

Climate

The continued reliance on fossil fuels has led to higher greenhouse gas emissions, far exceeding the Paris Agreement's goal. Climate scientists have warned of the consequences of a "business as usual" trajectory for decades now, and they believe their IPCC efforts have proven futile. Human exposure to climate extremes in 2050 is now double compared to at the start of the century. For example, heatwaves in locations such as Phoenix, Arizona, are now nearly twice as frequent compared to 2020, with locals experiencing 150 days above 100° F. Furthermore, the urban heat island effect puts urban communities at even higher risk during extreme heat events. Cities across the U.S. are providing hydration and cooling stations at record levels, but their accessibility to vulnerable individuals, especially the homeless and elderly, continues to be a challenge. Extreme heat events are therefore still the leading cause of weather-related deaths, health care facilities are strained during prolonged heatwave events, and local leaders are working to implement additional heat adaptation measures to better protect all members of society.

In addition to experiencing heat extremes, the population are now at much higher risk due to flooding. Warming oceans and melting glaciers have led to a mean sea level rises in the U.S. of 16 inches. Low-lying developed areas along the mid-Atlantic, South, and Gulf coast regions are regularly experiencing coastal flooding. This flooding has been made even worse due to increased hurricane intensity, especially in the Northern Atlantic. More intense hurricanes are evident in their stronger winds (more Category 4 and 5 hurricanes), stronger storm surges, and increased rainfall amounts (by 15%). The effects of sea-level rise and more intense hurricanes are compounding, and Mid-Atlantic coastal towns are especially experiencing the consequences. During the 2050 hurricane season alone, several coastal communities have been entirely displaced due two Category 4 hurricanes. The loss of life due to these events has been minimal though due to improved seasonal and short-term predictions (i.e., next three days) of hurricane activity. These predictions are a result of Congress boosting appropriations to NOAA for hurricane research and forecast advancements since 2040. The outcome of this investment is an increased capacity for communities to prepare for hurricane seasons, with much of the preparedness effort directed by emergency managers.

Despite these recurring catastrophes and incentives for individuals to rebuild in lower risk areas, many people continue to live in coastal areas, evacuation procedures are becoming a more regular occurrence during hurricane season, and record-breaking levels of property damage is challenging the insurance industry. Inland regions are also experiencing increased property damage from flooding due to convective storm events that are occurring more frequently CONUS-wide. In particular, the Southwest region is experiencing the greatest increase in flash floods (an increase of more than 10%). Flash flood events leave communities with little to no time to prepare, and so despite overall increases in the populations' disaster preparedness efforts, cities are urgently implementing greater adaptation measures to make them more resilient to flooding. Cities have the necessary resources to complete these implementations and protect their communities from growing flood risks. Additionally, many households can afford their own mitigation and preparedness efforts, including floodproofing their properties, securing flood insurance, and developing emergency

plans and buying emergency supplies. Under-resourced communities are supported by government shelters and reconstruction efforts.

The Southwest region has also implemented geoengineering disruption capabilities by injecting clouds with sodium chloride to force flash flood events prior to convection reaching built-up and populated locations. This disruption capability raises many ethical questions about when, where, and who flash flooding impacts, and has potential to introduce tensions within and across states. In the face of continued natural hazard uncertainty, individual households are also undertaking their own adaptation and preparedness efforts, including flood proofing their properties, securing flood insurance, and developing emergency plans.

Society

The performance of the U.S. economy has helped to increase opportunity across income groups and contributed to record low poverty across most of the U.S. This allows the government to invest in expanding the social safety net, resulting in greater access to education, healthcare, and social security benefits for older and disabled Americans.

Due to the general failure of the 2015 Paris Agreement to translate into meaningful reductions in greenhouse gas emissions by mid-century, the U.S. population rates climate change as one of its greatest concerns and there is significant climate anxiety. Improvements in tracking climate-related morbidity and mortality generates sobering statistics on the growing impacts of climate change on the U.S. population. The White House Climate & Health Emergency Summit in 2045 reported that annual heat-related mortality had exceeded 10,000 per year. The anticipation of continued growth in global warming and escalation of climate-related risks throughout the rest of the century have triggered a broad movement toward disaster preparedness. Local, state, and federal governments collaborate to enhance resilience, including buybacks of repetitive loss properties. The buyback process has been facilitated by mandatory climate disclosure laws enabled in Sunbelt states by negotiations with developers that not only allowed for greater new construction density in areas deemed at less climate risk, but also more stringent building codes that could compel greater profit margins for FORTIFIED 3.0 standard-compliant homes.

Population growth and sprawling urbanization drive steady land use conversion, thus contributing to degradation of biodiversity, reduced ecosystem resilience, and increased greenhouse gas emissions. Rapid growth in climate litigation during the early 2030s helped to enshrine the principle of “right to relocation,” meaning communities at the risk of repetitive or existential loss due to climate change have the right to be compensated or relocated to address risk when technological solutions such as better sea walls or cheaper water desalination will not help them anymore. The Climate Resilience Investment Act of 2035 helped create the appropriate mechanisms by channeling windfall corporate earnings into state budgets for resilience measures. This created a window of opportunity for movement for the widespread movement of people away from climate-vulnerable areas and out of

harm's way. The Act was first pioneered by using oil and gas revenues in Alaska to resettle indigenous communities in the face of declining permafrost and coastal erosion.

These trends are offset, however, by an increase in the value placed on greenspace, which incentivizes conservation. In particular, nature-based solutions to resilience are embraced as a win-win solution – addressing substantial resilience challenges while also reducing the degradation of the environment associated with the growing economy.

Economy

By 2050, the U.S. economy is continuing an uninterrupted economic expansion that is second only to that of the 1984-1999 boomtimes under Presidents Reagan and Clinton. The explosion of the innovation-based knowledge economy makes the U.S. a global leader in entrepreneurship and investment of capital in a thriving business environment. This growth is fueled, in part, by a relaxation of environmental regulations, particularly around carbon. Concerns for climate change have enhanced the perceived need to grow the economy to enhance the Nation's resilience. This was a cornerstone of President Bartlet's 2040 campaign mantra: *"A strong economy is the best defense against a changing climate."*

The Nation's economic success is a result of the serendipitous alignment of multiple factors. A multi-year legislative push in the late 2030s resulted in a sweeping immigration reform including a flexible guest worker program targeting young, skilled workers from around the world. The influx of talent results not only in high labor productivity but strong growth in high-tech industries including various forms of automation, virtual and augmented reality, and applications of artificial intelligence. There is strong demand for these innovations among American consumers who readily open their wallets to keep the economy growing. Concern for the social and environmental externalities of growth is muted, due to firm belief in the ability of technological innovation to offset negative impacts of growth. However, continued exploitation of natural resources, land use change, and declining biodiversity suggest such techno-optimism may be unwarranted with advocacy groups issuing increasingly strident warnings about looming tipping points of no return for threatened and endangered species as well as threats to food security.

The private sector leads investments in research and development, human capital, and infrastructure to maximize economic gains and to meet the need for human capital as well as efficient, robust, and resilient infrastructure systems to enable commerce. With the economy experiencing steady growth, policymakers are under pressure to keep the good times going. Hence, government institutions collaborate with the private sector to incentivize innovation, business development, and extra-regional trade. Massive growth in subsidies, particularly for high tech industries combined with massive borrowing in the face of low borrowing costs raises fears that the U.S. is vulnerable to a tech bubble. Comparisons are made to the collapse of China's property bubble in the late 2020s that set its development back a decade. But these are largely ignored by those who see plenty of opportunity to continue to profit.

Not everyone has prospered in the booming economy. The Nation's fascination with technology has negative impacts on those industries that struggle to finance the recapitalization needed to remain financially viable in a techno-centric economy. This leads to adverse, but localized, economic impacts across the U.S., particularly in rural areas and disadvantaged communities of color that were left out of the technology transition.

Technology

The country has never been healthier; personalized medicine paired with genetic testing means that diseases are caught early and treated well. While high quality care is resource-intensive, the U.S.' older population can regularly be seen exercising and working with synthetic limbs. A new surgery that improves eyesight is so popular that the elderly are just as likely to be willing to evacuate during nighttime, increasingly necessary with the rapid intensification of hurricanes, as their younger counterparts. Because emergency responders take longer to age out of the physical demands of their positions, the workforce has bifurcated and the part that has been around for more than 15 years (and calls themselves the "old guard") are better trained and more specialized than they were 20 years ago.

More training is essential for senior staff because of how much more data there is about a disaster and how many more technological options there are for responding to it. Often, autonomous or remote-controlled robots are the true first responders to an emergency. Someone must do the relatively dull work of running these robots, and the other part of the workforce does so far from the disaster-zone. To avoid cyberattacks, after large disasters these human first responders sleep in bunkers at dedicated regional bases. Emergency managers advertise these jobs to young people in virtual reality games and are constantly filling vacancies when new hires burn out because the work lacks the human and emotional connection that was previously so integral to the job.

New biomaterials assist with detecting and tracing emerging diseases, but every few years, some novel illness closes schools and businesses for a couple of weeks while scientists work to stop its spread. A series of outbreaks at designated cooling centers during an otherwise standard heatwave led to the hospitalization of dozens of people and a couple dozen deaths. Because journalists uncovered evidence of tampering with detectors that had indicated the presence of unusual viral activity, the families of those who got sick are suing the privatized cooling center operators. These families include those of first responders who wore inadequate contamination protection gear.

While extreme heat, wildfires, hurricanes, and storms are more common, artificial intelligence and an extensive sensor network enable hyperlocal weather information and mean that there are fewer false alarms and resources can be mobilized quickly and efficiently. The majority of the public has had to evacuate their homes at some point, but people expect rescues, emergency relief, and recovery to occur quickly. Most of the time, thanks to investments in remote sensing technologies, emergency responders can estimate the location and extent of damage.

The public has grown accustomed to knowing exactly when and where extreme weather will hit. After meteorologists underestimated the duration and intensity of a heat dome that affected the Midwest, the federal government ordered an extensive investigation into what information was missed. Many local disaster managers in charge of running cooling centers lost their jobs in the public outcry, leaving a lack of institutional memory.

Geopolitics

The U.S. government has largely given free rein to private technology companies, initially failing to regulate or intervene, but eventually, the divergence from the European Union's strategy bears fruit. Talent flees to the traditional hubs, but blockchain-enabled collaboration enterprises that are disaggregated allow digital nomads to contribute from anywhere in the world. Governments do not develop their own technology and are increasingly reliant on contractors to provide support, which leads to privacy, accountability, and other associated concerns.

The apparent success of the American growth model, however, is the envy of the world. A second round of globalization spurred on by rapid technical progress has resulted in numerous bilateral and a few multilateral free trade agreements amongst "have" countries. Tariffs and other trade barriers present earlier in the century have fallen and integrated capital markets mean that investments can be made nearly anytime, anywhere, as long as they are aligned in a tripolar world with mechanisms such as SWIFT2 (successor to the Society for Worldwide Interbank Financial Telecommunication), the equivalent CIPS (Cross-Border Interbank Payment System), or up and coming MUM-MAX (Mumbai Money Access Exchange). The economic ties amongst the G7 states are deep, but in other areas there are downsides to countries left out of the exclusive economic clubs. For example, global fish stocks outside of protected waters have plummeted. This tension is particularly apparent in Congress of the Parties (COP) negotiations, which are no longer about emissions reductions but apportioning investments for geoengineering projects and countries competing activities on their soil.

The U.S. has courted other G20 members to place their foreign direct investments in the Caribbean and Latin America to help generate the opportunities to resettle immigrants from island nations and other regions that have been impacted by inexorable sea level rise. In exchange, the country has extended its security blanket as well as generous and prompt disaster relief. States, particularly around the Great Lakes and in other climate-stable locales, have taken it upon themselves to solicit similar investments, giving other countries who have exclusive immigration channels a large say in local affairs, with some cities run more like corporations with professional managers governance boards rather than elected mayors and civil servants. While most Americans are happy with the relative amounts and types of civil liberties in their region, it varies substantially depending on the cultural norms of which countries operate nearby and the values of their overseas department citizens.

In recent years, international ecoterrorists have ratcheted up the tempo and intensity of targeted cyber strikes at fossil fuel infrastructure and the systems that enable, for example shutting down chemical facilities, desalination plants, or an autonomous vehicle production line. In addition to the clear dangers of leaks or explosions, water shortages, or economic damages, FEMA has been called upon to help manage strategic stockpiles to avoid disruption. These in turn, have been deemed targets. One of these “resilience hubs” containing petrochemicals had a known vulnerability in its artificial intelligence-monitored biometric security log because of a contractor lapse, and the attack resulted in a large conflagration in a disadvantaged community along the Gulf Coast. Not only has the neighborhood been rendered uninhabitable from contamination – and FEMA been found liable for negligent oversight, but the area is expected to have elevated rates of health issues such as cancer and birth defects over time unless biotechnology researchers can come up with a gene therapy.

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GDP data is derived from:

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Climate Indicators:

- Disaster Declarations are extrapolated from historical data, excluding outlier years of 2011 and 2020, with adjustments to maintain consistency with underlying scenario. Data available at <https://www.fema.gov/openfema-data-page/fema-web-disaster-declarations-v1>.
- Disaster Losses are extrapolated from historical billion-dollar disaster time series, excluding outlier years of 2005 and 2017. Data available at <https://www.ncei.noaa.gov/access/billions/time-series>.
- Exposure to Coastal Flooding metrics are based on Hauer, M.E., Hardy, D., Kulp, S.A. et al. Assessing population exposure to coastal flooding due to sea level rise. *Nat Commun* **12**, 6900 (2021). <https://doi.org/10.1038/s41467-021-27260-1>.
- Heat Index metrics are based on Dahl, K., Licker, R., Abatzoglou, J.T. and Delet-Barreto, J., 2019. Increased frequency of and population exposure to extreme heat index days in the United States during the 21st century. *Environmental Research Communications*, **1**(7), p.075002. <https://iopscience.iop.org/article/10.1088/2515-7620/ab27cf>.

- Wildfire Acres Burned metrics are based on Abatzoglou, J.T., Battisti, D.S., Williams, A.P. et al. Projected increases in western US forest fire despite growing fuel constraints. *Commun Earth Environ* 2, 227 (2021). <https://doi.org/10.1038/s43247-021-00299-0>
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Scenario Narrative:

- For more information on human exposure to climate extremes, see: <https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2019EF001421>.
- For more information on flooding risk and sea level rise, see: <https://www.nature.com/articles/nclimate2736>.
- For more information on shifting intensity of hurricanes, see: <https://www.gfdl.noaa.gov/global-warming-and-hurricanes/>.
- For more information on future flash flooding, see: <https://www.nature.com/articles/s43247-022-00409-6>.