

24. FEDERAL BUDGET EXPOSURE TO CLIMATE RISK

No challenge poses a greater threat to future generations than climate change. This past year was the planet's warmest on record. To be sure, one year does not make a trend, but this does: the 14 warmest years on record have all fallen in the first 15 years of this century. Across the American landscape, the imprint of climate change is growingly visible. Along our Eastern seaboard, a number of cities now flood regularly at high tide. The vast majority of the largest fires in modern U.S. history have occurred in just the last decade. In parts of the Midwest, higher temperatures will increase irrigation demand and exacerbate current stresses on agricultural productivity. And in the Mississippi and Missouri River Basins, numerous studies indicate increasing severity and frequency of flooding leading to disruptions to the Nation's inland water system. The imprint of climate change on the Federal Budget is also apparent—in the escalating costs of disaster relief, flood and crop insurance, wildland fire management, and host of other Federal programs that are exposed to the impacts of climate change. For this reason, understanding the Federal Government's exposure to climate risks is increasingly critical for policymakers charged with making sound investment decisions and stewarding the Federal budget over the long term.

In May 2014, the U.S. Global Change Research Program released the Third National Climate Assessment (NCA). The report was developed over four years by a team of more than 300 of the Nation's top climate scientists and technical experts, guided by a 60-member Federal Advisory Committee and extensively reviewed by the public and experts including the National Academy of Sciences. The NCA confirms that climate change is affecting every region of the country and key sectors of the U.S. economy. Key findings of the NCA include the following:

- Heavy downpours are increasing nationally and increases in extreme precipitation are projected for all U.S. regions.
- Regionally, floods and droughts are increasing and future changes are projected. Heat waves have become more frequent and intense.
- The intensity, frequency, and duration of North Atlantic hurricanes and the frequency of the strongest hurricanes all increased in the last few decades. Hurricane intensity and rainfall are projected to increase with further climate change.
- Winter storms increased in frequency and intensity since mid-20th Century.
- Global sea level has risen about 8 inches since reliable record keeping began and is projected to rise another 1 to 4 feet by 2100.

- Oceans are becoming more acidic as they absorb a quarter of the carbon dioxide emitted annually, putting marine ecosystems at risk.¹

The Federal Government has broad exposure to escalating costs and lost revenue as a direct or indirect result of a changing climate. For example, the Federal Government plays a critical role in helping to ensure American families, businesses, and communities against the impacts of extreme weather. As economic damages from such catastrophic extreme weather events grow, so does the liability for the Federal budget. At the same time, the Federal Government is directly at risk from extreme weather impacts on Federal facilities nationwide and the growing incidence of fire on Federal lands.

While existing climate-related expenditures can be identified for a number of Federal programs, it is inherently difficult to isolate climate-related expenditures for many other programs across the Federal Government. Even in these cases, however, the directional impact on the Budget of expected climatic changes is clear.

Identifiable direct costs

Over the last decade, the Federal Government has incurred over \$300 billion in direct costs due to extreme weather and fire alone, including for domestic disaster response and relief (\$176 billion), flood insurance (\$24 billion), crop insurance (\$61 billion), and wildland fire management (\$34 billion). While it is not possible to identify the portion of these costs incurred as a result of climate change, costs for each of these Federal programs have been increasing and can be expected to continue to increase as the impacts of climate change intensify.

Domestic Disaster Response and Relief

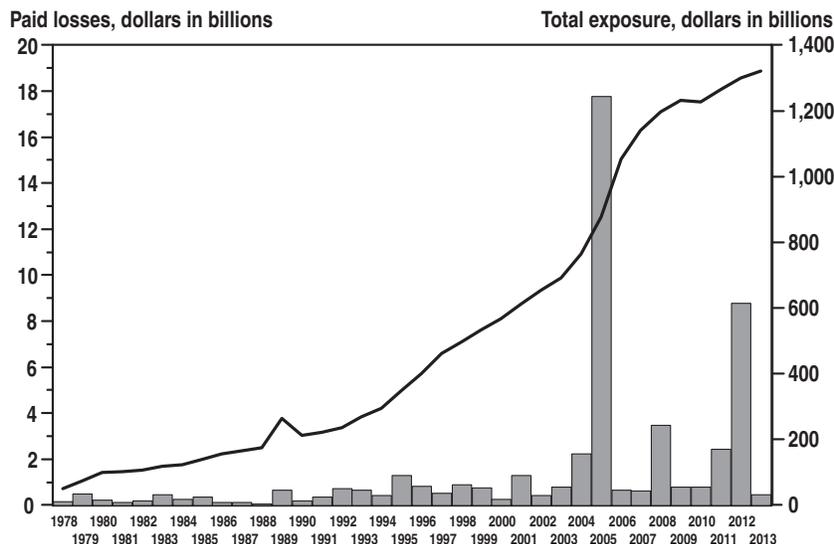
The Federal Emergency Management Agency (FEMA) has incurred \$84 billion in costs for domestic, extreme weather-related disaster response over the last decade. Over that time period, other Federal agencies incurred at least \$92 billion in domestic disaster relief costs. This figure is likely to underestimate the full extent of Federal costs incurred for extreme weather-related disaster relief.²

Climate models predict that climate-driven changes, such as higher sea levels and more intense hurricanes, are likely to magnify damages due to extreme weather

¹ Ibid.

² Estimate includes discretionary budget authority from 2005-2011 explicitly linked to Stafford Act declarations, as well as Hurricane Sandy disaster relief appropriations and 2012-2013 disaster relief costs aggregated by the Center for American Progress. Estimate does not include disaster relief costs in 2014 or those in the 2005-2011 period that were not explicitly linked to the Stafford Act, and is therefore likely to be an underestimate.

**Chart 24-1. National Flood Insurance Program
Paid Losses & Total Exposure**



and associated needs for disaster response and relief.³ For example, a review by the Government Accountability Office of 20 scientific studies found a predicted increase of 14-47 percent in inflation-adjusted U.S. hurricane losses by 2040. This increase is solely attributable to the increasing severity of storms. By 2100, losses are projected to grow by 54 to 110 percent. Accounting for the combination of projected sea level rise and changes in hurricane activity, hurricane losses could more than quadruple by the year 2100.⁴

Historically, the cost of Federal action following a major disaster has averaged roughly a third of total economic losses.⁵ If this share of total losses continues, Federal disaster response and relief costs can be expected to rise proportionately with projected increases in total economic losses. However, this type of linear extrapolation may underestimate the true exposure of the Federal budget given that a major event or series of major events could, for example, affect the solvency of an industry, municipality, or State.

Flood Insurance

In addition to its disaster response activities, FEMA manages the National Flood Insurance Program (NFIP), established in 1968. NFIP is designed to provide an insurance alternative to disaster assistance to meet the escalating costs of flood damage. While the program is designed to offset paid losses with premium collections,

catastrophic events in any given year can have outsized impacts on NFIP. Due largely to Hurricane Katrina in 2005 and Hurricane Sandy in 2012, the program incurred substantial paid losses in excess of premiums collected, accruing approximately \$24 billion to the U.S. Treasury as of September, 2014. The figure above details the program's historical paid losses and total exposure—the total value of property insured by the program. NFIP's total exposure has quadrupled over the last two decades to \$1.3 trillion.

Nationwide, the Special Flood Hazard Area (SFHA)—the land area subject to a one percent or greater chance of flooding in any given year—is projected to increase by 40-45 percent by 2100 (with large regional variations), driven predominantly by the effects of climate change. In the coastal environment, this increase is a direct result of rising sea levels and increasing storm intensity and frequency. In the riverine environment, less than one-third of the increase in typical areas is attributable to population growth and associated impacts on storm-water runoff, while more than two-thirds is attributable to the influence of climate change. As a result, the average loss cost⁶ per policy in today's dollars is estimated to increase approximately 50-90 percent by 2100, with a 10-15 percent increase as soon as 2020. These increases will be compounded by projected growth in the total number of policyholders participating in NFIP—approximately 80-100 percent through 2100 as a product of population growth but also the expansion of the flood hazard area. These projected increases in loss cost per policy are median estimates; catastrophic events in any given year could have much larger impacts on NFIP and the Federal budget.⁷

³ Kopp, Robert, and Solomon Hsiang, 2014: American Climate Prospectus. Economic Risks in the United States. Rhodium Group, LLC.

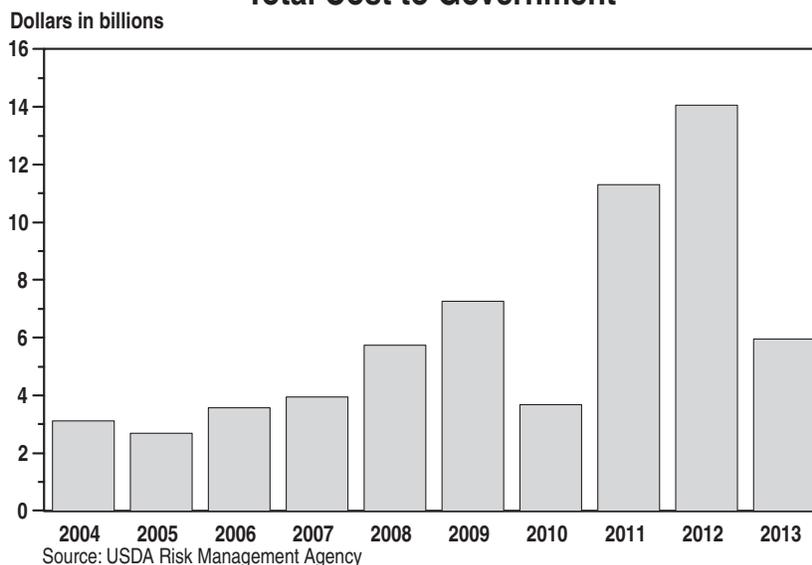
⁴ U.S. Government Accountability Office, 2014. Climate Change: Better Management of Exposure to Potential Future Losses Is Needed for Federal Flood and Crop Insurance. GAO 15-28: Published October 29, 2014.

⁵ Cummins, J. David, Michael Suher, and George Zanjani. 2010. Federal Financial Exposure to Natural Catastrophe Risk in Lucas, D. (ed.) Measuring and Managing Federal Financial Risk. National Bureau of Economic Research. University of Chicago Press.

⁶ Loss cost is a measure of expected loss payments per \$100 of insured building value.

⁷ AECOM, 2013. The Impact of Climate Change and Population Growth on the National Flood Insurance Program through 2100.

**Chart 24-2. Crop Insurance
Total Cost to Government**



Crop Insurance

The United States Department of Agriculture's Risk Management Agency (RMA) provides crop insurance to American farmers and ranchers through the Federal Crop Insurance Corporation (FCIC). Federal crop insurance policies cover loss of crop yields from natural causes including drought, excessive moisture, freeze, disease, and hail. The Federal Government incurs costs for crop insurance in the form of subsidized premiums, losses associated with any claims paid in excess of collected premiums, and costs for program administration and operation—a total of \$61 billion between 2004 and 2013. Costs can increase sharply in years affected by extreme weather. For example, droughts caused the surge in costs in 2011 and 2012 shown above. The Federal Government's total exposure for crop insurance is currently about \$110 billion, up from \$67 billion in 2007.

Wildland Fire Management

The U.S. Forest Service (USFS) and Department of the Interior (DOI) manage wildland fire to protect human life and property. Climate change is contributing to an increase in wildland fire frequency and intensity across the western United States and Alaska.⁸ The vast majority of the largest fires in modern U.S. history have occurred in just the last decade. Firefighting budgets at USFS and DOI reached \$3.5 billion in 2015. On average, firefighting appropriations grew 25 percent per year over the last two decades, adjusted for inflation. At the USFS, appropriations for wildland fire management grew from 16 percent of the agency's total budget in 1995 to 42 percent in 2014. These budget increases are due to a number of factors, including

population growth in the wildland-urban interface, a legacy of aggressive fire suppression, and climatic factors. For example, in the Southwest, increased warming, drought, and insect outbreaks, all caused by or linked to climate change, have increased wildfires and impacts to people and ecosystems. Fire models project more wildfire and increased risks to communities across extensive areas.⁹

Other direct and indirect costs

The Federal Government's climate risk exposure extends well beyond disaster response, flood and crop insurance, and wildland fire management. For example, the Federal Government will likely incur additional direct and indirect costs for health care, property management, and national security as a result of climate-driven changes across sectors of the economy. However, it is inherently difficult in these areas to identify current expenditures that are related to climatic factors such as extreme weather and rising temperatures.

Health care

Climate change threatens the health and well-being of Americans in a number of ways, including increasing impacts from increased extreme weather events, wildland fire, decreased air quality, and illnesses transmitted by food, water, and disease carriers such as mosquitoes and ticks. While the economic literature on the current and projected health costs associated with climate change is limited, a number of studies have found substantial health costs due to climate-related events.¹⁰ While the bulk of these costs are related to premature deaths and associated economic loss, these events also directly burden the health care system. The Federal Government is

Prepared for Federal Emergency Management Agency.

⁸ Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

⁹ Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds., 2014. *Climate Change Impacts in the United States: The Third National Climate Assessment*. U.S. Global Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

¹⁰ Kopp, Robert, and Solomon Hsiang, 2014. *American Climate Prospects*. Economic Risks in the United States. Rhodium Group, LLC.

the Nation's largest purchaser of health care services—spending \$815 billion in 2014 on Medicare, Medicaid, and the Children's Health Insurance Program. These programs provide health care for those most vulnerable to the health-related impacts of climate change: children, the elderly, and low-income individuals.

Federal Property Management

Federal facilities are directly at risk from the kinds of extreme weather events associated with climate change. Extreme weather in recent years has provided several examples of such risk:

- The U.S. Army Corps of Engineers and the National Aeronautics and Space Administration (NASA) invested over \$50 million in shoreline stabilization to protect almost \$1 billion in Federal and State assets located on Virginia's eastern shore. The project's costs were higher than originally estimated after Hurricane Sandy removed about 700 feet of protective raised barrier and about 20 percent of the beach protecting Wallops Island, the location of NASA launch pads and support facilities as well as the U.S. Navy Surface Combat Systems Center.
- An Army installation in the Southwest incurred \$64 million in damages due to unusual torrential downpours. Within an 80 minute period, the installation experienced as much rain as typically falls over the course of a year. The flooding caused by the storm damaged 160 facilities, 8 roads, 1 bridge, and 11,000 linear feet of fencing.
- Several Air Force early warning and communication installations on the Alaskan coast are experiencing operational challenges due to rising seas, decreasing sea ice, and thawing permafrost. Coastal erosion has damaged roads, utility infrastructure, seawalls, and runways, limiting the size of aircraft that are able to land. The estimated cost of hardening the seawall and protecting the runway is \$25 million.¹¹
- Record-breaking rainfall and severe flash flooding in 2010 overwhelmed man-made drainage systems at the Department of Energy's Pantex Plant—the Nation's only nuclear weapons assembly and disassembly facility. Since the incident, the facility has invested in improved drainage, response plans, and procedures to better prepare for flash flooding events.

Pursuant to Executive Order 13653, Federal agencies must continue to update comprehensive adaptation plans that describe how the agency will consider the need to improve climate adaptation and resilience with respect to agency suppliers, supply chain, real property investments, and capital equipment purchases. Such consideration could include updating agency policies for leasing, building upgrades, relocation of existing facilities and equipment, and construction of new facilities.

¹¹ Government Accountability Office, 2014. Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts. GAO-14-446.

National Security

National security agencies expect that climate change will intensify the challenges of global instability, hunger, poverty, conflict, pandemic disease, disputes over refugees and resources, and destruction by natural disasters. The Department of Defense (DOD) refers to climate change as a "threat multiplier" because it can exacerbate many challenges, such as infectious disease and terrorism. Climate change will impact the Department's military readiness, stationing, environmental compliance and stewardship, and infrastructure planning and maintenance. It will change the frequency, scale, and complexity of future missions, and may cause the military to be called upon more frequently to support civil authorities. Changes in climate will also alter or constrain the way the military executes its missions, impact supply chains, and change critical equipment needs. As a result, climate change is not only a threat to national security, but also a risk for the Federal budget as costs increase for military and humanitarian operations.

Species Recovery

Climate change is expected to fundamentally alter ecosystems in ways that are costly to those systems and the people who depend upon and value them. For example, a changing climate is expected to cause rapid shifts in habitat and species ranges and to exacerbate the traditional stressors that drive species populations down (e.g., habitat loss, overutilization, invasive species), which may lead to reductions in biodiversity through the endangerment or extinction of many species.

For example, climate change has already caused a mismatch between the life cycle of the Edith's checkerspot butterfly and the timing of the flowering plants it depends on, causing the butterfly's population to crash along its southern range. Similarly, warming and reduced stream flows due to declining snowmelt are affecting salmon species. A small increase in water temperature can cause coho salmon eggs to hatch weeks early, leading to a mismatch between the time the salmon reach the ocean and the abundance of their prey.¹²

Of all of the species—plant and animal—that have been the focus of climate change studies, the IPCC estimates that 20-30 percent face extinction risks under temperatures projected for the end of this century.¹³ These and other ecosystem impacts are likely to pose significant costs, though it is difficult to quantify the precise value of lost species and ecosystems. In addition to costs to private citizens and industry, the expected decline in species may increase the costs of Federal species recovery efforts.

¹² National Fish, Wildlife and Plants Climate Adaptation Partnership. 2012. National Fish, Wildlife and Plants Climate Adaptation Strategy, Association of Fish and Wildlife Agencies, Council on Environmental Quality, Great Lakes Indian Fish and Wildlife Commission, National Oceanic and Atmospheric Administration, and U.S. Fish and Wildlife Service. Washington, DC.

¹³ Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, United Kingdom.

Lost Revenue

Unabated climate change is projected to hamper economic production in the United States and across the globe. Economic loss in the United States means lost revenue for the Federal Government. Projections by the Intergovernmental Panel on Climate Change include a median warming estimate of four degrees Celsius over preindustrial levels by 2100 if recent global emissions growth rates are allowed to continue. While most economic assessments of climate change risks have focused on warming in the 2 to 3 degrees range, available assessments suggest that warming of 4 degrees would cause economic damages of more than four percent of global GDP each year by 2100.

There are a number of factors that may cause this estimate to be too low or too high. For example, available studies typically do not account for important factors that are inherently difficult to model, such as biodiversity, ocean acidification, political reactions, sea-level rise, changes in ocean circulation, catastrophic events, irreversibility, and tipping points. As a result, these estimates should be considered order-of-magnitude illustrations of possible economic impacts of climate change.

The uncertainty of these economic loss projections is compounded when attempting to estimate the associated potential for lost Federal revenue in the United States. For illustrative purposes only, if the underlying economic loss projection is accurate, lost revenue could be as high as 0.7 percent of U.S. GDP in 2100, or over \$120 billion in to-

day's dollars. This estimate also assumes that the United States incurs a share of global losses proportional to its current share of global GDP, and that Federal revenue as a share of U.S. GDP remains constant. The estimate also ignores the fact that a portion of the projected economic losses include non-market losses that may not directly translate into lost revenue.

The Need for Action

The exposure of the Federal budget to climate risks provides yet another call to action for policymakers. How we respond to one of the most significant long-term challenges that our country and our planet faces speaks volumes about our values. It speaks to who we are as policymakers—if we embrace the challenge of developing pragmatic solutions. It speaks to who we are as Americans—if we seize this moment and lead. It speaks to who we are as parents—if we take responsibility and leave our children a safer planet.

The President has set the United States on an ambitious course to tackle our emissions and prepare our communities for the effects of climate change because he believes we have a moral obligation, but also because climate action is an economic and fiscal imperative. For this reason, the President's Budget invests in cutting carbon pollution and in preparedness and resilience — providing necessary tools, technical assistance, and on-the-ground partnership to communities that are dealing with the effects of climate change today.

