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CHAPTER



Introduction

Authors:

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As a major expression of its objective to provide the best possible scientific information to support decision-making and public discussion on key climate-related issues, the U.S. Climate Change Science Program (CCSP) has commissioned 21 “synthesis and assessment products” (SAPs) to summarize current knowledge and identify priorities for research, observation, and decision support in order to strengthen contributions by climate change science to climate change related decisions.

These reports arise from the five goals of CCSP (<http://www.climatescience.gov>), the fourth of which is to “understand the sensitivity and adaptability of different natural and managed ecosystems and human systems to climate and related global changes.” One of the seven SAPs related to this particular goal is concerned with analyses of the effects of global change on energy production and use (SAP 4.5). The resulting SAP, this report, has been titled “Effects of Climate Change on Energy Production and Use in the United States.”

This topic is relevant to policy-makers and other decision-makers because most discussions to date of relationships between the energy sector and responses to concerns about climate have been very largely concerned with roles of energy production and use in climate change mitigation. Along with these roles of the energy sector as a *driver* of climate change, the energy sector is also subject to *effects* of climate change; and these possible effects – along with adaptation strategies to reduce any potential negative costs from them – have received much less attention. For instance, the U.S. National Assessment of Possible Consequences of Climate Variability and Change (NACC, 2001) considered effects on five sectors, such as water and health; but energy was not one of those sectors, even though the Global Change Research Act of 1990 had listed energy as one of several sectors of particular interest.



Because the topic has not been a high priority for research support and institutional analysis, the formal knowledge base is in many ways limited. As a starting point for discussion, this product compiles and reports what is known about likely or possible effects of climate change on energy production and use in the United States, within a more comprehensive framework for thought about this topic, and it identifies priorities for expanding the knowledge base to meet needs of key decision-makers.

I.1 BACKGROUND

Climate change is expected to have certain effects in the United States: a rise in average temperatures in most regions, changes in precipitation amounts and seasonal patterns in many regions, changes in the intensity and pattern of extreme weather events, and sea level rise [(IPCC, 2001a; NACC, 2001; also see other SAPs, including 2.1b and 3.2)].

Some of these effects have clear implications for energy production and use. For instance, average warming can be expected to increase energy requirements for cooling and reduce energy requirements for warming. Changes in precipitation patterns and amounts could affect prospects for hydropower, positively or negatively. Increases in storm intensity could threaten further disruptions of the sorts experienced in 2005 with Hurricanes Katrina and Rita. Concerns about climate change impacts could change perceptions and valuations of energy technology alternatives. Any or all of these types of effects could have very real meaning for energy policies, decisions, and institutions in the United States, affecting discussions of courses of action and appropriate strategies for risk management.

According to CCSP, an SAP has three end uses: (1) informing the evolution of the research agenda; (2) supporting adaptive management and planning; and (3) supporting policy formulation. This product will inform policymakers, stakeholders, and the general public about issues associated with climate change implications for energy production and use in the

United States, increase awareness of what is known and not yet known, and support discussions of technology and policy options where the knowledge base is still at an early stage of development.

The central questions addressed by SAP 4.5 follow:

- How might climate change affect energy consumption in the United States?
- How might climate change affect energy production and supply in the United States?
- How might climate change affect various contexts that indirectly shape energy production and consumption in the United States, such as energy technologies, energy institutions, regional economic growth, energy prices, energy security, and environmental emissions?

SAP 4.5 is being completed by the end of the second quarter of calendar year 2007 (June 30, 2007), following a number of steps required for all SAPs in scoping the study, conducting it, and reviewing it at several stages (see the section below on How the Report Was Developed).

I.2 THE TOPIC OF THIS SYNTHESIS AND ASSESSMENT REPORT

This report summarizes the current knowledge base about possible effects of climate change on energy production and use in the United States as a contributor to further studies of the broader topic of effects of global change on energy production and use. It also identifies where research could reduce uncertainties about vulnerabilities, possible effects, and possible strategies to reduce negative effects and increase adaptive capacity and considers priorities for strengthening the knowledge base. As is the case for most of the SAPs, it does not include new analyses of data, new scenarios of climate change or impacts, or other new contributions to the knowledge base, although its presentation of a framework for thought about energy sector impacts is in many ways new.



As indicated above, the content of SAP 4.5 includes attention to the following issues:

- possible effects (both positive and negative) of climate change on energy *consumption* in the United States (Chapter 2),
- possible effects (both positive and negative) on energy *production and supply* in the United States (Chapter 3), and
- possible *indirect effects* on energy consumption and production (Chapter 4).

These chapters are followed by a final chapter that provides conclusions about what is currently known, prospects for adaptation, and priorities for improving the knowledge base.

1.3 PREVIOUS ASSESSMENTS OF THIS TOPIC

As mentioned on page 1, unlike some of the other sectoral assessment areas identified in the Global Change Research Act of 1990—such as agriculture, water, and human health—energy was not the subject of a sectoral assessment in the *National Assessment of Possible Consequences of Climate Variability and Change*, completed in 2001 (NACC, 2001). As a result, SAP 4.5 draws upon a less organized knowledge base than these other sectoral impact areas. On the other hand, by addressing an assessment area not covered in the initial national assessment, SAP 4.5 will provide new information and perspectives.

The subject matter associated with SAP 4.5 is incorporated in two chapters of the Working Group II contribution to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (Impacts, Adaptation, and Vulnerability), scheduled for completion in 2007. Chapter 7, “Industry, Settlement, and Society,” Section 7.4.2.1, briefly summarizes the global knowledge base about possible impacts of climate change on energy production and use, reporting relevant research from the United States but not assessing impacts on the United States. Chapter 14, “North America,” summarizes the knowledge base about possible impacts of climate change in this continent, including the United States, in Sections 14.2.8 and 14.4.8.

1.4 HOW THE REPORT WAS DEVELOPED

SAPs are developed according to guidelines established by CCSP based on processes that are open and public. These processes include a number of steps before approval to proceed, emphasizing both stakeholder participation and CCSP reviews of a formal prospectus for the report, a number of review steps including both expert reviewers and public comments, and final reviews by the CCSP Interagency Committee and the National Science and Technology Council (NSTC).

The process for producing the report was focused on a survey and assessment of the available literature, in many cases including documents that were not peer-reviewed but the authors determined to be valid, using established analytic-deliberative practices. It included identification and consideration of relevant studies carried out in connection with CCSP, the Climate Change Technology Program (CCTP), and other programs of CCSP agencies (e.g., the Energy Information Administration), and consultation with stakeholders such as the electric utility and energy industries, environmental non-governmental organizations, and the academic research community to determine what analyses have been conducted and reports have been issued. Where quantitative research results are limited, the process considers the degree to which qualitative statements of possible effects may be valid as outcomes of expert deliberation, utilizing the extensive review processes built into the SAP process to contribute to judgments about the validity of the statements.

SAP 4.5 is authored by staff from the Department of Energy (DOE) national laboratories, drawing on their own expertise and knowledge bases and also upon other knowledge bases, including those within energy corporations and utilities, consulting firms, nongovernmental organizations, state and local governments, and the academic research community. DOE has assured that authorship by DOE national laboratory staff will in no way exclude any relevant research or knowledge, and every effort is being made to identify and utilize all relevant expert-



BOX I.1 SAP 4.5 Author Team

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ise, materials, and other sources. For the author team of SAP 4.5, see Box 1.1.

Stakeholders participated during the scoping process, have provided comments on the prospectus, and submitted comments on the product during a public comment period, as well as other comments via the SAP 4.5 web site. The development of SAP 4.5 included active networking by authors with centers of expertise and stakeholders to assure that the process was fully informed about their knowledge bases and viewpoints.

As indicated above, because of limitations in available research literatures, in some cases the report is only able to characterize categories of possible effects without evaluating what the effects are likely to be. In other cases, the report offers preliminary judgments about effects, related to degrees of likelihood: likely (2 chances out of 3), very likely (9 chances out of 10), or virtually certain (99 chances out of 100).

This report avoids the use of highly technical terminology, but a glossary and list of acronyms are included at the end of the report.

1.5 HOW TO USE THIS REPORT

The audience for SAP 4.5 includes scientists in related fields, decision-makers in the public sector (federal, state, and local governments), the private sector (energy companies, electric utilities, energy equipment providers and vendors, and energy-dependent sectors of the economy), energy and environmental policy interest groups, and the general public. Even though this report is unable—based on existing knowledge—to answer all relevant questions that might be asked by these interested parties, the intent is to provide information and perspectives to inform discussions about the issues and to clarify priorities for research to reduce uncertainties in answering key questions.