

Climate Change in the FY 2011 Budget

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HIGHLIGHTS

- Funding for the U.S. Global Change Research Program (USGCRP), which coordinates and integrates research over 13 executive branch departments and agencies, would increase 21 percent to \$2.6 billion.
- The National Oceanic and Atmospheric Administration (NOAA) requests \$2.2 billion, an increase of 58 percent, for the National Environmental Satellite, Data, and Information Service (NESDIS). This would restore climate sensors, advance sea height monitoring, and fund NOAA's Joint Polar Satellite System (formerly NPOESS).
- NASA requests a 27 percent increase for Earth Science. NASA would accelerate four Decadal Survey missions, initiate one new climate related mission, and re-launch the Orbiting Carbon Observatory (OCO), which would monitor carbon sources and sinks throughout the world.
- The Department of Energy (DOE) request would increase funding for renewable energy (up 37 percent) and energy efficiency (up 12 percent), and eliminate \$2.7 billion in subsidies to high emitting industries. Robust funding would continue for Energy Innovation Hubs, Energy Frontier Research Centers, and the Advance Research Projects Agency-Energy.
- The Department of the Interior (DOI) request would substantially increase funding for its Climate Change Adaptation initiative (up 26 percent) and renewable energy programs (up 24 percent).
- The National Science Foundation (NSF) requests \$955 million Geosciences Directorate (a 7.4 percent increase) with \$480 million requested for Atmospheric and Earth Sciences.

Table 1. Climate Change in the Federal R&D Budget
(budget authority in millions of dollars)

	FY 2009 Actual	ARRA Estimate	FY 2010 Estimate	FY 2011 Budget	Change FY 10-11 Amount	Percent
US Global Change Res Prog	2,059	604	2,122	2,561	439	20.7%
Natl Oceanic & Atmos Admin						
<i>USGCRP</i>	424	170	360	437	77	21.4%
National Science Foundation						
<i>USGCRP</i>	269	121	319	370	51	16.0%
<i>Geosciences</i>	809	347	890	955	66	7.4%
<i>Atmospheric Sciences</i>	246	68	260	281	21	8.1%
<i>Earth Sciences</i>	171	85	183	199	16	8.7%
<i>Sci, Eng and Edu for Sustain</i>			661	766	105	15.9%
Natl Aero and Space Admin						
<i>Earth Science</i>	1,377	325	1,421	1,802	381	26.8%
Department of Energy						
<i>Office of Science</i>	4,813	1,633	4,904	5,121	218	4.4%
<i>Bio and Environ Research</i>	585	166	604	627	23	3.8%
<i>Energy R&D</i>	2,104	1,560	2,275	2,430	155	6.8%
Department of Interior						
<i>Climate Change Adaptation</i>	45	0	136	171	35	26.0%
<i>Renewable Energy</i>	0	0	59	73	14	24.0%
Environ Prot Agency R&D	563	0	595	606	11	1.8%
US Dept of Agriculture						
<i>Climate Change</i>	52	0	112	159	47	42.0%
<i>Renewable Energy</i>	88	0	127	179	52	40.9%

Source: Agency budget justifications, budget supplements, and other agency communications.
All figures rounded to the nearest million. Changes calculated from unrounded figures.

INTRODUCTION AND POLITICAL BACKGROUND

Past scientific research demonstrates that the Earth’s climate is changing, that humans are very likely responsible for most of the well-documented increase in global average surface temperatures over the last half century, and that further greenhouse gas emissions, particularly of carbon dioxide from the burning of fossil fuels, will almost certainly contribute to additional widespread climate disruption. This climate disruption poses considerable risk to society because it can be expected to cause major negative consequences for most nations and to a wide range of species.

In the broadest sense, society has three proactive policy options for reducing the risks associated with global climate disruption (global warming). We could reduce our greenhouse gas emissions and thereby reduce the amount that climate changes (often called mitigation). We could build our capacity to cope with the climate changes that lie ahead (adaptation). We could deliberately manipulate the earth system in the hope of counteracting the worst impacts of our emissions—critically, without triggering unintended and harmful side-effects (often called geoengineering). Each of these broad categories (mitigation, adaptation, and geoengineering) encompasses a wide range of more specific policy

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options and none is mutually exclusive—we could use them together and in a wide range of different combinations.

Two notable policy developments in climate change risk management occurred in 2009. First, the Environmental Protection Agency's (EPA) found that greenhouse gas emissions endanger human health and wellbeing. This finding would allow EPA to regulate greenhouse gas emissions under the Clean Air Act without further Congressional action. Second, the U.S. House of Representatives passed the American Clean Energy and Security Act of 2009 (ACES), which includes a cap-and-trade provision. This marks the first time that either Congressional chamber has passed legislation that would put a price on greenhouse gas emissions and mandate emission reductions. However, whether the Senate will pass a similar bill (and whether remaining differences between the House and Senate would be overcome) remains unclear.

Research, observations, scientific assessments, and technology development support and enhance the risk management options by providing knowledge and understanding to decision makers. Expansion of the knowledge base allows policy makers to select and refine risk management strategies to increase their effectiveness. Increasing the knowledge base can also reveal entirely new approaches for protecting the climate system or reducing the risks of climate disturbance.

Research on the climate system spans multiple disciplines including atmospheric science, oceanography, hydrology, biology, and cryology. Understanding the societal impacts of climate variability and change also requires input from social sciences including (but not limited to) economics, sociology, history, and political science. Furthermore, policy choices must also consider ethical concerns, value judgments, philosophical views, and uneven distributional consequences. Given this level of inter-disciplinary complexity, accurately and comprehensively describing President Obama's FY 2011 budget request as it relates to climate change R&D is challenging and requires at least some subjective judgments.

Similarly, the individual disciplines described above are considerably broader in scope than their respective contributions to climate change. Atmospheric research includes the study of weather, air quality, atmospheric chemistry, and space weather among others. Oceanography examines a wide range of physical, chemical, and biological characteristics, many of which are entirely unrelated to the climate

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system. The same can be said for biology, hydrology, cryology, and the social sciences.

OVERARCHING PROGRAMS

The United State Global Change Research Program (USGCRP). The USGCRP coordinates and integrates climate research over 13 executive branch departments and agencies. The total requested budget for FY 2011 that falls within the scope of the USGCRP is \$2.6 billion, which would be a 20.7 percent increase over the FY 2010 appropriation.

Note however, that funds counted within the USGCRP framework are allocated directly to the agencies and each agency has discretion in what it counts as being within the framework. Therefore, the number reported for USGCRP does not account for all climate related research and year-to-year changes in USGCRP funding can reflect accounting changes rather than actual changes to agency requests. Nevertheless, increases in climate research are real and significant in this budget request as is evident from the agency specific funding requests.

The Climate Change Technology Program (CCTP). CCTP is a companion to the USGCRP that seeks to provide direction, planning, and analyses to help coordinate and prioritize federally-funded climate change technology R&D. CCTP involves 11 federal departments and agencies with DOE acting in a lead capacity. As with USGCRP, funds are allocated directly to the agencies and an agency has discretion in what it counts as being within the CCTP framework. As of this writing, cumulative CCTP funding numbers are not available from most agencies, potentially reflecting a de-emphasis on the CCTP framework. DOE identifies \$706 million within its request as CCTP related funding, which appears to be considerably less than what DOE could reasonably count toward CCTP.

SPECIFIC AGENCIES

National Oceanic and Atmospheric Administration (NOAA). NOAA's total budget request is \$5.6 billion, which would be an increase of 17.0 percent. Of this, \$437 million would be for climate research funding, which is an increase of \$77 million.

The Office of Oceanic and Atmospheric Research (OAR) budget request includes funds for national and regional assessments of climate impacts, and enhanced funding for the examination of ocean acidification. The

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request also includes funding for a Climate Services Portal that will provide climate information to the public.

The National Environmental Satellite, Data, and Information Service (NESDIS) requests \$2.2 billion, an increase of 58.0 percent, relative to the FY 2010 appropriation. This includes funding to restore climate sensors to satellite missions and increased funding for the Jason-3 satellite mission which will monitor sea height.

The administration is restructuring the tri-agency National Polar-Orbiting Environmental Satellite System (NPOESS) and separating responsibility for operations to the participating agencies (NOAA, NASA, and the Department of Defense). NOAA's portion of the operation is now called the Joint Polar Satellite System, which will seek to provide a wide range of global environmental data. The Joint Polar Satellite System would receive an increase of \$678.6 million to \$1.1 billion in FY 2011.

National Science Foundation (NSF). NSF would receive \$7.4 billion in FY 2011, an increase of 8 percent relative to the FY 2010 appropriation. The request includes \$370 million under the USGCRP framework, which is an increase of 16.0 percent. The Geosciences Directorate would receive \$955 million (a 7.4 percent increase) in FY 2011 with \$480 million going to Atmospheric and Earth Sciences.

NSF's Science, Engineering, and Education for Sustainability (SEES) program would receive \$765.5 million. This is intended to promote discoveries and capability needed to inform societal actions in ways that contribute to environmental and economic sustainability.

NSF's request also includes \$19 million for RE-ENERGYSE, a joint program with the Department of Energy intended to promote education in clean energy research. An additional \$10 million would fund Climate Change Education, which seeks to increase understanding of climate among the next generation of Americans.

National Aeronautics and Space Administration (NASA). NASA's FY 2011 budget request is \$19.0 billion. NASA Earth Science is a relatively small fraction of this total, \$1.8 billion or 9.5 percent, but would increase substantially relative to the FY 2010 appropriation (up 26.8 percent).

NASA Earth Science funds climate change R&D through several programs. Two of particular note are Earth Science Research, which would receive \$438.1 million (an increase of 14 percent), and satellite

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observations (i.e., Systematic Missions), which would receive \$809.3 million (a 12 percent increase).

NASA has 15 satellite missions for global observations in operation. These collect information relating to climate variability and change as well as existing weather patterns. Measurements include: temperature and precipitation throughout the world, atmospheric composition and chemistry, solar irradiance, cloud characteristics, aerosols in the atmosphere, air pollution, ocean circulation, sea-surface height, surface winds, and land surface characteristics such as land-use patterns, the carbon cycle, and ecosystems, among others.

NASA has several missions in development. The FY 2011 request would accelerate two ongoing “Decadal Survey” missions, which are designed to meet the goals outlined in the 2007 National Research Council Report *Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond*. The Soil Moisture Active-Passive (SMAP) mission will provide new information on soil moisture. The Ice, Cloud, and Land Elevation satellite (ICESat II), will continue measurements of ice-sheet changes and the contribution of polar ice sheets to sea level changes, cloud characteristics, and land-surface topography.

Two additional Decadal Survey missions are in development: the Climate Absolute Radiance and Refractivity Observatory (CLARREO), which would provide a benchmark global climate record, and the Deformation, Ecosystem Structure, and Dynamics of Ice (DESDynI), which seeks to predict ice sheet responses to climate change and impact on the sea level, and characterize the effects of changing climate and land use on species habitats and the carbon cycle. NASA intends to identify and initiate at least one additional climate related mission from the Decadal Survey.

NASA’s request also includes funding to re-launch the Orbiting Carbon Observatory (OCO), which failed catastrophically in early 2009. Through the re-launch, NASA seeks to monitor carbon sources (emissions) and sinks throughout the world.

Department of Energy (DOE). The President’s budget request for DOE in FY 2011 is \$28.4 billion. This includes \$4.6 billion for R&D in the Office of Science (an increase of 3.8 percent), and \$2.4 billion for energy R&D (an increase of 6.8 percent). Within the Office of Science, the Office of Biological and Environmental Research (BER), which supports

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basic research in atmospheric sciences, terrestrial ecosystems and climate modeling, would receive \$627 million (an increase of 3.8 percent). BER's request includes \$28.6 million for the Terrestrial Ecosystem Science (TES) program, which examines the impact of climate change on biological systems and land-surface carbon cycle feedbacks to climate change.

DOE's FY 2011 budget request also includes considerable resources for technology development relating to climate change, including funding for three recent initiatives: \$107 million for Energy Innovation Hubs within DOE to promote energy security and greenhouse gas emissions reductions, \$40 million for additional Energy Frontier Research Centers (EFRCs) to develop clean energy, and an additional \$300 million for the Advance Research Projects Agency-Energy (ARPA-E) to advance high risk, high reward energy research projects.

DOE's budget request includes \$650 million for renewable energy generation (an increase of 37 percent), \$758 million to promote energy efficiency (an increase of 12 percent), \$186 million for modernization of the energy grid (an increase of 7 percent), and \$438 million for Advanced Carbon Capture and Storage, among other efforts.

Notably, DOE's request would eliminate \$2.7 billion in tax subsidies for oil, coal, and natural gas industries. This would increase the competitiveness of non-fossil energy sources and reflects a shift in priority toward non-emitting sources of energy.

Department of the Interior (DOI). DOI requests \$171 million (an increase of 26.0 percent) for its Climate Change Adaptation initiative, which seeks to identify areas and species most vulnerable to climate change and implement coping strategies. Of this, the United States Geological Survey (USGS) would receive \$77.9 million for climate science (an increase of 15.5 percent). As part of this initiative, DOI is in the process of establishing eight regional Climate Science Centers to aggregate and synthesize data on climate impacts, to assist local decision makers implement adaptation strategies, and to educate the public.

DOI's New Energy Frontier initiative would receive \$73.3 million for renewable energy programs (an increase of 24.0 percent). The initiative's renewable energy goal is to increase approved capacity for solar, wind, and geothermal energy generation on lands managed by DOI.

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Environmental Protection Agency (EPA). EPA requests \$169 million to reduce greenhouse gas emissions (an increase of 1 percent). Of this, \$43.5 million is new funding for regulatory efforts to reduce greenhouse gas emissions through the Clean Air Act.

EPA requests \$22 million for its Global Change Research Program, which assesses the impacts of global change on air and water quality, ecosystems, human health, and socioeconomic systems in the United States with a primary goal of promoting adaptation efforts.

U.S. Department of Agriculture (USDA). USDA requests \$159 million for climate change research, an increase of 42.0 percent, and \$179 million for renewable energy, an increase of 41.0 percent.

USDA's climate change efforts (and those of the U.S. Forest Service which is part of USDA) center on helping farmers and land owners adapt to climate change impacts (e.g., enhanced fire stress, insect outbreaks, droughts, floods, and heat stress) and promoting carbon storage in soils and forests.