the requirement to plan for an emergency. All permitted RCRA sources could be required to plan for an emergency or disaster, or a subset of major sources could be so required (above a certain threshold amount of emissions). Limiting or starting with the subset of largest sources also would make the review of such plans more manageable by the implementing agency. Each source subject to the emergency and disaster planning could be charged an amount to cover the additional personnel necessary to review such plans. The EPA could start a process of basic implementing regulations to determine minimum requirements for such plans.

Prioritize RCRA enforcement

EPA and state environmental agencies should give a higher priority to enforcing the requirements of RCRA, including but not limited to the requirements pertaining to hazardous waste generators and the manifest system for cradle-to-grave waste management. RCRA enforcement has often been given an inappropriately low priority across the country. This de-emphasis should stop. The manifest system was intended to be a critical tool to track the generation and movement of hazardous wastes. In many areas, it is observed only in the breach. Far too many hazardous waste generators fail to properly test and classify their hazardous waste byproducts. Nor do they properly prepare manifest documents that direct how their hazardous wastes are to be transported and disposed of. Regulatory inattention to this situation encourages it to continue. Regulators should be provided with adequate resources and political support from elected and appointed officials to enforce RCRA effectively.

Adopt chemical spills safeguards under the Clean Water Act

The EPA should establish a rule on chemical spills under its Clean Water Act Authority for chemical spills that discharge into the Waters of the United States. In February 2016, the EPA entered into a court-ordered settlement to issue such rules after the disastrous chemical spill in West Virginia's Elk River. Now the EPA has reversed course, claiming that such rules are unnecessary. Given the major disasters that have occurred at Clean Water Act-permitted facilities, and the likelihood of increasing emergency and disaster situations, the EPA should issue recommended rules on safety and containment.

The National Environmental Policy Act and Disasters

by Joel A. Mintz

In August, 2017, Hurricanes Harvey and Irma brought widespread devastation to the southeastern United States, destroying buildings, flooding neighborhoods, and taking lives. Harvey shattered the national rainfall record for a single storm, dropping over 50 inches of rain in a 36-hour period. The Houston area suffered massive flooding, as the U.S. Army Corps of Engineers attempted to balance flooding behind strained older retention dams while releasing water to avoid dam breaches.

However, even before the unprecedented rainfall of Hurricane Harvey, severe problems had been noted at the dams. In 2016, the Army Corps noted that the dams needed repair and that a failure would be catastrophic. The federal government concluded that the dams were in critical condition in 2009. The Army Corps had multiple opportunities to evaluate the state of the dams decades before the problem reached crisis level.

In fact, despite raising the dams, rebuilding the gates, and creating various additional outflows, the Corps never did an environmental impact assessment, as required under the National Environmental Policy Act (NEPA) for federal actions that significantly affect the quality of the human environment. The Corps' last major construction on the dams in 2015 cost more than $100 million, but the project was not deemed significant enough to invoke the Environmental Impact Statement requirement that would have forced the federal and state agencies in charge of the dams to evaluate newer stresses, including development and climate change. Other critical infrastructure controlled by federal agencies has also received scant attention.

Hollowed Out Government Environmental Analysis

Adopted in 1969, NEPA was the first major environmental statute of the modern era. The law, which has been amended only modestly since its passage, makes environmental protection a part of the mandate of all federal agencies. It also requires that all national policies, regulations, and public laws be interpreted in accordance with the broad, environmentally protective policies that the statute declares. Although it was enacted well before natural disasters intensified by climate change became a focus of national and international concern, NEPA should be used by federal agencies to mitigate, respond to, and proactively adapt to such catastrophic events.

NEPA has particularly important implications in our world of disasters and climate change. Climate change is widely recognized by the scientific community as a significant factor in the intensification of hurricane events, flooding rains, sea level rise, and other actual or potential disasters.

NEPA has particularly important implications in our world of disasters and climate change.

NEPA expresses a bold purpose: "to declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; [and] to enrich the understanding of the ecological systems and natural resources important to the Nation…" To accomplish these important goals, the law states that "it is the policy of the Federal Government, in cooperation with state and local governments, and other public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic and other requirements of present and future generations of Americans." NEPA further declares that it is the "continuing responsibility of the federal government…to improve and coordinate Federal plans, functions, programs and resources to the end that the Nation may…assure for all Americans, safe, healthful, productive, and aesthetically and culturally pleasing surroundings; and attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable or unintended consequences."

It is difficult to conceive of anything more inconsistent with these statutory purposes and policies than the overwhelming damage from storms intensified by human-caused climate change that could have been mitigated by federal agencies. The federal government's continued failure to adopt clear national policies to mitigate and adapt to climate change — and the extraordinary devastation that followed Hurricanes Harvey, Irma, and Maria in 2017 — did precisely the opposite of fostering and promoting the general welfare. In fact, the horrific damage wrought by those storms created conditions of grotesque disharmony between humankind and nature. That damage also set back the social and economic requirements of residents in the storm-affected regions. Moreover, the dilatory, under-resourced, and profoundly inequitable responses of the federal government to these disasters entirely failed to fulfill our national government's statutory responsibility to ensure safe, healthful, and productive surroundings for all Americans, and to make beneficial use of the Nation's

environment without degradation, risk to health or safety, or other unintended, undesirable consequences.

NEPA's policies are more than mere grandiloquent rhetoric. They have clear legal significance. The statute directs that "to the fullest extent possible," the "policies regulations and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act."

Notably, this provision employs the directive word "shall," as opposed to the permissive word "may," to describe what must occur. Traditionally, the use of "shall" is intended as a legislative command as opposed to a mere aspiration. Moreover, the inclusion of the phrase "to the fullest extent possible" strongly suggests that Congress intended to require a wholehearted and vigorous application of the policies set forth in NEPA. The emphasis on ensuring safety for all Americans demands that agencies consider the vulnerability of affected communities if they are to ensure "safe, healthful, protective" conditions without risk to health or safety for those who already bear a disproportionate share of risks and environmental burdens.

These aspects of the statute call into serious legal question some of the Trump administration's policy priorities. One example is the recent cancellation of the National Aeronautics and Space Administration's (NASA's) Carbon Monitoring System, a $10 million program that (until very recently) undertook remote satellite and aircraft monitoring of greenhouse gas emissions and created high-resolution models of the Earth's flow of carbon. It seems impossible to rationally justify this misguided action as compliant with NEPA's stated policy of enriching the understanding of the ecological systems and natural resources important to the nation.

NEPA's language also appears to call into question the legality of the administration's decision to remove a previously effective regulatory requirement that Environmental Impact Statements (EISs) contain an analysis of the impacts of (and on) climate change with regard to proposed federal projects. The statute specifically requires all federal agencies to include "in every major federal action significantly affecting the quality of the human environment" a detailed statement on the environmental impact of the proposed action, and any "adverse environmental effects which cannot be avoided should the proposal be implemented." These statements are required to "recognize the worldwide and long-range character of environmental problems." They must also "lend appropriate support to initiatives, resolutions,

and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment."
Inclusion of climate-impact analyses in EISs clearly furthers these mandatory congressional policies. Their wholesale elimination, in sharp contrast, runs grossly afoul of them.

What Should Be Done?

Incorporate climate change analysis

The executive branch (through the Council on Environmental Quality (CEQ)) should require all agencies to incorporate climate change analysis into agency environmental impact statements.

Require systematic examination of flood control projects

CEQ should issue guidance to the U.S. Army Corps of Engineers to require them to systematically examine large-scale flood control projects to ensure that they are consistent with the stressors that are increasing because of climate-induced weather.

Reiterate that NEPA applies across the board

It bears reiteration that NEPA's policies and "action-forcing" provisions apply to all significant executive branch actions, activities, and programs. CEQ should issue guidance to clarify to federal executive branch agencies that NEPA applies to the interpretation of *all* federal policies, statutes, programs, and regulations, regardless of whether or not they are primarily intended to protect the environment and public health. Thus, for example, consistent with NEPA, the Energy Policy Act of 2005 — which is administered by the Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC) — must be interpreted by those agencies in a manner that fosters productive harmony between humankind and nature. Doing so should require adopting and implementing policies that mitigate the impacts of climate change, and such an interpretation must necessarily encourage the development of renewable sources of energy and de-emphasize the fossil-fuel based generation of electricity.

Require disaster assistance to be distributed equitably

While the Stafford Act exempts emergency disaster assistance from NEPA's EIS requirement, that act contains no exemption from NEPA's mandate that federal laws be interpreted in accordance with NEPA's policies. Thus, FEMA should be required (by executive branch directive) to distribute disaster assistance in an

equitable manner. It can be strongly contended that inequitable distribution of FEMA assistance — such as occurred when that agency provided considerably more aid to the victims of Hurricane Harvey in Texas then it did to the American citizens of Puerto Rico and the U.S. Virgin Islands after Hurricane Maria — is not consistent with NEPA's declaration that the federal government has a responsibility to ensure *for all Americans* "safe, healthful and productive surroundings." Nor does uneven administration of the Stafford Act square with NEPA's requirement that federal government entities avoid "risk to health or safety or other unavoidable and dangerous consequences" for American citizens.

Disaster in Disaster: The Emergency Planning and Community Right-to-Know Act Must Be Enforced

by Rebecca Bratspies, Sarah Lamdan, and Victor Flatt

This chapter is excerpted from a law review article that is forthcoming in U. Arkansas Law Review, titled "Taking a Page from FDA's Prescription Medicine Information Rules: Reimagining Environmental Information for Climate Change."

What Happened?

In August 2017, Hurricanes Harvey and Irma hit the southern United States in rapid succession. These massive hurricanes wrought widespread devastation — destroying buildings, flooding neighborhoods, and taking lives. Harvey shattered the national rainfall record for a single storm, dropping more than 50 inches of rain in a 36-hour period. Thousands of stranded Houstonians waded through chest-deep floodwaters. Unbeknownst to them, those residents were wading through more than just water. Many storm victims were in fact wading through a toxic stew. The same floodwaters that filled the streets had also inundated scores of industrial facilities and at least 13 of Houston's 41 Superfund sites. According to the *Houston Chronicle*, "In all, reporters cataloged more than 100 Harvey-related toxic releases — on land, in water and air. Most were never publicized."

Hurricane floodwaters notoriously carry all manner of contaminants, from pesticides and landfill waste to the contents of inundated chemical waste storage containers. The problem is particularly bad in industry-heavy cities like Houston, where floodwaters travel from industrial stockyards and production plants through the bayous, channels, and temporary waterways to residential areas, leaving toxic water and chemicals behind.

Disasters can also affect the containment of industrial byproducts and processes. Texan first responders dispatched to the Arkema chemical plant in Crosby, Texas, found this out first-hand. After the rains from Harvey abated, the plant, which manufactures organic peroxides used in plastics and rubbers, was inundated under six feet of water. Water had flooded the plant's backup generators, cutting off power to the refrigeration system that kept the plant's chemicals at a safe, non-flammable temperature. Without refrigeration, the chemicals exploded, sending 40-foot plumes of toxic chemicals into the air and floodwaters. First responders collapsed after inhaling the thick fumes. Police

officers and medical personnel were "doubled over vomiting, unable to breathe."

Deliberate choices to hide chemical hazard data sent first responders into harm's way unprepared.

Deliberate choices to hide chemical hazard data sent these first responders into harm's way unprepared. In 2014, then-Texas Attorney General Greg Abbott (now the governor) restricted access to Arkema's chemical records citing potential "terroristic activities." Abbott's decision made the records detailing the toxic chemicals stored and used in the Arkema plant almost impossible to access. As a result, the Arkema first responders faced dangerous chemical fires without critical knowledge about the hazards involved. Politically motivated choices made critical information inaccessible and placed first responders in needless jeopardy.

The Arkema disaster and exposure to all sorts of unknown contaminants highlight the importance of access to chemical data when disasters strike. Lack of information put first responders in jeopardy and leaves the general public without any warnings about possible health impacts of chemical spills.

In addition to the Arkema example, hazardous chemical releases have injured thousands of people across the country. An explosion at the Bayer CropScience plant in Institute, West Virginia, killed two employees and injured eight others, and a pipe failure at a Chevron Refinery in Richmond, California, sent 15,000 people to the hospital. We don't know how many Harvey casualties can be attributed to toxic exposure. Overall, the U.S. Chemical Safety Board, which investigates chemical accidents to protect workers, has responded to over 800 chemical release incidents since 1998.

As climate change-supercharged disasters threaten industrial infrastructure with high winds, flood waters, intense heat, wildfires, and mudslides, chemical disasters are far more likely to occur. The standard safety mechanisms we rely upon to avoid chemical explosions and releases, including temperature control and pressure devices, as well as structural retaining walls and containers, are at increased risk of failure in the face of extraordinary disaster conditions that the mechanisms were not designed to withstand.

One clear lesson that emerged from the post-mortem analysis of emergency response during Hurricane Katrina was that arming the public and first responders with adequate risk information is imperative for effective emergency preparation and response. Indeed, information access is a cornerstone of effective chemical disaster preparation.

When hurricanes, mudslides, and wildfires rip through cities and towns, information about the chemical hazards lurking in inundated storage facilities, broken refrigeration units, and plants with crippled infrastructure becomes critical to protecting human health and safety. The more people know about the risks at hand, the more efficiently localities and individuals can react to chemical hazards.

Hollowed Out Government Protection

Since the Bhopal disaster in the 1980s, the United States has had laws on the books designed to deal with many of the problems exposed by Hurricane Harvey. The Emergency Planning and Community Right-to-Know Act (EPCRA) (and the Clean Air Act's Risk Management Program (RMP)) require emergency planning and information access — provisions designed to prepare first responders and their communities for chemical catastrophes. Congress enacted EPCRA and the RMP to respond to the need for accurate, timely information about chemical risks. Both statutes included sweeping public information access provisions. The resulting statutory and regulatory schemes provided for information disclosure to make public the chemical hazard data needed to improve awareness, planning, and preparation for potential disasters.

Yet U.S. federal, state, and local governments too often fail to ensure that first responders, localities, and individuals have the information they need to prepare for chemical disasters. Not enough resources are provided to ensure adequate enforcement. EPCRA and RMP-mandated programs are typically low priorities, thinly staffed with small budgets. Violations often go unchecked, and fines for noncompliance are light and sparsely enforced.

Moreover, information access is curbed by policies designed to protect information from unintended use. Ever since September 11, 2001, information about chemical hazards in the United States has been increasingly difficult to access. Government protection and enforcement against chemical disasters has been hollowed out, and the information access systems established under federal law have not been properly maintained and enforced. Under the guise of keeping dangerous information out of the hands of terrorists, key information access requirements enshrined in EPCRA and the RMP have been bypassed. While terrorism may change how such information should be generated and shared, it cannot be an excuse for avoiding vital recordkeeping and reporting at potentially dangerous plants.

What Should Be Done?

EPCRA mandates the public availability of two major types of information: 1) emergency plans and 2) information about toxic releases. While that sweep might be broad, the law's focus is actually fairly narrow. EPCRA mandates access to information that is likely to help reduce acute health effects from short-term exposure to chemical releases. In other words, EPCRA covers precisely the type of information that is key to ensuring the safety of civilians and first responders facing hurricanes, wildfires, flooding, and other disasters. The problem has been the lack of enforcement, as well as the information-limiting policies that many states imposed post 9/11.

First, enforce the law

More than anything, EPCRA requirements must be taken seriously, and state and federal governments must provide adequate resources to fund enforcement. While budgetary decisions are ultimately legislative, implementing agencies should also lead the way in reminding legislators of the importance of the requirements.

Use waivers sparingly

Concerns about making hazard information public can be genuine, but it is important that the basic EPCRA disclosures are made, at least in some manner. We propose that the focus be shifted to disclosing key information vital for disaster preparation and public safety.

Effective disaster preparation and reaction usually requires quick thinking and streamlined processes. People must know three basic things: 1) whether there is danger, 2) what the danger is, and 3) how best to prepare for it. Is there a chance that a nearby plant will release a toxic plume into the air? Is the plume going to be filled with chemicals that will hurt people's throats or eyes? Is there a danger that the emission may ignite or cause an explosion? These types of information should be clearly and efficiently communicated to people at risk.

One way to fulfill EPCRA mandates is to adopt the model the FDA has used successfully to communicate drug risks. This FDA risk-communication system is built around plain language circulars and direct-to-consumer messages about medication risks.

FDA labelling and packaging provides just enough information to help people make sound choices. Labelling laws require package inserts, direction circulars, and package circulars that list potential risks and side effects. They provide

relevant warnings, specifying what could occur when using the medication and what to do when a negative side effect occurs. These labelling requirements are designed not only for consumers, but to help health care practitioners easily find, read, and convey information important for the safe and effective use of prescription drugs. The end result is useful, easy-to-understand information for both consumers and professionals. This model offers a simple, accessible way to reach the public, and it preserves the balance of providing information access while safeguarding information from unintended uses.

The disclosures necessary for effective natural disaster safety are not in-depth or technical. They need not reveal information at the heart of the unintended use concerns; people do not need to know precise, trade secret chemical "recipes," nor do they need precise address or location descriptors directing people to the chemicals themselves. Rather, citizens simply need to know what the risks are and whether they are in a location that is at risk. Streamlined, plain-language communication would help people prepare for chemical disasters. In fact, EPCRA already requires that facilities generate workplace-related safety data sheets. These documents are akin to FDA circulars — they provide key data on the health and physical hazards of chemicals and list protective measures. Adopting an FDA model for disseminating these data sheets could help ensure that critical information reaches the public in an efficient, easy-to-access manner.

Coastal Storms, Private Property, and the Takings Issue

by John Echeverria

On October 29, 2012, Hurricane Sandy made landfall on the New Jersey shore, claiming dozens of lives and destroying or damaging more than 300,000 homes. Properties along the shore were especially hard hit, with many oceanfront homes lifted off their foundations and tossed inland. All told, business losses were estimated at more than $30 billion. While no single storm event can be entirely attributed to climate change, Hurricane Sandy is precisely the kind of severe storm event that scientists predict will become more frequent in the era of climate change.

One issue raised by Hurricane Sandy — and the prospect of other, potentially even more severe storms in the future — is how to keep residents and businesses (and their occupants) out of harm's way. This question in turn implicates the rights and privileges of private property owners. The scope of government authority to affect property interests is governed largely by judicial interpretations of the Takings Clause of the U.S. Constitution, which provides: "Nor shall private property be taken for public use, without just compensation."

The basic problem, generally stated, is that climate change is expected both to increase sea levels and exacerbate the severity of hurricanes and other storm events. According to the latest information from the U.S. Global Change Research Program, "global average sea level has risen by about 7–8 inches since 1900, with almost half (about 3 inches) of that rise occurring since 1993." Looking to the future, the program predicts that, "Global average sea levels are expected to continue to rise—by at least several inches in the next 15 years and by 1–4 feet by 2100." Ominously, taking into account new information about melting of the ice sheets in Greenland and Antarctica, the report says, "A rise of as much as 8 feet by 2100 cannot be ruled out." Storm surges from more violent storms, on top of elevated sea levels, will predictably result in ever more frequent and destructive coastal flooding.

The Legal Landscape for Controlling New Development along the Coast

One logical policy response to these coastal threats is for state and local governments to use their traditional police powers to restrict new and expanded development along the shore. While there is little question that state and local governments have the power to restrict development in this fashion, there is

considerable room for debate over whether such regulations might be compensable "takings" within the meaning of the Takings Clause, meaning, in effect, that the government could impose the restrictions only if it were able to buy the properties and maintain them in public ownership.

The key and much contested Supreme Court precedent is the 1992 decision in *Lucas v. South Carolina Coastal Council*. This case arose from South Carolina's adoption of a setback line prohibiting new development along the ocean shore. David Lucas had purchased two building lots shortly before the adoption of the setback line, and he claimed that because the new rule barred him from developing the property, he suffered a compensable taking. While the South Carolina courts rejected the takings claim, the U.S. Supreme Court reversed, holding that because the setback line denied Lucas "all economically viable use" of his properties, he should be presumptively entitled to financial compensation under the Takings Clause. The Court indicated that an exception should be recognized to this *per se* taking rule only in two circumstances — when the "background principles" of nuisance or property law preclude a landowner from claiming an entitlement to engage in the regulated activity to begin with, or when the government is addressing an "emergency situation," such as the need to tear down buildings to block the spread of a large urban fire.

The key and much contested Supreme Court precedent is the 1992 decision in Lucas v. South Carolina Coastal Council.

While some applaud *Lucas* as a forceful defense of private property, the Court's decision has had a major chilling effect on coastal regulators across the United States. The shorthand understanding of *Lucas* has been that regulators cannot prohibit development of coastal property without running afoul of the Takings Clause, and since state and local governments lack the funds to buy all of the land along the coast that is ill-suited for development, they are left no choice but to allow the development to proceed. Rational buyers of real estate are deterred to some degree from investing in the coastal zone by the threat of sea-level rise. But the combination of unscrupulous real estate developers, the natural tendency of individuals to downplay the significance of low-probability risks, and the perverse incentives created by federal flood insurance and disaster polices, means that citizens continue to over-invest in the coastal zone.

What Should Be Done?

Overturn or adopt a narrow reading of Lucas

Only the Supreme Court can fix the *Lucas* decision, and the Court is generally reluctant to overturn its prior precedents. But there is reason to hope that, over time, given the overwhelming evidence of sea-level rise, the Supreme Court

may come to think better of its *Lucas* decision, leading either to its outright reversal or its reinterpretation so that it does not stand in the way of restrictions on land threatened by sea-level rise.

As discussed above, the Court said that a takings claim may be defeated by showing how a regulatory restriction parallels background principles of nuisance or property law. While some courts and commentators have interpreted this background principles defense narrowly, it's possible that the Supreme Court could give it a broader reading. For example, the Court has said that background principles could defeat a takings claim by "the corporate owner of a nuclear generating plant, when it is directed to remove all improvements from its land upon discovery that the plant sits astride an earthquake fault." It is hardly farfetched, depending on the pace of sea-level rise, to see developing a residential community on the eroding ocean shore as creating a probability of harm comparable to building a nuclear power plant above an earthquake fault (if not harm of a similar magnitude).

The *Lucas* Court also has said that takings liability may be defeated where the government is acting to address an emergency, including when "grave threats to the lives and property of others," might be avoided. While this exception has generally been understood to involve threats of imminent harm, such as a wildfire, it might sensibly be extended to apply to the threat of sea-level rise due to climate change. As Professor Robin Craig has observed, climate change and its threatened coastal impacts can be analogized to the kinds of emergencies that have stood as a bar to takings liability in other contexts. As she puts it, "[a]s sea-level rise becomes an increasingly pressing concern … [state courts] could choose to evolve their common-law doctrines away from a strict emergency requirement, making them more supportive of longer-term governmental actions to address this problem."

Finally, it is possible that there is no longer a solid majority of Supreme Court justices willing to stand behind the Court's *Lucas* opinion. Justice Anthony Kennedy often served, in takings cases as in other types of cases, as the swing vote on the Court. In *Lucas*, he concurred only in the judgment, arguing that the reasonableness of a claimant's investment expectations should be a relevant factor in takings analysis, even if a regulation deprives the owner of all economically viable use. He continued:

> [R]easonable expectations must be understood in light of the whole of our legal tradition. The common law of nuisance is too

> narrow a confine for the exercise of regulatory power in a complex and interdependent society. The State should not be prevented from enacting new regulatory initiatives in response to changing conditions, and courts must consider all reasonable expectations whatever their source. The Takings Clause does not require a static body of state property law; it protects private expectations to ensure private investment. I agree with the Court that nuisance prevention accords with the most common expectations of property owners who face regulation, but I do not believe this can be the sole source of state authority to impose severe restrictions. *Coastal property may present such unique concerns for a fragile land system that the State can go further in regulating its development and use than the common law of nuisance might otherwise permit*.

Justice Kennedy's replacement could change the equation, one way or another. But if the Kennedy viewpoint gains ascendancy on the Supreme Court, the *Lucas* decision should no longer be a barrier to restrictions on development of coastal lands facing inundation and destruction from sea-level rise due to climate change.

Acquire and relocate communities threatened by sea-level rise

But restricting new development along the seashore addresses only one aspect of the challenge presented by sea-level rise and the prospect of more severe hurricanes and other storms. The other challenge is that enormous stretches of coastlines that have already been heavily developed are threatened with inundation and destruction. Significant portions of Louisiana, Maryland, and Florida are seriously threatened by sea-level rise over the next 200 years. According to one report, based on projections developed by Zillow, nearly 1 million Florida properties worth more than $400 billion are at risk of being submerged by rising seas.

Enormous stretches of coastlines that have already been heavily developed are threatened with inundation and destruction.

Recognizing the unavoidable need to get out of harm's way, how will individuals, families and entire communities manage to move to higher, safer ground? One option is to simply rely on individuals' own motivation to leave their threatened communities. The difficulty with this approach is that purely voluntary migration is likely to leave the poorest, the least educated, and the least physically able behind, imposing a disproportionate burden on those most vulnerable. In addition, even as a community hollows out due to out-migration,

the need to provide infrastructure (roads, water, sewer, etc.) and services (education, trash collection, social services, etc.) to those who remain will continue. Over time, the costs of sustaining all these facilities and services will be imposed on fewer and fewer taxpayers with a shrinking capacity to pay. It is easily predictable that community financial (and social) collapse will arrive before communities are literally inundated by water.

A potentially superior alternative is a program of organized retreat managed by government. Mandatory evacuations are an infrequent but not completely unfamiliar response to hazardous conditions. During Hurricane Sandy, for example, New Jersey Governor Chris Christie ordered temporary evacuation from all barrier beaches from Cape May to Sandy Hook. In limited circumstances, local communities have ordered the removal of coastal structures facing imminent collapse that pose serious risks to human life and welfare. But mandatory relocations of entire communities threatened by sea level rise would represent an interference with private property interests and human lives on a far vaster scale.

One option would be use of eminent domain power to accomplish coastal retreat. The Takings Clause did not create the power of eminent domain; rather, this power is generally regarded as an essential attribute of sovereignty. Under the Takings Clause, eminent domain can only proceed if it is for a "public use" and the government is able and willing to pay "just compensation." Under the Supreme Court's 2005 decision in *Kelo v. City of New London*, the term public use is synonymous with "public purpose." There is no legitimate room for doubt that relocating individuals and communities from the path of threatening seas would serve a public purpose. In theory, eminent domain for coastal retreat purposes could be exercised by the federal, state, or local governments.

One obvious advantage of the use of eminent domain is that entire communities could be moved together at one time, leaving no one to fend for themselves in a dying community and creating the opportunity to keep communities intact at new locations. But the very effectiveness of this tool would also likely be a source of great controversy, especially if some members of the community contested the need for relocation. Public concerns about the use of eminent domain might be mitigated by a condition that a supermajority of the affected community affirmatively votes in favor of relocation.

Calculating the amount of "just compensation" due under the Takings Clause also would be complicated. In general, just compensation is equated with a

property's fair market value as determined by evidence of actual market transactions involving comparable properties. Under this traditional approach, estimating the fair market value of properties threatened with sea level rise would prove very difficult. As sea level rise proceeds and (equally important) as public awareness of sea level rise projections expands, demand for coastal properties will naturally decrease and banks will be less willing to finance purchases of such properties, leading to long-term declines in coastal property values. As a result, evidence of past market transactions will be a poor indicator of current market values, much less of future market values. One can imagine scenarios in which property values might remain stable for long periods until a major storm hits or a critical mass of residents starts heading for the exit and the market collapses. That said, the real estate market in Miami, Florida, which is especially threatened by sea level rise, appears remarkably stable, perhaps due to irrational exuberance or investment in real estate as a money laundering tactic. When that market will (or may?) actually begin to collapse is hard to say.

The constitutionally mandated level of "just compensation" (however hard that turns out to be to calculate) need not be the ceiling on payments to property owners affected by sea level rise; governments might choose to make payments above the constitutional minimum. For example, compensation might be awarded based on the value of properties prior to the advent of sea level rise. This additional compensation can be justified on the ground that coastal residents are bearing the brunt of sea level rise but are no more responsible for generating the harm than everyone else. The case for additional compensation is especially strong in the case of the poor or people with disabilities, who are unlikely to have the financial resources or physical capacity to adapt to climate change on their own. The primary argument against awarding compensation above the constitutional minimum is that it would create a moral hazard, that is, a positive incentive against individual adaptation steps. Just as the dysfunctional National Flood Insurance Program has had the perverse effect of encouraging more flood-prone development, overly generous relocation payments could encourage more development in areas at risk of sea level rise. Some possible solutions might include reasonable caps on relocation payments and a firm prohibition on relocation assistance for *future* purchasers of properties at risk of sea level rise.

Seeking Climate Justice in the Common Law

by Karen C. Sokol

The 450 Inupiat residents of Kivalina, a small village on the frozen tundra of Alaska at the edge of the Arctic Ocean, are among the first communities in the world to lose their ability to survive because of climate change. With temperature increases that double the global average, Alaska is one of the canaries in the coal mine of climate change. As a result, the Arctic's ice has diminished by half over the last three decades, triggering a series of reactions that are transforming the environment. The people of Kivalina risk plunging into frigid waters whenever they use their snowmobiles — the only viable motorized means of transportation in the region. That, along with the fact that their principal source of food is wildlife whose habitats are being destroyed by rising sea levels, means that the Inupiat of Kivalina are losing their ability to feed themselves.

The Kivalina villagers will eventually suffer the same fate as the wildlife they depend on: According to the U.S. Army Corps of Engineers, Kivalina will be under water within ten years. Life is challenging on frozen tundra, but in the face of climate change, it is no longer possible. And the federal government has not done anything about it. Although in 2015 President Obama did submit a proposal to Congress that would have allocated $400 million for the residents of Kivalina and other Alaskan communities to relocate, Congress never approved it. Left unprotected by their government, the villagers sued ExxonMobil, BP, Chevron, Shell, and other major greenhouse gas emitters for their contribution to climate change. The village claimed the right to monetary compensation to relocate based on the common law claim of public nuisance.

In addition to the relatively slow-moving disasters such as those destroying the lives of the Kivalina Inupiat, climate change has caused an increased frequency of devastating storms such as the recent hurricanes, discussed throughout this report, that pummeled Gulf Coast states and U.S. island territories in the Caribbean. Also as pointed out in this report, the government's response has been woefully inadequate, particularly in Puerto Rico. In light of this, coupled with the fact that scientists are now able to attribute specific extreme weather events such as Hurricanes Harvey and Maria to anthropogenic greenhouse gas emissions, we may see individuals, communities, and the governments of those states and territories bring suits similar to the one brought by the village of Kivalina to secure some relief for themselves and their residents.

Tort Litigation and Climate Justice in the United States

Tort law — also known as the civil justice system — has long provided a critical way for individuals to hold others accountable for causing injury and to secure redress for those injuries. Particularly since the mid-twentieth century, individuals and communities have sought compensation for harms caused by national and multinational for-profit entities whose widespread commercial activities harm the health and well-being of humans and their environment. The pathbreaking litigation seeking redress for climate change harms such as that brought by the village of Kivalina may prove to be the most important example to date of this function of the tort system at work. Importantly, it could prove to be a powerful tool for marginalized communities who are particularly vulnerable to climate change threats.

In 2007, the Intergovernmental Panel on Climate Change (IPCC) noted the likelihood of an increase in what is now often referred to as "climate change" or "climate justice" litigation. [16] The reason for the increase, predicted the IPCC, was that "countries and citizens [will] become dissatisfied with the pace of international and national decision-making on climate change." In addition to suits against national governments based on international and national environmental laws in various countries, the IPCC pointed to one of the first climate change tort cases brought in the United States: *American Electric Power Co. v. Connecticut* (*AEP*). In that case, a group of state attorneys general sued five major electric power companies for climate change harms caused by their greenhouse gas emissions based on the common law action of public nuisance. Although the case was eventually dismissed, more and more groups have since sued the fossil fuel industry for climate change harms based on common law causes of action. Some of those cases have a greater chance of success than that initial case because of shifting legal strategies and the continued increase in the strength of the evidence (1) supporting causal links between climate change and the greenhouse gas emissions caused by the fossil fuel industry's manufacturing processes, and between climate change and myriad risks to life on this planet, such as sea level rise, droughts, wildfires, and hurricanes, and (2) the fossil fuel industry's continued marketing of its products notwithstanding its decades-long knowledge of both links.

In *AEP*, the U.S. Supreme Court held that the federal common law claim of public nuisance brought by eight states and New York City was "displaced" by the Clean Air Act. Although longstanding, federal common law, such as the public nuisance claim in *AEP*, is much more limited than state common law,

both in types of claims and the frequency with which they are brought. As the Court has repeatedly emphasized in the handful of public nuisance cases that it has decided, federal common law is "an unusual exercise of [the] law-making power [of] federal courts." Federal common law is relatively rare for two reasons. First, state common law is usually more appropriate; only in exceptional cases has the Court required a federal law of decision to ensure uniformity. Second, because this need for a federal law of decision is the only reason justifying federal common law, it is appropriate only when Congress has not addressed the issue presented by the case. As the Court has noted, "[f]ederal common law is a necessary expedient" that is no longer necessary once Congress has addressed the issue. When Congress has addressed the issue, as the Court held that it had in *AEP*, federal common law is displaced by the federal statutory law.

Recent cases brought by California counties and cities have been consolidated into two actions: *San Mateo v. Chevron* and *California v. BP*. In both cases, the plaintiffs brought only state common law claims. And they were the first climate tort plaintiffs who have decided to file their complaints in state court. Two Colorado counties and one city, a Washington State county, and Rhode Island recently made the same litigation decision as the California plaintiffs, bringing only state tort claims for climate harms against Exxon and Suncor and filing in state court.

Further, in both *San Mateo* and *California*, the oil and gas industry defendants made two related arguments that the cases should be dismissed based on *AEP*. First, they claimed that the cities' and counties' state claims all raised matters of federal concern and thus had to be addressed as federal common law claims. With only federal laws at stake, the defendants would be entitled to remove the cases from the state courts in which they were filed to federal courts. Second, the defendants argued that the federal courts should dismiss the cases because the only proper claim — the federal law claim — was displaced by the Clean Air Act under *AEP*. The plaintiffs challenged the removal to federal court in both cases. The federal district judge hearing the *San Mateo* case agreed with the plaintiffs and sent their case back to state court. The judge hearing the *California* litigation, however, reached the opposite conclusion and held that the case should remain in federal court. The Ninth Circuit Court of Appeals will ultimately decide who has the law right. That decision, in turn, has significant implications for the future of climate justice tort litigation.

California v. BP is the first climate tort case in which a court has addressed the question whether federal common law should trump state law claims. Both the Supreme Court in *AEP* and the district judge in *San Mateo* held only that the federal common law claim was displaced by the Clean Air Act, leaving open the question of whether the state law claims were preempted by the act. The caselaw on the preemption of state law by federal *statutory* law is well-developed, but the framework for addressing the issue of whether federal common law preempts state common law is less clear. Although the Court has stated that there are issues of special federal interest that should be governed by federal common law rather than state common law, it has done so mainly with the goal of justifying the rare exercise of its authority to make and apply federal common law rather than leaving the matter to resolution by state tort law, which is appropriate in most cases. Based on this limited guidance from the Supreme Court, the *California* decision on the viability of the plaintiffs' state law claims is defensible as a legal matter. As a policy matter, however, the decision that state climate tort claims are preempted by federal common law is concerning. For several reasons, it is important that, at this stage, when climate justice tort claims are at their strongest, plaintiffs be allowed to proceed under state common law.

As noted above, the California and other recent climate justice tort suits filed by local governments are based on extensive, extremely strong scientific evidence of the causal link between the companies' marketing of fossil fuels and climate change. Additionally, the plaintiffs have evidence supporting the specific, large contributions of each particular defendant's products to climate change. Finally, they present documentation of the defendants' knowledge of their contribution to climate change and its devastating consequences and their response to that knowledge; namely, a concerted disinformation campaign about climate change and its connection to fossil fuel use. Although such evidence certainly would support a federal nuisance claim, state tort law is in many ways better equipped to handle claims, such as the climate justice claims brought in the California cases, that allege liability for the production and marketing of products.

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Initially, state tort law is a much richer body of law than the federal common law of nuisance. The plaintiffs in the *San Mateo* case allege not only state nuisance claims, but also several products liability claims that are unavailable in federal common law. The ability to allege multiple claims in this way does not, of course, allow for multiple damage awards; plaintiffs can recover only once for a

given injury. But it does give plaintiffs the opportunity to describe more fully — and thus voice their opposition to — conduct that they claim has unlawfully harmed them. Indeed, state courts throughout the nation, including California, developed products liability law relatively late in the history of tort law. In the 1960s, in response to new types of business activities by national companies — including mass-marketing of their products, engaging in misleading marketing strategies, and selling unsafe products with the potential to cause widespread and devastating harms — state courts drew on existing state tort law principles to develop products liability claims. Products liability claims are based on the allegation that a product, or, more often, an entire line of products, is defective and consequently caused harm. These claims often more comprehensively captured the nature of the sorts of wrongful conduct and harms that had emerged with national mass-marketing than existing state tort claims such as negligence did. In one of the seminal products liability opinions, a justice on the California Supreme Court explained the justification for the development of products liability claims:

> Manufacturing processes, frequently valuable secrets, are ordinarily either inaccessible to or beyond the ken of the general public. The consumer no longer has means or skill enough to investigate for himself the soundness of a product, even when it is not contained in a sealed package, and his erstwhile vigilance has been lulled by the steady efforts of manufacturers to build up confidence by advertising and marketing devices....

In sum, the California justice recognized that, in an era of corporate national marketing campaigns that made representations of products essential to what consumers perceived the product to be, tort law had to be able to address harms that were caused not by isolated instances of individual actions, but rather from systematic and systemic activities of corporations. This is the sort of conduct and harms that state courts have been addressing in their tort law for decades; federal courts applying the very limited federal common law of nuisance have not.

Additionally, because state tort law is usually applicable and federal common law exceptional, state judges have significantly more expertise with common law and its development than federal judges do. Consequently, even though the recent climate justice tort claims based on the fossil fuel industry's marketing of its products are novel in their specifics, they are the sort of claims that state

courts have been addressing on a regular basis for over half a century. For both of these related reasons, contrary to the opinion of the district judge in the *California* climate case, state tort law is well-suited to address the cities' and counties' claims, and, in fact, arguably much better-suited to do so than federal common law is. Unfortunately, in that case, neither the federal common law claim nor the state common law claims will be heard unless the plaintiffs successfully appeal the removal decision. After deciding that federal courts could not decide suits based on climate change harms without encroaching on the powers of the executive and legislative branches, the *California* district court dismissed the case. And, unlike in *AEP*, there are no state claims remaining for the plaintiffs to refile in state court, as the court had already held that the state claims were preempted by federal common law.

The Future of Climate Justice Tort Litigation

Although comprehensive federal legislation and regulation is urgently needed to address the myriad threats presented by climate change, state tort law is urgently needed to address the myriad climate change harms exacerbated by the federal government's inaction. This is the gap-filling role that state tort law has been serving for this country's citizens for decades. And the *California* district court's decision holding that federal common law preempts state tort law threatens to deprive citizens of this vital avenue of redress in the U.S. system at the time that they are facing the most serious threats that they, and, indeed, all the citizens of the world, have ever faced. Now more than ever, state tort law must be allowed to serve its long-standing functions that provide the American public — particularly those communities most vulnerable as a result of social inequity — with a safety net when federal protections are weak or non-existent. Those functions are redressing harms and "prodding" federal policymakers to take much-needed actions to protect those whom they serve.

Ideally, the Supreme Court should create a clear standard for preemption of state common law by federal common law that accounts for the importance of state law in the U.S. system. Given the limited nature of federal common law, this standard should be stricter than the one applied to the question of whether federal statutory law preempts state law, which requires significant deference to the states' independent and unique role in protecting their citizens. This is why a decision that a federal statute displaces federal common law does not mean that the same statute preempts state law claims based on the same allegations. As the Supreme Court explained in *AEP*, unlike the decision whether a federal statute preempts state law, "[d]ue regard for the presuppositions of our

embracing federal system … as a promoter of democracy does not enter in the calculus" when the question is whether a federal statute displaces federal common law. At the very least, the same regard for the states' constitutional role should be factored into the decision whether federal common law preempts state law. This is particularly so when state common law claims have increasingly been used to mitigate the local consequences of corporate conduct that may have widespread impacts throughout the rest of the nation, or indeed, the world. As noted, the climate justice tort claims are not new in this regard.

As all the sections of this report make clear, the current era of climate change demands not only new and improved governmental mechanisms, but also using current ones that are effective to the fullest extent possible. Lives — particularly those of socially marginalized communities such as the Inupiat of Kivalina and the residents of U.S. territories — depend on it.

Endnotes

[1] For an account of the formation and evolution of FEMA, *see* James F. Miskel, *Disaster Response and Homeland Security: What Works, What Doesn't*, 67–74 (2008).

[2] Miskel, *supra* note 2, at 84–45.

[3] Presumably it would not have taken three weeks to get helicopters to the scene if Puerto Rico had been invaded by Venezuela, for instance.

[4] The CRS Report directs readers to additional resources on the remapping process including Section 4.4.2 in Technical Mapping Advisory Council, *Annual Report, 2015*, December 2015, pp. 4-55, and a section on Process, in Technical Mapping Advisory Council, *National Flood Mapping Program Review,* June 2016, pp. 13-17, both at http://www.fema.gov/media-library/assets/documents/111853.

[5] For a report on possible changes, see Technical Mapping Advisory Council, *TMAC 2016 Annual Report*, December 2016, 3-2, https://www.fema.gov/media-library-data/1492803841077-57e4653a1b2de856e14672e56d6f0e64/TMAC_2016_Annual_Report_(508).pdf.

[6] H.R. REP. NO. 90-1585, at 2966–67 (1968), *reprinted in* 1968 U.S.C.C.A.N. 2873 (emphasis added).

[7] H.R. REP. NO. 90-1585, at 2972–73 (1968), *reprinted in* 1968 U.S.C.C.A.N. 2873.

[8] For related discussion on "climate gentrification" and its possible effects on geographies and property markets in Miami-Dade County, Florida, *see* Jesse M. Keenan, Thomas Hill, and Anurag Gumber, "Climate gentrification: from theory to empiricism in Miami-Dade County, Florida," *IOPScience*, http://iopscience.iop.org/article/10.1088/1748-9326/aabb32.

[9] For a brief introduction to domestic climate relocation and a study of seven tools for displaced communities seeking to secure and manage new land, see Maxine Burkett, Robert R.M. Verchick, and David Flores, "Reaching Higher Ground: Avenues to Secure and Manage New Land for Communities Displaced by Climate Change," Center for Progressive Reform (2017).

[10] *See* Melissa Luckman, Daniel Strafer, Christina Lipski, *Three Years Later, Sandy Survivors Remain Homeless*, 32 Touro L. Rev. 313, 323 (2016) (describing that after Superstorm Sandy, FEMA provided more than one billion dollars in grant money via the Individuals and Households program but that while IHP helped homeowners, thousands of individuals three years post disaster were being asked to give this money back, on the basis a FEMA internal audit that flagged wrongful dispersal of some grant money).

[11] *Id*. at 349.

[12] *See* Gretchen Bakke, *The Grid: The Fraying Wires Between Americans and Our Energy Future* 119–26 (2016).

[13] Joseph P. Tomain, *Ending Dirty Energy Policy: Prelude to Climate Change* 92 (2011).

[14] Denise Fairchild & Al Weinrub, (eds.), *Energy Democracy: Advancing Equity in Clean Energy Solutions* (2017).

[15] See e.g. Sidney A. Shapiro & Robert R. M. Verchick, Inequality, "Social Resilience, and the Green Economy," 79 *UMKC L. Rev*. 1 (2011).

[16] See generally, e.g., Chilenye Nwapi, *From Responsibility to Cost-Effectiveness to Litigation:* "The Evolution of Climate Change Regulation and the Emergence of Climate Justice Litigation," in *Climate Justice: Case Studies in Global and Regional Governance Challenges* 517 (Randall S. Abate, ed., 2016).