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# Climate Change Is a Chronic Condition

## And Policymakers Need to Respond to It Accordingly

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Last June, dozens of flights were canceled for multiple days at Phoenix Sky Harbor International Airport. The culprit? Extreme heat, grounding planes not able to operate at temperatures above 118 degrees Fahrenheit. Two months later, trillions of gallons of rain fell on Houston in the space of just a few days. The city's third "500-year flood" in just three years, the storm damaged more than 200,000 homes. The estimated damage is over $100 billion. Recovery from the flood, which displaced nearly 40,000 people, is expected to last for years. Fast-forward to last September, when Idaho battled 23 active wildfires, caused by dry and hot conditions making lightning strikes exceptionally dangerous. Smoke in the air kept children inside for days and cost the state over $20 million in fire suppression. Nearby Washington and Oregon experienced similar losses.

These incidents took place over a few months in the summer and fall of 2017. That's just one snapshot in time: one could easily point to more recent developments, including Hurricane Florence's destructive and deadly path through the Carolinas; the wildfires currently devastating wide swaths of central California; or the fact that southern Japan just suffered devastating flooding [1] that drove two million people from their homes and destroyed 10,000 houses [2].

Continuing shifts in climate around the United States and the world are driving up current and future costs, putting new strains on short-term emergency response but also on long-term investments and economic growth. These are no longer one-off events but chronic problems, and managing them requires a fundamentally different approach from the way most policymakers currently think about climate change.

## CLIMATE CHANGE ACTS LOCAL

For many Americans, climate change still seems like an esoteric global issue, too far removed from daily life to rise to the level of urgency. But climate change is not someone else's problem—it's a profoundly local issue, with both acute and chronic impacts being felt across the country.

The brunt of costs falls on cities and states. Already, climate impacts ranging from extreme heat (Phoenix, Los Angeles) and sea level rise (Miami, Norfolk) to inland flooding (Grand Forks, St. Louis) and warming winters (Minneapolis, Aspen) are taxing state and local governments: in 2017 alone, there were 16 climate-related disasters in the United States that each caused $1 billion or more in damages. These costs hammer cities in the short term but also mortgage their future, as bond-rating agencies begin to downgrade cities based on frequent climate events. The climate analytics group Four Twenty Seven, which recently came up with a set of "climate risk scores" [3]to help investors better understand the specific risks to U.S. cities, notes that after 2017's Hurricane Harvey, "Moody's downgraded Port Arthur from A1 to A2

due to its 'weak liquidity position that is exposed to additional financial obligations from the recent hurricane damage . . . above and beyond the city's regular scope of operations.'" Many firms are increasingly incorporating climate risk into their municipal credit analyses.

Climate impacts are also causing businesses to relocate and change their models. The nonprofit Carbon Disclosure Project, which collects climate risk and carbon emission disclosure information from more than 6,000 companies, has found that over 70 percent of global companies believe physical climate impacts will disrupt their supply chains and are making key investment and location decisions with an eye toward these impacts. Investors and insurers, too, are turning their attention to climate risks as they evaluate the essential resilience of their portfolio companies. Swiss Re, one of the world's largest reinsurers, will no longer insure companies that get 30 percent or more of their revenues or power from coal. Similarly, the Church of England's $16 billion investment fund will no longer invest in companies that fail to meet the 2023 terms of the Paris agreement. This will magnify further as the physical threats of climate change become more localized.

## THE CHRONIC NATURE OF CLIMATE CHANGE

The rising burden faced by local and state governments, companies, supply chains, and communities reminds us of the rise in costs of chronic health-care conditions. Imagine the increase in U.S. climate costs as akin to the increase in U.S. costs of type 2 diabetes, a long-term metabolic disorder caused by too much sugar in the blood and not enough insulin. The symptoms—thirst, drowsiness—seem modest, but the long-term complications from the disease include heart failure, stroke, blindness, kidney failure, and occasionally amputation. Type 2 diabetes is largely preventable—it's caused by overeating, lack of exercise, and too much sugar in the diet. Despite that, epidemiologists project a severe increase in diabetes in the United States over the next decade. From 1990 to 2010, the number of cases has tripled, as has the rate of incidence. Today, 30 million Americans have diabetes and 83 million have prediabetes. Experts predict a 54 percent increase by 2030 to approximately 55 million people, with societal costs of $622 billion each year.

Before chronic diseases such as diabetes had become so widespread, many medical systems, including emergency medical response programs, were traditionally configured in training and operation for acute care. But in 2002, the World Health Organization published a report calling for a shift toward chronic care, noting this structural problem and suggesting specific actions that national and local governments could take to improve care and reduce costs.

The country faces the same mismatch between past and present when it comes to dealing with the chronic nature of climate change. Imagine carbon is like sugar, natural carbon uptake (as in forests and soil) is like insulin, and rapid emissions growth is like overeating. Absent a shift to chronic climate care, society will suffer growing impacts with increasing severity.

## THE HEAT IS ON

Thanks to advances in climate modeling, we know far more about the physical impacts of climate change on specific regions than we did even five years ago. The work of the Intergovernmental Panel on Climate Change to model climate impacts, spelled out in the U.S. Fourth National Climate Assessment [4], the bipartisan Risky Business Project [5] (founded by one of the authors, Kate Gordon), and a number of state-level reports provide a foundation to assess local and regional physical impacts and their potential economic impacts.

One of the key model findings is the march of extreme heat across southern and western U.S. states. Over the next several decades, states such as Arizona are expected to see many more days over 95 degrees Fahrenheit, adding up to an additional one to two months each year of these extreme temperatures. This year has also seen extreme heat waves in Canada (where up to 70 people died as a result), Los Angeles (where temperatures surpassed those in Death Valley earlier this summer), and Japan (where dozens died [6] and over 22,000 were hospitalized).

Increasing heat is a classic example of a chronic climate impact—slow moving, with the most extreme effects in the future. But the impact on regional economies today cannot be ignored. Agriculture suffers the brunt of these effects—commodity crops in southern midwest states such as Missouri and Illinois will see a 15 percent average yield decline by midcentury as temperatures rise. Already major agricultural companies are looking for suppliers in more northern areas, including all the way to Canada, to adjust for warming temperatures farther south. High-value specialty crops such as wine and fruit are even more temperature-sensitive. Eastern Washington State is seeing a boom in vineyards as temperatures climb in California. Almonds, an extremely water-dependent crop, are increasingly threatened by western drought conditions. And in Georgia, nearly 85 percent [7] of the state's peaches were destroyed after 2017's warm winter.

Animals, too, are heat-sensitive, and managing their temperature is a major business cost. Although it's possible to cool down mammals such as cows or pigs through constant misting with water, chickens are harder to cool. Providing air conditioning for longer periods each year has convinced some major chicken producers to think about moving their animal operations north or to invest in more costly poultry-housing designs that can withstand higher temperatures.

Heat also affects the ability of humans to do their jobs efficiently and well. A significant economic impact on the U.S. economy from unchecked climate change is the decline in labor productivity due to increasing temperatures. This is most evident in industries where workers have to spend hours outside, such as construction, agriculture, and some transportation and manufacturing. Extreme temperatures have already impacted the construction trades in the Southwest, where road repairs are increasingly done at night [8], leading to high overtime and additional lighting costs.

Naturally, industries are busy working to adapt to these conditions. Already a strain of heat-resistant chickens is being developed [9]by the University of Delaware, and the agriculture sector has long relied on genetically modified seeds made to withstand challenging climate conditions. But we need a more consistent, forward-looking strategy to deal with the impacts we know are coming down the pike.

## WARMER WINTERS

Another chronic effect of climate change is warmer winters. The small U.S. ski towns that host 55 million visitors each year depend on snow for their livelihoods. Last year saw a ten percent decrease in skiers due to low snow conditions and $1 billion in lost revenues [10]. Aspen, Colorado, one of the wealthiest municipalities in the United States, opened its first soup kitchen [11] last season because of lost revenues.

Scientific projections suggest those "low snow" periods are now a chronic condition that will worsen: a recent study [12] indicates that by 2050 there will be a 50 percent decrease in the number of snow days across the country, and all regions will receive less snow than they do today.

In these same regions, a warming climate is causing pine bark beetle infestations that have killed enormous numbers of trees. Pine bark beetles and related pests die off in cold winters. When winters are warmer, pests destroy trees, leaving forests devastated. This puts mountain communities at a fire risk. In 2017, over 70,000 wildfires caused more than $12 billion in damages across ten million acres [13], mostly in the mountains. The 13 western states had a "very high" combined exposure risk exceeding $49 billion that encompassed four million homes. Alaska has warmed twice as fast as the rest of the nation and is hit hardest by warm winters. One example is the shortened season for ice roads, which are used for almost all heavy equipment on the North Slope. In addition to avoiding environmental damage to the tundra, ice roads cost $400,000 per mile to build—construction that supports both local workers and industries. Average temperature in Alaska has increased 6.5 degrees Fahrenheit over the past century, mostly since the mid-1970 [14]s. Since that year, the season for ice roads has shortened dramatically—a 50 percent reduction, which translates into approximately 60 fewer days of reduced economic productivity.

Climate change affects permanent infrastructure as well, including pipelines and foundations. Melting permafrost, which causes heaving of foundations and settling, is the main culprit. Over 100,000 Alaskan citizens live on permafrost, and 87 communities with roughly 40,000 inhabitants are at risk [15] of permanent damage. Associated costs are expected to add [16] $3 billion to $6 billion over the next 20 years, including water and sewage disruptions.

## FUTURE FLOODS

Flooding is another type of chronic climate condition, both the coastal flooding stemming from sea level rise and the flooding from climate-related storms. On the latter, the experience of the Greater Houston area is instructive. Although the flood damage caused by Hurricane Harvey was unprecedented, Houston has experienced seven episodes of extreme flooding since 2001—including the devastating Tropical Storm Allison, which dropped 40 inches of rain on the city, and the 2016 Tax Day Flood, with over 17 inches of rain, eight fatalities, and the destruction of 700 homes.

A shift in thinking to "chronic climate care" can help cities such as Houston recover, regroup, and plan more effectively for the inevitable future floods and other climate events. Some of this involves classic infrastructure investment: culverts can be widened, pumps installed, and impoundment dams built. Other aspects of the shift would be novel, such as installing permeable concrete paving systems, which allow rainwater to infiltrate into the soil over large areas.

Today, Houston is beginning to reassess its water impoundments and dams through the lens of chronic-care planning. The city has two upstream impoundments [17], both built during the 1930s as public works projects. The dams were not designed for such regular extreme weather and are listed by the U.S. Army Corps of Engineers as "extremely high-risk" cases for both seepage and overspilling. Houston and the corps are also studying additional impoundments, levees, dam repairs, and dam improvements under Section 216 of the Water Resources Development Act. Although these proposed actions are not cheap, they are a bargain compared with the $120 billion to $250 billion price tag of Hurricane Harvey, much less the cost of the next round of storms. Meanwhile, Houston Mayor Sylvester Turner has proposed to tighten development rules [18] to strengthen the city's flood resilience, including updating the "500-year" floodplain for new construction. He also plans to direct builders to provide more storm-water retention for large parcels in development. These are initial steps, and more may be required, but they reflect the recognition of a new climatic base line that requires different approaches to local governance.

## HOW CITIES CAN RESPOND

Climate change impacts are now a permanent feature of our world. This means the task of managing them is a permanent and ongoing responsibility for government staff at all levels. There are several steps that cities and states in particular, standing as they do at the frontlines of these climate impacts, can take as they shift climate policies from triage to chronic care.

First, cities and states clearly must acknowledge not only the need to reduce greenhouse gas emissions but also the need to manage the physical impacts of chronic climate change. Cities in particular should commission climate risk analysis using available climate science modeling that factors in both acute and chronic climate conditions over several decades. Once this analysis is in hand, cities need to incorporate climate risk considerations into local planning decisions every time they consider an investment in infrastructure, real estate, or other long-term, place-based assets. They should consider adding staff with relevant expertise and requiring contractors bidding on projects to demonstrate the climate resilience of their design.

Cities should also work across departments to move toward decarbonization. Investing in distributed energy systems often has the added advantage of making many cities more resilient, since these systems are less likely to go down in a storm or under extreme heat conditions. They should add options to directly reduce carbon dioxide emissions, including carbon dioxide removal and purchasing low-carbon concrete, steel, and other building materials. Municipalities that lead on resilient and low-carbon city design can use this as a competitive advantage to attract companies, especially those with strong sustainability goals or resilience needs. Finally, municipalities should focus on moving financial assets into climate-smart projects, such as resilient development and low-carbon energy generation, using mechanisms that include municipal "resilience bonds" and city pension funds. Although such financial approaches can be politically tricky, reframing this as a necessary long-term investment in prosperity can build public support.

## FUTURE FORECAST

Already some cities and leaders have begun to act. One example is Tulsa, Oklahoma, where municipal leaders have taken steps to manage chronic flooding, including construction of retention ponds, stringent application of flood maps to development, and relocation of flood-prone homes. This has led to a dramatic reduction in the city's flood insurance rates. The U.S. Department of Defense has done the same. To maintain readiness and avoid burdens to taxpayers, it assesses how climate change affects not only future threat profiles but infrastructure function and cost. At the Norfolk Naval Station, headquarters of the U.S. Atlantic Fleet, the Department of Defense and U.S. Navy acknowledge the risks from chronic and increasing sea level risk and have made plans to manage and adapt to tidewater risks over the next ten years.

Judicious planning and proactive investments can and will minimize U.S. costs and damages from long-term climate impacts. It's time to recognize that this is a chronic illness, not a passing cold—and plan accordingly.



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