CLIMATE CHANGE AND ENERGY SUPPLY AND USE

*Technical Report for the US Department of Energy
in Support of the National Climate Assessment*

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Climate Change and Energy Supply and Use

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About This Series

This report is published as one of a series of technical inputs to the Third National Climate Assessment (NCA) report. The NCA is being conducted under the auspices of the Global Change Research Act of 1990, which requires a report to the President and Congress every four years on the status of climate change science and impacts. The NCA informs the nation about already observed changes, the current status of the climate, and anticipated trends for the future. The NCA report process integrates scientific information from multiple sources and sectors to highlight key findings and significant gaps in our knowledge. Findings from the NCA provide input to federal science priorities and are used by U.S. citizens, communities and businesses as they create more sustainable and environmentally sound plans for the nation's future.

In fall of 2011, the NCA requested technical input from a broad range of experts in academia, private industry, state and local governments, non-governmental organizations, professional societies, and impacted communities, with the intent of producing a better informed and more useful report. In particular, the eight NCA regions, as well as the Coastal and the Ocean biogeographical regions, were asked to contribute technical input reports highlighting past climate trends, projected climate change, and impacts to specific sectors in their regions. Each region established its own process for developing this technical input. The lead authors for related chapters in the Third NCA report, which will include a much shorter synthesis of climate change for each region, are using these technical input reports as important source material. By publishing this series of regional technical input reports, Island Press hopes to make this rich collection of information more widely available.

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Preface

In connection with the U.S. National Climate Assessment scheduled to be completed in 2014, the U.S. Global Change Research Program (USGCRP) and the National Climate Assessment Development and Advisory Committee (NACDAC) invited technical inputs. Many of the most substantive inputs were sponsored by USGCRP agencies, reflecting the knowledge and experience represented by their programs. The technical inputs were due to be submitted by March 1, 2012.

The U.S. Department of Energy (DOE) produced three technical input reports: Climate Change and Infrastructure, Urban Systems, and Vulnerabilities; Climate Change and Energy Supply and Demand; and Climate and Energy-Water-Land system interactions. All three reports were based in part on a major national workshop of experts from a wide variety of communities of knowledge and experience, and all three reports were peer-reviewed. This book provides the content of the first of these reports to a broader audience.

The author team would like to acknowledge the inspiration, leadership, guidance, and support of Bob Vallario, Director of the Integrated Assessment Research Program of DOE's Climate and Environmental Systems Division, Office of Biological and Environmental Research, Office of Science. Without Bob's knowledge and perspectives on everything from the subject areas to the expert communities, the technical input report could not have been produced and delivered on schedule; and he has continued since the report was delivered to put its scientific content to use; not only in the National Climate Assessment but in a wide variety of other program efforts related to DOE's missions. Although he is not listed as an author of this technical report, he is in every way a full partner of the report's authors and their commitments to advance knowledge about the report's topics.

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Executive Summary

This technical report on “Climate Change and Energy Supply and Use” was prepared for the U.S. Department of Energy by the Oak Ridge National Laboratory in support of the U.S. National Climate Assessment (NCA). Prepared on an accelerated schedule to fit time requirements for the NCA, it is a summary of the currently existing knowledge base on its topic, nested within a broader framing of issues and questions that need further attention in the longer run (also see the on-line version of the report, which includes figures in color: <http://www.esd.ornl.gov/eess/NCAEnergySupply.shtml>).

The report arrives at a number of “assessment findings,” each associated with an evaluation of the level of consensus on that issue within the expert community, the volume of evidence available to support that judgment, and the section of the report that provides an explanation for the finding.

GCRP, 2009, indicates that the US energy sector is large and complex, with impressive financial and management resources, capable of responding to major challenges. It is accustomed to strategy development and operation in the face of uncertainties and risks, both environmental and political. No sector has better capabilities to respond to challenges posed by climate change impacts.

Current knowledge indicates that such challenges tend to focus on climate-change-related episodic disruptions of energy supply and demand related to extreme weather events at a regional scale, on exposures related to risks in especially vulnerable areas, and on implications of changes in temperature and precipitation patterns – extremes as well as averages – for supply and use systems that are sensitive to climate parameters.

More specifically, the report’s assessment findings are as follows. In each case, the report includes further information to support the finding.

Regarding implications for components of energy supply and use systems and cross-cutting implications for energy supply and use, we find that there are:

Implications for components of the nation’s energy supply and use systems

- In most cases, the major current risk for both supply and use is from episodic disruptions related to extreme weather events
- Impacts from weather phenomena associated with climate change pose risks of economic costs to energy suppliers and users
- Increases in average temperatures and temperature extremes will mean increasing demand for electricity for cooling in every US region, along with reductions in energy demands for space heating
- Climate change is expected to have a larger impact on peak electricity demand than on monthly average electricity demand
- Impacts of climate change are risks to many oil and gas supply activities in vulnerable coastal areas, offshore production areas, and tundra areas
- Both climate change and rising concentrations of atmospheric carbon dioxide will affect bioenergy production potentials

- Expected seasonal and/or chronic water scarcity represent risks of electricity supply disruptions in many US regions
- Climate change will affect the geographical pattern of renewable energy supply potentials in the US
- Expected reductions in precipitation in the form of snowfall in the US West will reduce hydropower production, at least in some parts of the region
- In most cases, adaptation measures can reduce risks and prospects of negative consequences for energy supply and use

Cross-cutting implications for energy supply and demand

- Energy system resilience will benefit from progress with technology R&D
- Most vulnerabilities and risks for energy supply and demand reflect relatively fine-grained place-based differences in situations
- The variability of risks from weather-related events in both time and space will increase with climate change
- Climate change implications interact with and are affected by regulatory environments
- In many cases, gaps in the availability of data limit the capacity to answer key assessment questions

Regarding climate change risk management strategies for energy supply and use, we find that:

- Despite uncertainties about climate change impacts in the future, robust risk management strategies can be developed and – in an iterative manner that incorporates continuing observation, evaluation, and learning - implemented
- Many of the elements of such strategies can be identified based on existing knowledge
- A critically important step toward developing such strategies is conducting vulnerability assessments

Regarding knowledge and research gaps, we find that:

- Improving knowledge about vulnerabilities and possible risk management strategies is essential for effective climate change risk management in the energy sector
- Particularly important is improving knowledge about and improving capacities related to potentials for renewable energy development, resilience to extreme events, and potential tipping points for particular aspects of energy supply and use

Regarding the challenge of developing a self-sustained assessment process for the longer term, we find that:

- A self-sustaining long-term assessment process needs a commitment to improve the science base, working toward a vision of where things should be in the longer term
- Capacities for long-term assessments of vulnerabilities, risks, and impacts of climate change on energy supply and use will benefit from effective partnerships among a wide range of experts and stakeholders
- Self-sustaining assessment structures will provide value to all partners