SOA Research INSTITUTE

Catastrophe and Climate

Municipalities and Climate Change

Successful Strategies Depend on Circumstances

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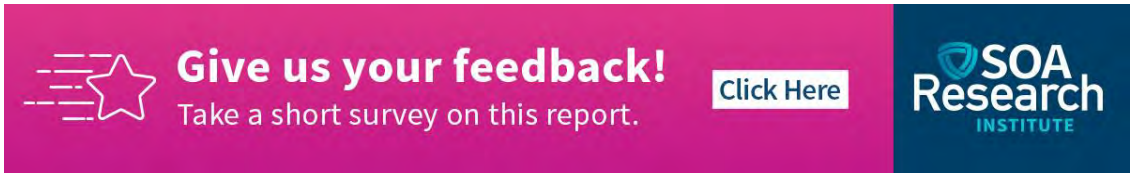

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Municipalities and Climate Change

Successful Strategies Depend on Circumstances

This is our new reality, and we need to focus on preparing for it. It's happening right now. It's not a future threat, it's a current situation.

- New York Governor Kathy Hochul September 2, 2021, discussing the climate crisis, as remnants of Hurricane Ida ravaged the northeast[1]

Executive Summary

Progress toward global reductions of greenhouse gas (GHG) emissions using mitigation and adaptation techniques occurs between meetings of national political leaders (e.g., COP26[2] was held in November 2021 as the 26th in a series of annual meetings) and meetings of scientists (the Intergovernmental Panel on Climate Change, or IPCC, is expected to complete its sixth cycle in 2022).[3] During the most recent IPCC cycle we have encountered an increasing number of extreme weather events and recognition is growing that climate change is a risk that needs to be addressed.

Unfortunately, divided political lines have attached to climate risk, with extreme and opposite stances. Positions range across a continuum of 'an existential global disaster is about to happen' to 'it's real, it's us, it's serious, but there are solutions,' to 'it's a minor problem' to complete denial. Despite its scientific importance, few view the topic as one that can be discussed in a reasonable and objective manner, even as time grows short to avoid feedback loops that limit solutions. Insurers can be part of the solution by encouraging market-based incentives that include appropriately adjusted premiums based on risk and economically sound mitigations.

Rather than waiting, some companies, individuals and cities have accepted the challenge and are doing what they can to change behaviors and implement adaptations. They have decided to own the risk and serve the interests and needs of their local constituents, while at the same time also helping the rest of the world. Successful methods often incorporate economic pragmatism, acknowledging that everyone's views have value.

Successful solutions, or at least changes to the current path, are most likely to be adopted following a major event that scares a community. This could be a weather-related incident, like a hurricane or tornado, or something else. Earthquakes and the recent COVID-19 pandemic have both led cities to change. Sometimes a nudge is all that is needed to start the necessary transition.

Cities are a good size to get things done. Larger political entities often get bogged down in bureaucracy and smaller entities or groups rarely have the money or focus to complete a large project. Cities in many ways occupy a sweet spot for climate response.

[1] Hochul, K [@GovKathyHochul]. (2021, September 2). Twitter. https://twitter.com/govkathyhochul/status/1433520806252982272
[2] COP is Conference of the Parties, a UN sponsored climate change conference.
[3] Gutterman, Sam. *End Paper. Climate-The Long Term.* Contingencies magazine. March 2016. https://contingencies.org/older-issues/

Section 1: Introduction

Climate change affects everyone. Proactive responses that look forward to anticipate future conditions will optimize infrastructure investments rather than dealing with the crisis as extreme events arrive. Cities can address local concerns utilizing a process that is repeatable in other jurisdictions. In the sections that follow specific physical risks are discussed and examples are shared about how cities of various sizes have addressed climate risk, often leveraging the process to improve the local community in other ways.

Section 2: How Cities are Impacted by Climate Change

The impact on cities of climate change is best illustrated by examples. The urban heat-island effect combines heat absorbing buildings and roads with the sun's energy, raising temperatures relative to adjacent green spaces. Hotter temperatures lead to increased use of air conditioners, which use energy that leads to hotter temperatures, and so on in a feedback loop. Engineered draining systems change the natural flow of water, built over millennia, leading to unintended consequences and aging systems that fail. Infrastructure built up over time becomes more complex, less resilient and more fragile.

Climate change is one of several interrelated factors driving property losses higher. Humans have modified the natural landscape by building roads and structures, changing the flow of rivers and coastlines. Water serves as a source of transport, power and especially because it sustains life. Cities are at risk as climate change increases their risk from hazards like sea level rise, drought, heat waves, storms and wildfire. There is a need to improve the resilience of cities to reduce frequency or severity of losses. No two cities are alike, and local knowledge and buy-in are important considerations for developing successful adaptation and mitigation strategies. Factors like soil conditions and age of buildings should be considered.[4] Techniques selected will vary based on the hazard being addressed and the particular circumstances of the city.

There are several strategies that cities and regions can take to address the changing climate. Nature-based solutions include building coastal buffers and planting trees. Awareness of the physical risk impact can be built by working with insurers to manage private insurance plans or with government to create risk assessments. Early warning systems can be built, and proactive planning processes developed.

In addition to property damage, people are impacted by climate change through decreased livability and increased morbidity. Worker productivity is reduced during heat waves and other events, impacting worker safety and job satisfaction.

Millennials are attracted to cities with an active and desirable center that they can walk to. These features are a major selling point to top employees that regions want to entice and retain.

Cities historically improved their livability and lowered mortality and morbidity through improved sanitation and sewer systems. Today, many are taking ownership and not waiting for others to act on their behalf during the climate crisis. Cities are increasingly setting their own goals, including metrics like emissions targets.[5] They recognize their role in the effort to slow accumulation of greenhouse gases.

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[4] McKinsey Sustainability. *Focused adaptation: a strategic approach to climate adaptation in cities.* July 2021. https://www.mckinsey.com/~/media/mckinsey/business%20functions/sustainability/our%20insights/how%20cities%20can%20adapt%20to%20climate%20change/focused-adaptation-a-strategic-approach-to-climate-adaptation-in-cities-vf.pdf?shouldIndex=false

[5] Financial Times. *Cities Increase Emissions Disclosure.* August 19, 2021. https://channels.ft.com/en/ft-moral-money/cities-increase-emissions-disclosure/

Resources available in cities and towns are often tight, so they are unlikely to act on their own to move forward unless there are local benefits.

Worldwide, population continues to immigrate from rural to urban settings. Politically, it has proven hard to achieve consensus on climate initiatives. But many cities have recognized the importance for their own citizens and are seeking out research, mitigation techniques and ideas for adaptation to implement local solutions. These focus on the impact from physical risks as well as potentially aiding broader efforts to reduce the impacts of climate change. This is especially important to consider in a social justice context. Centuries of discrimination and short-term thinking have built up that directly or indirectly impact the same (lower) socioeconomic classes of the population. Some cities are choosing to use climate-related projects as an opportunity to address some of these accumulated inequities. Reviewing the history of a large city relative to trees planted in areas around town can be a predictor of prior practices of racism and inequality.[6] More trees are found in upscale neighborhoods with boulevards and homeowners who can afford to maintain landscaping. Fewer trees mean hotter temperatures, urban heat islands and can lead to lower family incomes. One technique could use carbon offsets to finance planting and maintaining appropriate tree management in areas where socioeconomic inequality is prevalent.

Today's political landscape can make it difficult to adopt a strategy around climate without considering how to make it appeal to everyone. Cities should avoid mandatory initiatives, as some people will dig their heels in and refuse to comply. Use of positive phrases, rather than focusing on negative outcomes from non-compliance, can lead to enhanced cooperation. That is, involving the community in the process can help. Strategies may want to consider how different socioeconomic classes view their day-to-day lives. Some enjoy 'everyday privileges' of their higher socioeconomic class while practicing NIMBYism (not in my back yard), for example when wind farms are being planned. Someone who struggles to put food on the table and a roof over their family's head will require a different strategy. For them, protecting nature is a luxury. Focusing on how renewable energy can empower a community to generate electricity off-grid and manage the process is an example of a strategy that has been effective with some groups.[7]

Another concern could be described using the tragedy of the commons. For example, farmers, cities or shale drillers may pump water from an aquifer at no charge to them beyond installing a well and a pump. As the aquifer goes dry it negatively impacts a large group that may not have participated in depleting the resource.

Some third world countries have little existing infrastructure and so have few sunk costs, allowing them to consider wireless solutions. For example, African citizens have readily adopted smartphones and solar charging stations to complete financial transactions.

A city may be the smallest group capable of creating solutions for what is a complex adaptive system. Results are nonlinear, so closed form solutions do not exist, requiring analysis of higher order interactions and generally necessitating simulations to develop a solution. These types of systems are susceptible to feedback loops, and unexpected inputs can generate surprising results. Thresholds occur when a distribution thought to be a continuum crosses over to something new, a regime change. Extinctions of shellfish due to higher ocean temperatures and acidity are an example, as would weather changes caused by the loss of the Greenland ice sheet or loss of a glacier that provided drinking water to a local population.

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[6] Borunda, Alejandra. *A Shady Divide.* National Geographic. July 2020. https://www.nationalgeographic.com/magazine/article/los-angeles-confronts-its-shady-divide-feature

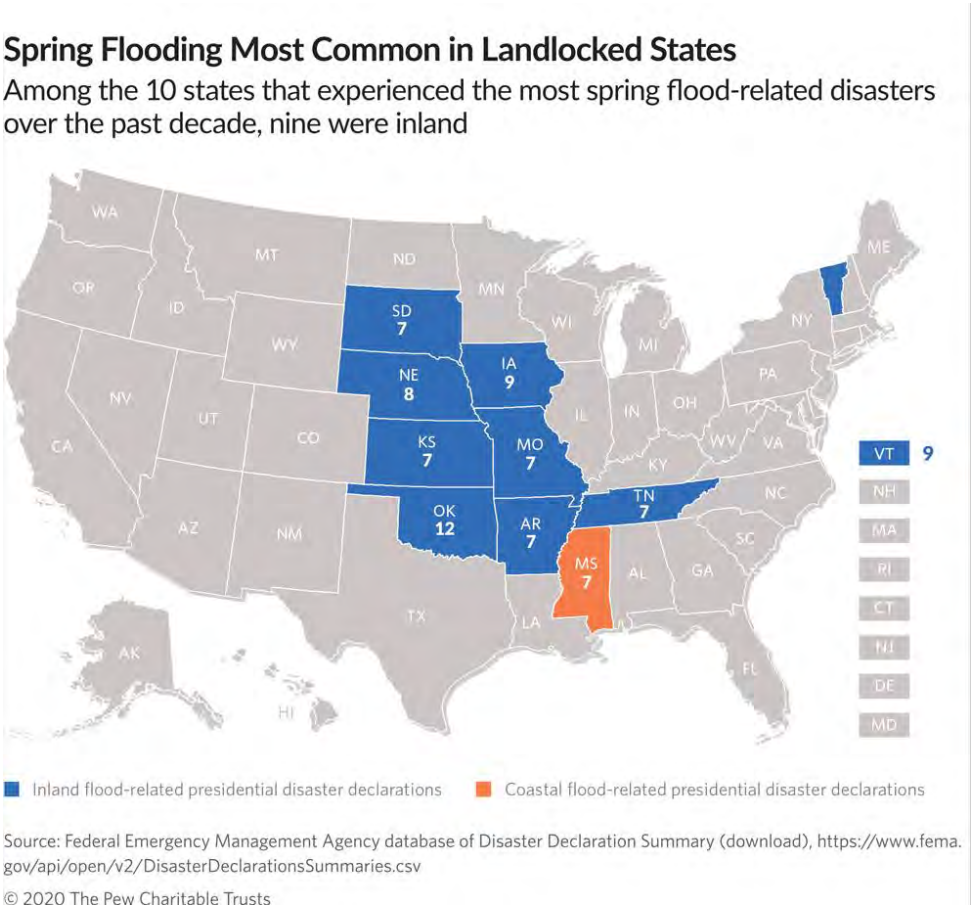
[7] Jon, Ihnji. *Cities in the Anthropocene: New Ecology and Urban Politics.* Pluto Press. 2021.

Cities are universal, often with more in common with similar entities in other countries than within their local region or country. In this way they can be leaders in developing climate solutions in ways that are difficult for larger political entities.

2.1 FLOODING BY SEA LEVEL RISE AND STORMS[8]

Many cities were originally located on coasts or major rivers due to ease of access, often as transportation hubs. Coastal cities are susceptible to risks like sea level rise and hurricanes, while inland cities are often overwhelmed by flooding due to spring melt or heavy rainfall. The impact of flooding is large and growing. For example, in the U.S., NOAA's (National Oceanic and Atmospheric Administration) assessment of large weather disasters has grown from an average of $17.8 billion (inflation adjusted) in the 1980s to over $80 billion per year in the 2010s. Over one-third is due to higher precipitation. While many think immediately of Hurricanes like Harvey or Sandy, the 2019 Midwest floods were also a multi-billion-dollar event.

Figure 1
DISASTER DECLARATIONS DUE TO FLOODING[9]



Source: Federal Emergency Management Agency database of Disaster Declaration Summary (download), https://www.fema.gov/api/open/v2/DisasterDeclarationsSummaries.csv

[8] Berardelli, Jeff. *Climate change is responsible for billions of dollars in flood costs, study says.* CBS News. January 11, 2021. https://www.cbsnews.com/news/climate-change-flood-costs-study/

[9] Tompkins, Forbes. *Nearly Half of States Are Likely to Experience Flooding This Spring.* Pew Research Center, Washington, D.C. April 2, 2020. https://www.pewtrusts.org/en/research-and-analysis/articles/2020/04/02/nearly-half-of-states-are-likely-to-experience-flooding-this-spring

Coastal flooding has similarities, but also differences, from inland flooding. Building codes can be strengthened, buildings elevated or moved to higher ground. Nature-based solutions include wetlands restoration, coastal barriers like seawalls, sandbags and artificial barriers that attempt to mitigate storm surges and coastal flooding. High winds also create damage, which becomes a source of contention as insurance policies often cover either damage due to water or wind.

The problem of flooding is coming sooner than many cities expect. Climate Central, an independent group of scientists and communicators, has taken data about expected elevation and level of local high tide to create maps showing the risk to specific locations.[10] Their charts show major global cities with loss of habitat due to a combination of sea level rise and elevation loss. Venice (Italy) and Bangkok (Thailand) suffer from these additive threats, while cities along the Bay of Bengal like Kolkata (India) and Dhaka (Bangladesh) are in imminent risk. Cities in the United States and Europe are not immune. Amsterdam (Netherlands), among others in the aptly named low countries, has used adaptation methods for centuries. In the United States cities like Savannah (Georgia) and New Orleans (Louisiana) will need to adapt quickly for much of the neighboring area to remain accessible.

While costly events can trigger projects that mitigate some of the effects of climate change and may lead to actions that can improve the global ecosystem's carbon footprint, others may use the same events to make changes that may not be in the community's best interests. Disaster capitalism, a term coined by activist author Naomi Klein, uses these focusing events when residents are distracted by monumental recovery efforts as windows of opportunity to reshape areas in the favor of outside interests.[11]

2.2 DROUGHT AND HEAT WAVES

Municipalities must deal with physical risks that happen quickly, like earthquakes and storms, but long-term survival may depend more on proactively dealing with evolving weather events. In many parts of the world excess water is not the most significant extreme meteorological event. Rather, it is the lack of water and extended heat that generates losses and impacts health. While proactive preparation for flooding deals primarily with infrastructure, with behaviors driven by the need to leave the danger area, drought and heat wave preparation requires cities to have both infrastructure and behavioral solutions.

In many cases, running out of water can't be solved by technology alone, although monitoring pipes for leakage and tracking water usage are components of the solution. Replacing old infrastructure can also serve other health benefits. Fresh water access in some regions will decline as climate change occurs due to glacier melt and changing weather patterns, but also as aquifers are depleted and sea level rise causes salt water to infiltrate the water table. Behavioral changes start with knowledge as use is monitored and communities work to educate and listen to their citizens. This includes industry, farmers and urban residents. A free resource is not managed as well as one that costs to use, so fees can be a tool in addition to voluntary conservation.

Heat waves impact health and morbidity directly. Insurers see increased accidents and emergency room visits as worker productivity drops.[12]

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[10] Climate Central. *Land projected to be below tideline in 2030.* https://coastal.climatecentral.org/map/9/-58.3056/6.3244/?theme=sea_level_rise&map_type=year&basemap=roadmap&contiguous=true&elevation_model=best_available&forecast_year=2030&pathway=ssp3rcp70&percentile=p50&refresh=true&return_level=return_level_0&rl_model=gtsr&slr_model=ipcc_2021_med

[11] Montano, Samantha. *Disasterology: Dispatches from the Frontlines of the Climate Crisis.* Park Row Books. 2021.

[12] Bell, Jesse et al. *Determining the role of anthropogenic climate change on human health outcomes: a case study on heat related illness attribution.* Society of Actuaries. February 2021. https://www.soa.org/resources/research-reports/2021/determining-role-climate-change/

These risks are important for cities to study. Situations to consider include outdoor workers spending extended time in urban heat-sinks, water use challenges between urban and rural users, and air conditioning needs of the elderly.

2.3 INFRASTRUCTURE FUNDING AND MUNICIPAL BONDS

Many municipalities are recognizing the need to address evolving infrastructure needs as conditions change and aging basic structures need to be replaced. Paying for these projects, whether borrowing or using general revenues, could become a challenge for several reasons related to financing and taxation. Uncertainty is created in the municipal bond market, especially when these risks compete with other economic and demographic needs. For example, during the COVID-19 pandemic starting in 2020, many people in developed countries emigrated from larger cities and may not return. Climate-related emigration, as temperatures become unbearable and/or sea level rises, could similarly impact property tax collections negatively. State and federal grants provide infrastructure support in the United States, but local taxes come from a combination of income, property and sales taxes. Income tax collections were more robust than expected during the pandemic, but sales taxes were below recent years. This all impacts the tax base and local funding of projects. At the same time, inflationary pressures on housing have increased the tax base for some locations. How are towns and cities supposed to plan with all this uncertainty?

Those buying municipal bonds are often driven by preferential tax treatment, so unsettled tax rates can also add to the volatility of these investments.

2.4 LEVERAGING SOLUTIONS

Cities must constantly manage risks from all directions so must consider building resilience and interactions between risks. A smart city, with a goal to improve operational efficiency, can utilize its internet and 5G capabilities to better manage traffic flow and scheduling the routes for city services (where applicable) like trash pickup and snowplows, improving communication about schedules and dynamically adjusting traffic signals. On the downside, this may also leave the system open to cyber hacking. These efforts provide indirect benefits to climate change solutions. Much of this relates to transportation, setting up scooter and bike sharing facilities and developing smartphone apps combining information about bus, light rail and other forms of transit.[13] Even Google Maps now shows you fuel-efficient routes.

Section 3: Large Cities

Urban locations are warmer than their rural counterparts, but cities and individuals can take actions to lower the impact.[14] A large percentage of the population lives in metropolitan areas, where heat events can lower quality of life and impact health. Large cities are often the oldest, with infrastructure to match. This is exacerbated by urban heat islands, which create feedback loops directly or indirectly that should be considered in developing a localized response. The largest temperature differentials between urban and nearby rural areas in the United States are above 7°F, in locations like New Orleans, New York, Cleveland and Fresno.[15] This can make it difficult to work outside for long periods. It also creates physical and mental stress on healthy individuals, but especially for those who have underlying health conditions. Heat emissions come from transportation, machinery, appliances, industrial facilities, and the heating and cooling of buildings. Some, like air conditioning, contribute to a feedback loop by warming the

[13] Groth, Drew and Riehl, Jonathan. *Smart City Infrastructure: A Background for Risk Management.* Public Risk Management Association. October 2021. www.primacentral.org/education/podcasts-blog/smart-city-infrastructure-part-1/
[14] Note that urban has no standardized definition and heat islands can be localized to a small area, neighborhood or an entire city or metropolitan area.
[15] *Hot Zones: Urban Heat Islands.* Climate Central. July 14, 2021. https://www.climatecentral.org/news/urban-heat-islands

outdoor air and incenting air conditioning units to be added. This increases greenhouse gas emissions and makes the location hotter. Historically underserved communities, who already face barriers to many services, often bear the brunt of these events as they reside in industrial areas more prone to pollution and concentrated buildings. Factors that combine to determine high 'intensity scores'[16] are driven by contributions from the

- Albedo effect – since hard and dark surfaces absorb sunlight, limiting roads, buildings and parking lots as a percentage of surface area helps to reduce temperatures. Neighborhood parks (green spaces that create shade) can provide respite from the heat and designing cool roofs (made of reflective material) or green roofs (e.g., rooftop gardens) can also be beneficial.

- Percentage of greenery – adding vegetation helps to cool the air through evapotranspiration. Leaves absorb heat, causing water to evaporate and cool the air. Green spaces also increase soil moisture, which slows down stormwater runoff. Planting local species of trees can increase shade, cooling the area, and also aid in water management while minimizing the likelihood of invasive species interacting with the existing ecosystem in unexpected ways.

- Building height and shape – tall buildings and narrow urban canyons block the flow of air that would help to dissipate heat, with an added impact of keeping pollutants from dissipating (although they do provide shade).

Other solutions can be novel. New York City developed an artificial barrier against storm surge from hurricanes by placing discarded subway cars along the Atlantic Coast.[17]

3.1 CHICAGO

Originally built on marshes that mostly drained away from Lake Michigan, Chicago (Illinois) provides an engaging example of how a city adjusts to increasing cement cover and concern for their water source and sewage removal. Some citizen groups advocated for green infrastructure (adaptations to keep water out of the system) using detention ponds, rain barrels and home gardens that pools rainwater to allow localized soaking into the ground and also serve as pollinator habitat. Instead, the Deep Tunnel Project (officially the Tunnel and Reservoir Plan, or TARP)[18] was undertaken. This gray infrastructure project works in concert with the existing sewer system. Previously, when a sewer overflowed, it was pumped directly into local rivers and the lake without treatment. Instead, the overflow travels into 109 miles of deep tunnels that temporarily fill reservoirs until the water can be safely treated.

Chicago's flood exposure is not the same as when the TARP project was designed, and the changing climate has made storms impact the area even more. The city floods today more than it did prior to TARP becoming operational.[19] One wonders, given that the plan was designed in the 1970s, if the 2029 completion date will be the end of the project or if new and bigger tunnels will be needed.

[16] Ibid.
[17] Young, Michelle. *See stunning photos of NYC subway cars dropped into the ocean to become reefs.* Untapped New York. March 2019. https://untappedcities.com/2019/03/18/see-stunning-photos-of-nyc-subway-cars-dropped-into-the-ocean-to-become-reefs/
[18] Metropolitan Water Reclamation District of Greater Chicago. *Tunnel and Reservoir Plan (TARP).* https://mwrd.org/tunnel-and-reservoir-plan-tarp
[19] Grabar, Henry. *Tunnel Vision.* Slate. January 2, 2019. https://slate.com/business/2019/01/chicagos-deep-tunnel-is-it-the-solution-to-urban-flooding-or-a-cautionary-tale.html

3.2 CLEVELAND

In a process known as green gentrification, environmental improvements can drive out existing residents by making it too expensive to live in the area. Instead, some advocate for strategies that are 'just green enough' to improve conditions for existing residents without attracting upscale developments.[20]

Cleveland (Ohio) lost nearly half its population between 1950 and 1990 due primarily to industrial job losses. It also endured an environmental event when the local Cuyahoga River caught fire in 1969, making it harder to induce people to move to the area and replenish the local tax base. Initially, vacant lots were converted into community gardens and stormwater management sites as an economical way to improve quality of life. A green agenda became a form of job creation and economic growth, used to market Cleveland as a green city with a bright future. Terms for programs like Thriving Communities: Creating Healthy Cities were full of positivity and found to be useful for Cleveland to be viewed in a positive light.

Other municipalities, especially those in jurisdictions where government stimulus money was limited to environmentally friendly projects, have used COVID-19 as an opportunity to develop areas that are free of automobiles and pedestrian friendly. Others have used major events like earthquakes and floods to jump start projects.

3.3 CAPE TOWN

Many regions around the world have memories of historic disasters that contribute to successful climate projects. Economic growth is not always the primary objective. Others are simply trying to survive day to day and combining that with climate risk challenges to form solutions to make everyday life better and improve climate resilience. In Cape Town (South Africa), a recent drought led to the aquifer relied on for fresh water to get very close to empty. It got so bad that a 'Day Zero' campaign was mounted to identify when water taps would run dry. This had a hidden benefit of putting everyone into the same situation regardless of socioeconomic circumstances, reminding everyone that water availability is more important than economic growth. Poverty relief became the goal, and ownership of solutions like building 'off-the-grid' renewable electricity zones and localized water infrastructure like rain barrels and grey water management became integrated with other solutions.

3.4 MIAMI

The city of Miami (Florida) has long been of interest to those fascinated by climate change. Sea level rise is already affecting the city, with King Tides (high tide during a new or full moon) regularly flooding parts of the city. Concerns arise due to wealth inequality between residents and because the city sits on a bed of limestone. This type of rock, rather than holding back water, acts like a sponge and allows water to reach under the city through the water table. Beyond flooding, another concern is that this will contaminate the region's source of fresh drinking water with salt water.

While heat waves are a concern to health, floods and hurricanes are the immediate threat to the livability of Miami that the city seeks to address. Sea level is expected to rise by as much as 34 inches by 2060 (relative to 1992 mean sea level).[21] This will lead to higher storm surges and more powerful hurricanes. The city leaders are concerned about a shift to risk-based insurance for flood protection and an increased interest in the topic from bond rating agencies and mortgage companies, resulting in potential higher costs to residents.

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[20] Jon, Ihnji. *Cities in the Anthropocene: New Ecology and Urban Politics.* Pluto Press. 2021.
[21] City of Miami, Division of Resilience and Sustainability and Climate Resilience Committee. *Climate Change in the City of Miami.* https://www.miamigov.com/My-Government/ClimateChange

The Miami plan is forward looking, leveraging several goals at once while working simultaneously on stormwater, urban heat islands, drainage systems, tidal barriers and seawall standards. It is technically focused, favoring a sea wall rather than nature-based solutions. In the long run, it may be that hurricanes are a distraction from the threat posed by sea level rise. If the lower third of Florida is expected to be under water in less than one hundred years,[22] then is it an option to try to form an island around Miami, or is its loss inevitable? This is the question in coastal cities around the world. Migration, initially voluntary (and often to cities) but potentially forced, will occur as areas become unlivable or expensive solutions force many residents to leave as a result of gentrification. Many cities and individuals will be forced to make difficult choices.

Section 4: Mid-Sized Cities

Darwin (the capital of Australia's Northern Territory) is located near beautiful national parks and large fossil fuel resources, but climate change is having negative consequences. Tulsa (Oklahoma) has similar challenges. In neither has job creation been typically presented as a by-product of carbon reduction. Extreme weather events have impacted both, with heat waves and cyclones in Darwin and tornados, extreme heat and ice storms in Tulsa. Each moved climate projects forward after a large meteorological event made it clear that something had to change.

Through its Design with Nature program, Tulsa has built a state-of-the-art stormwater management system, turning flood-prone zones into green spaces with recreational bike trails.[23] Darwin reached out to its local indigenous peoples to incorporate their knowledge of the region through projects like building a resilient urban forest and cool fire (prescribed burns) that increases biodiversity and soil health. The Cherokee Nation (Oklahoma) built a solar canopy car-charging station for use by its tribal complex. Indigenous peoples that have lived in an area the longest often have wisdom they are willing to share with newer arrivals if they are only asked.

Pragmatic environmentalism is inclusive, moving beyond the us/them of environmental activism. Words like 'nature' and 'environment' are avoided, recoded to describe air and water quality and civic amenities. It's all about describing the economic and health benefits of choices.[24] These types of projects seem to have more examples among mid-sized cities. Tulsa collects county sales tax for river corridor redevelopment. Larimer County, in Colorado, does the same in support of natural areas with much of the funding going to develop and maintain outdoor recreational activities like trails and damsites. In Addis Ababa, the capital of Ethiopia, a public-private partnership converts local garbage into 20 megawatts of power.

Section 5: Small Cities

Much like small entities of every kind, small cities are often overstressed and under-resourced for staff and funds. The climate risk is no different and both the risk and their response continue to evolve. Small cities need to leverage solutions developed by their peers, larger government entities and non-governmental organizations (NGOs) in order to anticipate risks and deal with them proactively. Three examples follow.

Decorah (Iowa) is a typical midwestern town in the United States, located on the Upper Iowa River, and serves as an agricultural hub. The county seat has a population below 8,000. It is prone to flooding, with two events in the last 20

[22] Luscombe, Richard. *Will Florida be lost forever to the Climate Crisis.* The Guardian. April 21, 2020. https://www.theguardian.com/environment/2020/apr/21/florida-climate-crisis-sea-level-habitat-loss
[23] Jon, Ihnji. *Cities in the Anthropocene: New Ecology and Urban Politics.* Pluto Press. 2021.
[24] Ibid.

years.[25] Working with the Woodwell Climate Research Center, they first determined which local hazards and disaster scenarios were most relevant (other risks that could be considered include drought, wildfire, extreme wind and landslides). A flood model was built that incorporated precipitation, stream flow and storm surge, focusing on one-in-100 and one-in-500 year floods. It was important to involve local expertise concerning previous floods and mitigation/'adaptation efforts, as well as other stakeholders. Zoning ordinances, previously built dikes and elevation levels were considered when updating existing FEMA (Federal Emergency Management Agency) flood maps. Development planning efforts could then incorporate this information and avoid specific areas known to be at risk. This type of process can be replicated in other localities with limited resources.

The development of Rapid City (South Dakota), gateway to the Black Hills, was influenced by a major flood on Rapid Creek in 1972 that left hundreds dead, thousands injured and nearly $1 billion in losses (adjusted for inflation to current times).[26] An inflow of aid allowed Rapid City to rebuild following a plan that had previously been developed, based on knowledge of the flooding risk. Today, green space provides a buffer around Rapid Creek, recreation for residents, and increases the ability for the ground to absorb rainwater. To date, there have been no major recurrences.

Omaha (Nebraska) has long been prone to flooding, often due to the Papillion Creek Watershed rather than the nearby Missouri or Platte Rivers. The watershed is fed by small creeks that consolidate into three larger creeks before combining into one and emptying into the Missouri River just north of the mouth of the Platte River. The local Papio-Missouri River Natural Resources District developed a plan following a 1964 flood, building damsite lakes on feeder creeks and dynamic flood mitigation systems throughout the area using integrated catchment management. Like other projects, a by-product is green space for recreation and a reduced floodplain.[27] Future maintenance will still need to be considered, as the catch-basins will fill with sediment that needs to periodically be removed.

Section 6: Role of Insurance

The insurance protection gap, noting the difference between economic and insured losses, can be addressed through mitigation techniques that reduce premiums to make them more affordable. Educating the public about ways to reduce property risk exposure can better match their needs with an insurance policy.

Global catastrophic events have recently been dominated by climate related risks.[28] Greater frequency and severity, along with enhanced socioeconomic development, has led to a growing financial impact. Market-based incentives for adaptation and mitigation have been utilized by the insurance industry and can become a greater part of solutions as incentives become aligned. If you build a house in the woods, the insurance premium should reflect relevant future climate-related risks, such as wildfires. If you build on a coast that historically has been ravaged by hurricanes and is susceptible to sea level rise, the insurance premium should reflect that risk as well. Opportunities exist for mitigation efforts that reduce expected property losses. Alternatives include loss of coverage and litigation. These insurance feedbacks, if allowed to persist in a market driven environment, can help responsible decision making and reduce inequality.

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[25] *Risk team delivers climate risk analyses to under-resourced communities.* Woodwell Climate Research Center. June 10, 2021. https://www.woodwellclimate.org/risk-team-delivers-climate-risk-analyses-to-under-resourced-communities/

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Section 7: Leaders and Laggards

Adaptation practices differ widely between cities and regions. Those who plan proactively based on their specific risk profiles will build resilience and be better able to respond to acute and slow-onset forms of climate emergencies. Inclusivity is key, as noted in other sections. Cities should involve their local region so incentives align (for example building codes should be consistent or the risk level and eventual cost will not be reduced).

Cities and states are often trapped in political debates. In the U.S. Plains States, Lincoln (Nebraska), Kansas City (Missouri, Kansas) and Minneapolis (Minnesota) have climate action plans and Des Moines (Iowa) is developing one.[29] The Nebraska legislature has rejected creation of a statewide plan, despite hosting the National Drought Mitigation Center at the University of Nebraska. Omaha announced in November 2021 that it would develop a climate action plan by working with utilities and other business interests. There was no mention of inclusively working with groups that suffer from previous discrimination or inequality.

Some companies and sovereign nations have attempted to divert the discussion through marketing techniques, called greenwashing, also seen during the tobacco wars. One well publicized investment disclosure process, TCFD (Task Force on Climate-Related Financial Disclosures), allows self-reporting and does not require the information to be audited. This means that some companies will profess to be more environmentally friendly than they are.

Section 8: Conclusion

Many cities have taken the lead using a wide range of techniques in planning to respond to upcoming climate risks. While others talked, smaller political entities implemented local solutions that can be repeated elsewhere. During these projects indigenous peoples and those representing lower socioeconomic groups were often acknowledged as part of a team that improved climate resiliency while also reducing wealth inequality and increasing ownership in the projects by the community.

Purely technical solutions often have high price tags and unintended consequences. Localized nature-based projects and those incorporating communities in lower socioeconomic groups are more likely to succeed and add secondary benefits to the region. Pragmatic environmentalism techniques have been found to be useful here.

Insurers and institutional investors can provide incentives for reasoned decision making. By working together with all groups in a community, local solutions can be leveraged to create climate mitigation and adaptation strategies that are transferrable to other locations.

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