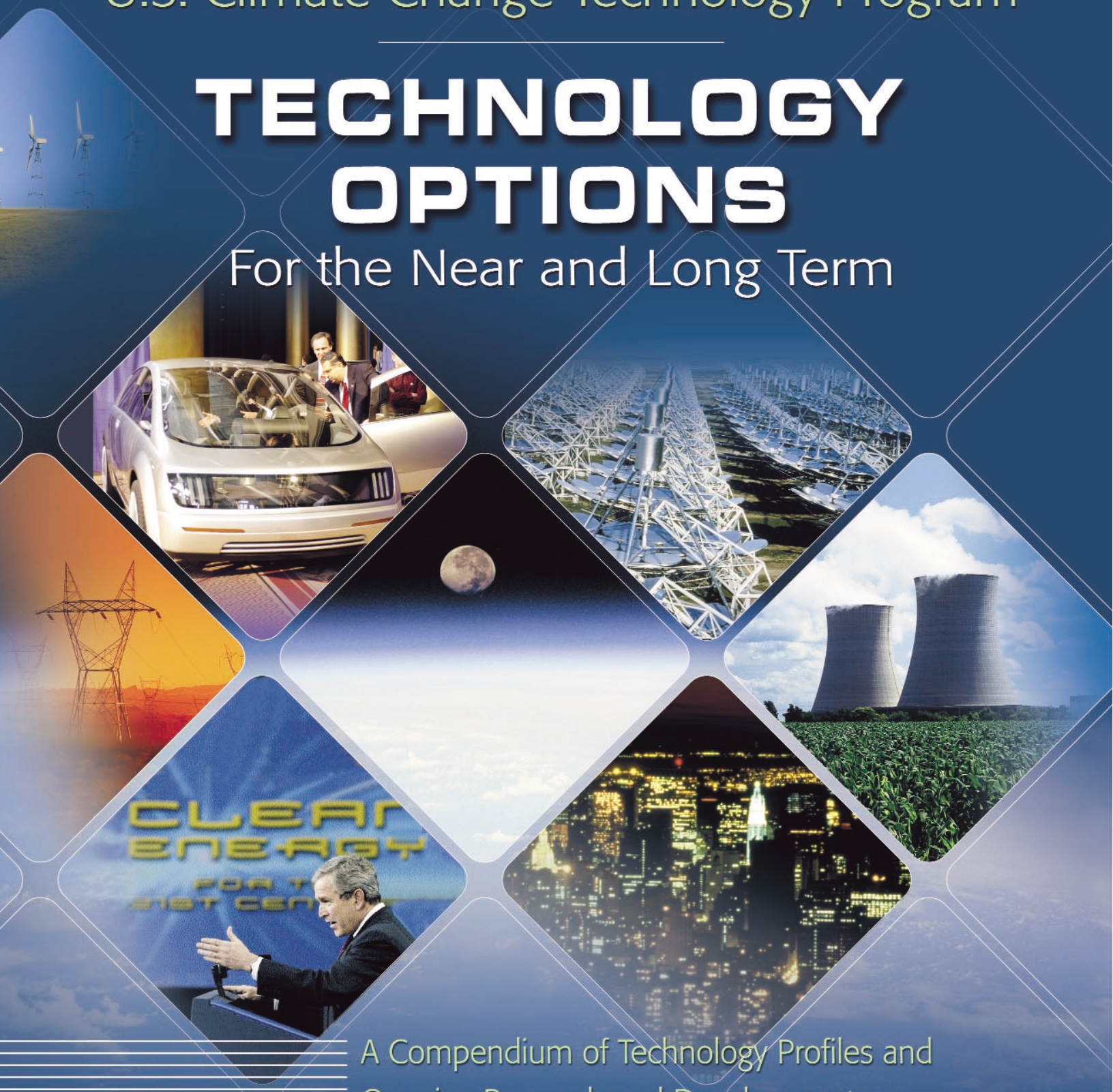
DOE/PI-0002

U.S. Climate Change Technology Program

TECHNOLOGY OPTIONS

For the Near and Long Term



A Compendium of Technology Profiles and Ongoing Research and Development at Participating Federal Agencies

November 2003

U.S. Climate Change Technology Program

U.S. Department of Energy (Lead Agency)
U.S. Department of Agriculture
U.S. Department of Commerce, including
National Institute of Standards and Technology
U.S. Department of Defense
U.S. Department of Health and Human Services, including
National Institutes of Health
U.S. Department of Interior
U.S. Department of State, including
U.S. Agency for International Development
U.S. Department of Transportation
U.S. Environmental Protection Agency
National Aeronautics and Space Administration
National Science Foundation
Other Participating Research and Development Agencies

Executive Office of the President, including
Council on Environmental Quality
Office of Science and Technology Policy
Office of Management and Budget

November 2003

To the Reader:

We are pleased to present this report titled *U.S. Climate Change Technology Program – Technology Options for the Near and Long Term*. The activities described in this report present a portfolio of Federal R&D investments in climate change technology development and deployment that are believed to offer significant potential for contributing to the President's near and long term climate change goals. A companion report titled *U.S. Climate Change Technology Program – Research and Current Activities* highlights Presidential initiatives and other important research, development, and deployment activities in this area.

Collectively, these technology-related activities form an integral part of a comprehensive U.S. strategy on climate change that rests on three pillars — science, technology, and international cooperation. They also complement the recent Climate Change Science Program (CCSP) strategic plan, which represents an unprecedented effort to advance our knowledge of climate variability, the potential response of the climate system to growing greenhouse gas concentrations and their implications, and management options for natural environments. The scientific information developed under the CCSP will help us better define our technology challenges.

Early in his term, President Bush charged his Administration with identifying a new approach to climate change that is science-based, encourages scientific and technological breakthroughs, harnesses the power of markets, does not hamper economic growth, encourages global participation, and helps achieve the goal of stabilizing atmospheric concentrations of greenhouse gases. As research continues, there is a growing realization that existing technologies, even with substantial refinements, cannot meet the world's increasing demand for energy and achieve the eventual goal of stabilizing greenhouse gas concentrations in the atmosphere. Doing so will require developing low or zero-emission technologies that will fundamentally transform current energy systems.

To achieve this vision, the participating agencies of the U.S. Climate Change Technology Program are pursuing research in carbon sequestration, hydrogen, bio-energy, nuclear fission and fusion, and many other revolutionary technologies. These transformational technologies will put us on a path to stabilizing atmospheric greenhouse gas concentrations and also ensure secure, affordable, and clean energy to power economic growth worldwide.

Through scientific research, technological innovation, and international collaboration, we are working to ensure a bright energy and economic future for our Nation and a healthy planet for future generations. For more information on the U.S. Climate Change Technology Program, please visit our website at http://www.climatetechnology.gov/.

Spencer Abraham
Secretary of Energy
Chair, Committee on Climate Change
Science and Technology Integration

Donald L. Evans
Secretary of Commerce
Vice Chair, Committee on Climate Change
Science and Technology Integration

John H. Marburger III, Ph.D.
Director, Office of Science and Technology Policy
Executive Secretary, Committee
on Climate Change
Science and Technology Integration

U.S. Climate Change Technology Program – Technology Options for the Near and Long Term

Under the leadership of President Bush, the United States is now embarked on a long-term technical challenge – guided and paced by science, and undertaken in partnership with others – to explore, develop, and deploy innovative and advanced technologies that could make a significant contribution to meeting climate change goals. The President directed relevant agencies of the Federal government to apply their resources to this challenge and established a new Cabinet-level management structure to guide and oversee the effort. Under the auspices of this Cabinet-level management structure, the U.S. Climate Change Technology Program (CCTP) is charged with coordinating and focusing these research, development, and deployment activities among the participating agencies.

This report, titled *U.S. Climate Change Technology Program – Technology Options for the Near and Long Term,* presents summary descriptions, or profiles, of technologies or technology areas believed to offer significant potential for contributing to the president's near- and long-term climate change goals. This collection is fairly complete and roughly represents the breadth of Federal R&D in climate change technology development and deployment. Federal investments are further augmented by those of states, local governments, the private sector, and governments abroad. To the extent possible, the CCTP seeks to leverage and coordinate the Federal investments with those of others.

In total, there is a robust portfolio of R&D now underway in the United States and worldwide. From these R&D investments, undertaken together, pragmatic technological opportunities will arise to fundamentally transform and dramatically improve our 21st century energy system, with significantly reduced greenhouse gases emissions as a result.

In this report, more than 80 technology options are identified. They are organized within a series of goals aimed at developing advanced technologies that, if successful, could enable: (i) reduced emissions from energy end use and infrastructure; (ii) reduced emissions from energy supply; (iii) the capture and sequestering of carbon dioxide (CO_2); (iv) reduced emissions of other greenhouse gases; and (v) enhanced capabilities to measure and monitor greenhouse gases emissions. To ease reading and cross-referencing, a standard format for the profiles was adopted (see inset).

Standard Technology Profile Outline

- Technology Description
  - System Concepts
  - Representative Technologies
  - Technology Status/Applications
- Current Research, Development, and Demonstration
  - RD&D Goals
  - RD&D Challenges
  - RD&D Activities
- Recent Progress
- Commercialization and Deployment Activities

Each technology represented here, if successful, could contribute significantly to one or more of the goals outlined above, resulting in climate change-related benefits as compared to a baseline without the technology. Specific estimates of these benefits, however, are uncertain and depend on a number of variables, including marketplace forces, advances in competing technologies, and other factors prevailing at the time. Most of the technologies described require additional R&D investments to improve performance and reduce costs, followed by significant private-sector investment to commercialize and widely diffuse the technologies into the marketplace. Accordingly, such benefits are acknowledged generally by inclusion in this report, but specific estimates are not presented in each profile.

Additional information about the technologies may be obtained by contacting the Federal agency and program office identified as responsible for the R&D or deployment activity. All profiles may be found electronically, in formats suitable for electronic transfer, at the Web site http://www.climatetechnology.gov/.

TABLE OF CONTENTS