

expected around the world and are likely to have a consequential impact on the global economy, U.S. national security, and international stability.

Background

For decades, the scientific community has achieved general consensus on climate change's causal factors and physical effects.⁴ NASA reports that 97 percent or more of actively published climate scientists agree that climate change is due to human activity.⁵ From rising sea levels to increased intensity of storms and from hotter and more frequent heat extremes to colder polar vortices, the changing climate is wreaking havoc all over the world. The National Oceanic and Atmospheric Administration (NOAA) has confirmed that the impact of climate change extends beyond mere temperature rising, permeating ecosystems and communities around the globe and substantially affecting the things upon which human life depends: water, energy, transportation, wildlife, agriculture, ecosystems and human health.⁶ This disruption, beyond upsetting natural cycles thousands of years in the making and threatening human life, is undermining economic stability and national security. Global climate change will likely inject market shocks through mass migration caused by flood and famine,⁷ has created conflict precipitated by drought and disease,^{8,9} and resulted in the shutdown of economic centers for days to weeks, posing both a core national security threat and a risk to financial stability.^{10,11} The purpose of this hearing is to discuss the macroeconomic effects of climate change on the U.S. economy as well as how financial regulators and institutions can respond to mitigate current and future impacts.

Domestic Economic Costs of Climate Change

The U.S. is projected to lose up to 10.5% of its gross domestic product (GDP) by 2100 due to climate change. According to the fourth National Climate Assessment, "annual losses in some economic sectors are projected to reach hundreds of billions of dollars by the end of the century,"¹² provided emissions continue to grow at historic rates. This represents a reduction in GDP larger than the economies of many states.

⁴ Leggett, Jane A. "Evolving Assessments of Human and Natural Contributions to Climate Change," Congressional Research Service, <https://www.crs.gov/Reports/R45086?source=search&guid=69c603875b1b4408b95a2335ac9d0a33&index=0>, (February 1, 2018).

⁵ "Scientific Consensus: Earth's Climate is Warming," NASA, <https://climate.nasa.gov/scientific-consensus/>.

⁶ "Climate Change Impacts," NOAA, <https://www.noaa.gov/education/resource-collections/climate-education-resources/climate-change-impacts>, (February 2019).

⁷ "Climate Change Could Force Over 140 Million to Migrate Within Countries by 2050: World Bank Report," The World Bank, <https://www.worldbank.org/en/news/press-release/2018/03/19/climate-change-could-force-over-140-million-to-migrate-within-countries-by-2050-world-bank-report>, (March 19, 2018).

⁸ Gleick, Peter H. "Water, Drought, Climate Change, and Conflict in Syria," American Meteorological Society, <https://journals.ametsoc.org/doi/full/10.1175/WCAS-D-13-00059.1>, (July 1, 2014).

⁹ Ryan, Devon. "Stanford-led study investigates how much climate change affects the risk of armed conflict," Stanford University, <https://news.stanford.edu/2019/06/12/climate-change-cause-armed-conflict/>, (June 12, 2019).

¹⁰ Davidson, Paul et al. "What will be Sandy's effect on economy?," USA Today, <https://www.usatoday.com/story/money/business/2012/10/29/hurricane-sandy-economy-impact/1666711/>, (October 29, 2012).

¹¹ Torry, Harriet, and Sarah Chaney. "Big Storms Leave Small Marks on the U.S. Economy," Wall Street Journal, <https://www.wsj.com/articles/big-storms-leave-small-marks-on-the-u-s-economy-1537027200>, (September 15, 2018).

¹² "Fourth National Climate Assessment, Volume II: Impacts, Risks, and Adaptation in the United States," U.S. Global Change Research Program, <https://nca2018.globalchange.gov/>.

When looking at the domestic impact on specific industries, the picture is similarly dire. Scholars at University of California Berkeley had this to say on the topic:

As sea levels rise and temperatures continue to creep up, vital elements of the U.S. economy are at risk. Energy resources, labor productivity, and entire infrastructures are threatened by the consequences of a changing climate. By 2050, between \$66 billion and \$106 billion worth of existing coastal property nationwide will likely be below sea level. Property losses from sea level rise will be concentrated in specific regions of the U.S., especially on the Southeast and Atlantic coasts, where the rise is higher and the losses far greater than the national average. As a result of increases in temperature, the labor productivity of outdoor workers, such as those working in construction, utility maintenance, landscaping, and agriculture, could be reduced by as much as 3%, particularly in the Southeast. Some states in the Southeast, lower Great Plains, and Midwest risk up to a 50% to 70% loss in average annual crop yields (corn, soy, cotton, and wheat).¹³

Very few American industries will be untouched by the effects of climate change.¹⁴ Industries like real estate, energy production, agriculture, and infrastructure construction will all suffer significant financial losses if the climate continues to warm and become more volatile. These financial costs are related to the value of land and material availability due to flooding supply chain interruptions, and population dislocation.

The U.S. Government, the largest participant in the domestic economy, is also greatly impacted. A changing climate could create risks and pressures for the U.S. Government to spend more money on many of its programs, including disaster relief and federal insurance payments for property and crops. According to the GAO, “There were 14 separate billion-dollar weather and climate disaster events in the U.S. in 2018—with a total cost of at least \$91 billion. The federal government faces substantial fiscal exposure from climate change risks in several areas, including disaster aid due to the rising number of natural disasters and increasing reliance on federal assistance. GAO has previously reported that the federal government does not adequately plan for disaster resilience.”¹⁵

Beyond increased government spending on relief efforts, other programs are affected by the increased frequency and potency of storms and other natural disasters. The GAO also states, “The federal government faces fiscal exposure from climate change risks in several areas, including federal insurance for property and crops due, in part, to the vulnerability of insured property and crops to climate change impacts. Federal flood and crop insurance programs were not designed to generate sufficient funds to fully cover all losses and expenses.”¹⁶ Furthermore, the Congressional Budget Office estimated in May 2019 that federal crop insurance would cost the federal government an average of about \$8 billion annually from 2019 through 2029. The federal budget, however, does not generally account for disaster assistance provided by Congress or the long-term impacts of climate change on existing federal infrastructure and programs.”¹⁷

¹³ Whitacre, Ryan. “Economic Impacts of Climate Change,” University of California, Berkeley, <https://matrix.berkeley.edu/research/economic-impacts-climate-change>, (November 15, 2014).

¹⁴ “Climate Change 2014: Impacts, Adaptation, and Vulnerability,” Intergovernmental Panel on Climate Change, https://www.ipcc.ch/site/assets/uploads/2018/03/ar5_wgII_spm_en-1.pdf, (2014).

¹⁵ “Climate Change: Opportunities to Reduce Fiscal Exposure,” U.S. Government Accountability Office, <https://www.gao.gov/products/GAO-19-625T>, (June 11, 2019).

¹⁶ Ibid.

¹⁷ Ibid.

The federal government has begun taking some steps to address climate change risks. In March, a researcher at the Federal Reserve Bank of San Francisco provided a comprehensive economic assessment of climate change's impact on the economy and underscored the efficacy of central banks including climate change in their monetary and financial supervisory policy.¹⁸ The Federal Reserve also appears to be considering climate risk when regulating financial institutions. In February, Chairman Jerome Powell remarked to a Senate Committee, "If you are a bank in the southern coast of Florida and you are subject to hurricanes, we definitely require you to have plans and risk management things in place to do with that sort of thing. So you would pick up natural disasters and that kind of thing, which are associated with climate change." The Federal Reserve is also looking, according to Chairman Powell, beyond the direct effects of climate change to secondary and tertiary effects on the economy. He said, "Climate change has direct effects on the economy resulting from various environmental shifts, including hotter temperatures, rising sea levels, and more frequent and extreme storms, floods, and droughts. It also has indirect effects resulting from attempts to adapt to these new conditions and from efforts to limit or mitigate climate change through a transition to a low-carbon economy."¹⁹

Global and National Security Costs of Climate Change

As early as 1987-1988, the National Security Strategy of the U.S. noted climate threats to security as posed by flood, drought, and food shortages^{20 21}. Calls by U.S. national security officials have amplified since. According to the 2019 Worldwide Threat Assessment of the U.S. Intelligence Community, "global environmental and ecological degradation, as well as climate change, are likely to fuel competition for resources, economic distress, and social discontent through 2019 and beyond... Climate hazards such as extreme weather, higher temperatures, droughts, floods, wildfires, storms, sea-level rise, soil degradation, and acidifying oceans are intensifying, threatening infrastructure, health, and water and food security."²² The concerns articulated by the national security community regarding the costs of climate change stretch beyond financial markets and depict a concern over human casualties and material losses.

The World Bank also estimates that climate change could force over 140 million to migrate by 2050,²³ which it highlights as "creating a looming human crisis and threatening the development process." The World Bank's report identifies that Sub-Saharan Africa, South Asia, and Latin America could be dealing with tens of millions of migrants forced to move to increasingly non-viable areas due to growing problems including water scarcity, crop failure, sea-level rise and storm surges. World Bank CEO, Kristalina Georgieva, stated that this research provides a wake-

¹⁸ Rudebusch, Glenn D. "Climate Change and the Federal Reserve," Federal Reserve Bank of San Francisco, <https://www.frbsf.org/economic-research/publications/economic-letter/2019/march/climate-change-and-federal-reserve/>, (March 25, 2019).

¹⁹ Derby, Michael S. "Fed Policy Makers Take Notice of Climate Change's Implications for Economic Outlook," The Wall Street Journal, <https://blogs.wsj.com/economics/2019/04/17/fed-policymakers-take-notice-of-climate-changes-implications-for-economic-outlook/>, (April 17, 2019).

²⁰ "National Security Strategy of the United States," National Security Strategy Archive, <http://nssarchive.us/NSSR/1987.pdf>, (January 1987).

²¹ Ibid.

²² Coats, Daniel R. "Worldwide Threat Assessment of the US Intelligence Community," Office of the Director of National Intelligence, <https://www.dni.gov/files/ODNI/documents/2019-ATA-SFR---SSCI.pdf>, (January 29, 2019).

²³ "Climate Change Could Force Over 140 Million to Migrate Within Countries by 2050: World Bank Report," The World Bank, <https://www.worldbank.org/en/news/press-release/2018/03/19/climate-change-could-force-over-140-million-to-migrate-within-countries-by-2050-world-bank-report>, (March 19, 2018).

up call to countries and development institutions. She noted that “we have a small window now, before the effects of climate change deepen, to prepare the ground for this new reality.”²⁴

These warnings are being echoed by other multilateral economic forums. Seven of the top 10 risks identified in the World Economic Forum’s 2019 Risk Report are related to, or caused by, climate change.²⁵ Second on that list is what the Forum calls “our inadequate response to deal with the threats posed by climate change and reduce greenhouse gas emissions.” The report highlights that environmental risks continue to “dominate the results” of their global risk projection survey.²⁶ There is good reason for these economic forums to have such considerable concern. The economic damage caused by a single ton of carbon dioxide emissions, often referred to as the ‘social cost’ of carbon, could be six times higher than United States regulators have estimated.²⁷ A report in the Nature Climate Change journal estimated the social cost of carbon is \$220 per ton for current emissions.

Since 2010, the Department of Defense (DOD), which manages a global real-estate portfolio with an almost \$1.2 trillion estimated replacement value, has identified climate change as a threat to its operations and installations.²⁸ In January 2019, DOD stated that the effects of a changing climate are a national security issue with potential impacts to the department’s missions, operational plans, and installations.²⁹ In September and October of 2018, hurricanes caused nearly \$7 billion in damage to Tyndall Airforce Base in Florida and Marine Corps installations in North Carolina.^{30,31}

While DOD has underscored the urgency of accurate assessment and needed action, according to a June 2019 GAO report, DOD installations have not consistently assessed risks from extreme weather and climate change effects or consistently used projections to anticipate future climate conditions. The report notes that, not assessing risks or using climate projections in installation planning may expose DOD facilities to greater-than-anticipated damage or degradation as a result of extreme weather or climate-related effects.³²

Legislation

- Discussion Draft that directs the Federal Reserve and SEC to produce annual reports to Congress projecting the economic costs directly and indirectly caused by the impacts of climate change.

²⁴ Ibid.

²⁵ “The Global Risks Report 2019, 14th Edition,” World Economic Forum, http://www3.weforum.org/docs/WEF_Global_Risks_Report_2019.pdf, (2019).

²⁶ Ibid.

²⁷ Than, Ker. “The economic damage from climate change may be more than you think,” Stanford Engineering, <https://engineering.stanford.edu/magazine/article/economic-damage-climate-change-may-be-more-you-think>, (February 26, 2016).

²⁸ “DOD Needs to Assess Risk and Provide Guidance on Use of Climate Projections in Installation Master Plans and Facilities Designs,” U.S. Government Accountability Office, <https://www.gao.gov/assets/700/699679.pdf>, (June 2019).

²⁹ Ibid.

³⁰ Ibid.

³¹ Ibid.

³² “DOD Needs to Assess Risk and Provide Guidance on Use of Climate Projections in Installation Master Plans and Facilities Designs,” U.S. Government Accountability Office, <https://www.gao.gov/assets/700/699679.pdf>, (June 2019).