

APPENDIX C

***CHARGE AND
ORGANIZATIONAL DETAILS***

Introduction

The Basic Energy Sciences Advisory Committee appointed this subpanel to help identify the basic research needed to resolve key issues in the development of a secure energy future for the United States. The charge letter to the subpanel is included in this appendix. The focus of the discussions of the subpanel was “the future.” Generally, for the solution of critical issues that require first-class basic research and the transition of the identified solutions to practice, experience has shown that an extended time scale is required, of the order of several years. The issue of a “Secure Energy Future” is even more demanding, and the time scale considered in the discussions was several decades.

Early in the discussions about the subpanel’s activities, it was determined that it was important that the discussions to identify the research directions should involve as large a group of stakeholders as possible, whose members were knowledgeable in the appropriate areas of DOE’s research. At the same time, it was recognized that meaningful discussions could not be accomplished in extremely large groups.

To focus the discussions, eight major energy areas, or topical areas, were identified:

- Fossil Energy;
- Nuclear Fission Energy;
- Renewable and Solar Energy;
- Fusion Energy;
- Distributed Energy, Fuel Cells, and Hydrogen;
- Transportation Energy Consumption;
- Residential, Commercial and Industrial Energy Consumption;
- Cross-Cutting Research and Education; and
- Energy Biosciences Research.

For each of these topical areas (with the exception of Energy Biosciences), chairpersons were selected. Their initial task was to identify a small group (4-6) to help them identify some needed basic research directions. The chairs were:

- Marvin Singer (DOE Office of Fossil Energy), Fossil Energy;
- John Ahearne (Sigma Xi), Nuclear Fission Energy;
- George Crabtree (Argonne National Laboratory), Renewable and Solar Energy;
- Charles Baker (University of California San Diego), Fusion Energy;
- Lutgard C. DeJonghe (University of California Berkeley), Distributed Energy, Fuel Cells, and Hydrogen;
- Jan Herbst (General Motors R&D Center), Transportation Energy Consumption;
- Mildred Dresselhaus (Massachusetts Institute of Technology), Residential, Commercial, and Industrial Energy Consumption; and
- Rick Smalley (Rice University), Cross-Cutting Research and Education.

The Workshop

The second phase of the subpanel’s work was the workshop held in Gaithersburg October 21–25, 2002. Prior to the workshop, additional members were identified to expand the small groups into Topical Teams of 10 to 12 members. The Teams were selected to be representative of the stakeholders: they included members from academia, the National Laboratories, industry, and the applied mission Offices of DOE. In

addition, members of the Office of Basic Energy Sciences were present, primarily to act as a resource for the Teams.

The Team members are listed at the end of this appendix. From this, it can be seen that over 100 people were involved as active members of the Teams at the workshop. Of these, 27% were from academia, 39% from the National Laboratories, 16% from industry, and 18% from DOE and other government agencies. Staff members from the Office of Basic Energy Sciences were also involved; these were evenly divided between the Materials Science and Engineering (MS) Division and the Chemical Sciences, Geosciences, and Biosciences (CS) Division.

After introductory presentations(found in Appendix D), the major focus of the 4-day workshop was interactive discussions among the members of the Teams. The details of the workshop program are included in this appendix. On Thursday morning, the Topical Team Chairs presented the conclusions of their deliberations. The slides from these presentations are included as Appendix E. On Thursday afternoon, Professor Smalley presented the results of his Team, who had been reviewing the progress of the other Teams; and also introduced three new topics.

On Friday morning, a discussion involving the subpanel and Team chairs identified a limited number of Research Directions on the basis of the proposals made by the Teams. There were approximately 34 proposed research directions (PRDs) from the week's deliberations (The full text of all of these are included in Appendix A). Rather than identify a shorter list of research directions, the group elected to identify the common threads from the full list. The next section of this report describes these.

In addition, during the Friday discussions, the group suggested that an additional workshop be held to provide additional insights on possible research directions related to energy biosciences. This area was incorporated in several of the PRDs, but the experts needed to support these topics were not at the October workshop. The second workshop was accomplished on January 13-14, 2003; the equivalent membership and attendance data and the PRDs for that workshop are included in the Appendices.

Products of the Workshop

The products of the workshop were the PRDs and the summary recommendations. The Teams prepared the support documents for the PRDs in a roughly consistent format. The format consists of two parts: an Executive Summary, readable by a lay audience, of about one page and a more extended technical description of the PRD of approximately three pages. In general, no references were used in these documents; appropriate references were included in the Factual Documents (Appendix B). The Teams were asked to identify the DOE applied mission to which each proposed research best related, and an estimate of the time required to achieve the stated goals. However, no discussion of the funding requirements was included in the text.

June 18, 2001

Professor Geraldine L. Richmond
Department of Chemistry
210 Willamette Hall
University of Oregon
Eugene, OR 97403-1253

Dear Professor Richmond:

I very much appreciate your willingness to serve an additional term as Chair of the Basic Energy Sciences Advisory Committee (BESAC). I believe that the continuity in leadership you provide is critical as BES hosts its first Committee of Visitors and as BESAC embarks on new challenges, which are detailed below. Under your leadership during the past few years, BESAC activities have produced extraordinary results that already have – and will continue to have – broad impacts in the Basic Energy Sciences program. I want to thank you for your leadership of BESAC, and I also want to express my sincere appreciation for the superb job that you did during your testimony on May 17th at the Hearing on *Department of Energy Office of Science – Issues and Opportunities* before the U.S. House of Representatives Committee on Science. I have heard from many that your testimony was articulate, focused, and had an enormous impact.

During the coming year, I would like BESAC to take on two new challenges relating to the research programs of the BES program. I expect that each will require one or more workshops. I have provided an overview of each activity below. The first activity is an extension of work that was done in the areas of nanoscale science and complex systems. I know that BESAC has been engaged in activities relating to nanoscale science, including the formation of Nanoscale Science Research Centers, and has clearly articulated that scientific understanding at the nanoscale is required for the development of larger functional systems that use nanoscale building blocks. *The report of the workshop on Complex Systems outlined an exciting science agenda that integrates the disciplines of physics, chemistry, materials science, and biology to build on the foundations that now have been put in place by the National Nanotechnology Initiative. I would like you to help refine that research agenda.* In the world “beyond nano,” it will be necessary to use atoms, molecules, and nanoscale materials as the building blocks for larger supramolecules and hierarchical assemblies. As was described in *Complex Systems – Science for the 21st Century*, the promise is nanometer-scale (and larger) chemical factories, molecular pumps, and sensors. This has the potential to provide new routes to high-performance materials such as adhesives and composites, highly specific membrane and filtration systems, low-friction bearings, wear-resistant materials, high-strength lightweight materials, photosynthetic materials with built-in energy storage devices, and much more. The magnitude of the challenge is perhaps more daunting than any faced before by these disciplines. I would greatly appreciate BESAC’s help in defining these challenges.

The second activity might build on some of the ideas discussed above to answer the question: *What are the 21st century fundamental scientific challenges that BES must consider in addressing the DOE missions in energy efficiency, renewable energy resources, improved use of fossil fuels, safe and publicly acceptable nuclear energy, future energy sources, science-based stockpile stewardship, and reduced environmental impacts of energy production and use?* Over the years, the BES research portfolio has evolved to address these issues and more. There have been many successes.

The *National Energy Policy* noted that the U.S. economy grew by 126 percent since 1973, but energy use increased by only 30 percent. Approximately one-half to two-thirds of the savings resulted from technological improvements in products and services that allow consumers to enjoy more energy services without commensurate increases in energy demand. At the heart of these improvements is fundamental research. During this 30-year period, the basic research supported by the BES program has touched virtually every aspect of energy resources, production, conversion, efficiency, and waste mitigation. The basic knowledge derived from fundamental research has resulted in a vast array of advances, including • high-energy and high-power lithium and lithium ion batteries and thin-film rechargeable microbatteries; • thermoacoustic refrigeration devices that cool without moving parts and without the use of freons; • compound semiconductors, leading to the world's highest efficiency photovoltaic solar cells; • strong, ductile alloys for use in high-temperature applications; • new steels, improved aluminum alloys, and high-performance magnet materials; • polymer materials for rechargeable batteries, car bumpers, food wrappings, flat-panel displays, wear-resistant plastic parts, and polymer-coated particles in lubricating oils; • new commercial processes for ethanol production, pulp and paper manufacturing, and *in planta* production of oils; and • new catalysts for the production of polymers and for a host of other products and energy-efficient processes; and • a host of new instruments, such as superconducting quantum interference devices (SQUIDs) that can sense minute magnetic fields for use in applications ranging from resource exploration to monitoring the human brain and heart. *These advances came by exploiting the results of basic research that sought answers to fundamental questions. The challenge is to continue the tradition of discovery. To that end, I would like BESAC to oversee a small number of workshops (perhaps 2 or 3) that articulate 21st century discovery potential in DOE mission areas. Defining the role and challenges of basic research is particularly timely given the recent release of the President's National Energy Policy.*

I would hope that by the time of the February 2002 BESAC meeting, the "Beyond Nano" workshop will have taken place and at least one workshop in the second category is scheduled. Again, thank you for your continued expert leadership of our largest Office of Science program.

With best regards,

signed June 18, 2001

James F. Decker
Acting Director
Office of Science

cc:

P. Dehmer, SC-10

I. Thomas, SC-13

S. Long, SC-10

Basic Research Needs to Assure a Secure Energy Future: Organization, Workshop, and Follow-up Activities

Dr. John Stringer, EPRI, Workshop Chair

Dr. Linda Horton, ORNL, Co-Chair

Fossil Energy

**Marvin Singer, Chair
Director, Advanced Research
Office of Fossil Energy, DOE**

Tim Armstrong, ORNL

Tof Carim, DOE-BES

Cindy Dogan, Albany Res Lab

David Keith, CMU

Tina Nenoff, SNL

Eric Suuberg, Brown U

Anbo Wang, VPI

John Wimer, NETL

Mike Bockelie, Reaction Eng.

Bob Carling, SNL

Brian Gleeson, Ames/U of Iowa

Larry Myer, LBNL

Doug Ray, PNNL

Roger Turpening, DOE- BES

Nick Woodward, DOE-BES

Distributed Energy, Fuel Cells, and Hydrogen

**Lutgard DeJonghe, Chair
Professor of Ceramics
Materials Science and Engineering
University of California, Berkeley**

Meilin Liu, Georgia Institute of Technology

Joan Ogden, Princeton University

Vitalij Pecharsky, Iowa State University

Philip N. Ross, LBNL

Subhash Singhal, PNNL

John Turner, NREL

Douglas Wheeler, UTC Fuel Cells

Mark Williams, NETL

Dick Kelley and Frank Tully, DOE-BES

Nuclear Fission Energy

**John Ahearne, Chair
Executive Director
Sigma Xi
Scientific Research Society**

Allen Croff, ORNL

(acting chair for workshop)

Ralph Bennett, INEEL*

Bob Gottschall, DOE-BES

Andy Klein, Oregon State

Frank Goldner, DOE-NE

John Taylor, EPRI*

Neil Todreas, MIT*

Todd Allen, ANL-W

Jim Beitz, ANL

Bill Millman, DOE-BES

Jack Richards, Cal Tech

Rob Versluis, DOE/NE

Brian Wirth, LLNL

Bill Weber, PNNL

Mike Kassner, Oregon State

*Did not attend workshop

Residential, Commercial, and Industrial Energy Consumption

**Millie Dresselhaus, Chair
Institute Professor, MIT
Physics and Electrical Engineering**

Sam Baldwin , DOE-EE
Hylan Lyon, Marlow Industries
Gerald Mahan, Penn State U.
Anne Mayes, MIT
Steve Selkowitz, LBNL
Jerry Simmons, SNL
Harriet Kung, DOE-BES
Aravinda Kini, DOE-BES

Speakers:
Anil Duggal, GE
Jerry Simmons, SNL
Woods Haley, UMN
Ron Judkoff, NREL
Ertugrul Berkcan, GE
Dickson Ozokwelu, DOE-EE
Vitalij Pecharsky, Ames/Iowa State

Panel Members with Phase I Task:

Paul Alivisatos, LBNL
Sam Bader, ANL
Terry Michalske, SNL

Transportation Energy Consumption

**Jan Herbst, Chair
Materials and Processes Laboratory
GM R&D Center**

Channing Ahn, Cal Tech.
Tarasankar DebRoy, Penn. State U.
Jim Eberhardt, DOE-EE
Ed Grostic, ORNL
Oren Hadaller, The Boeing Company
Kenneth Hass, Ford Motor Company
Joseph Heremans, Delphi Res. Labs
Chris Sloane, General Motors

Iver Anderson, AMES
Suresh Baskaran, PNNL
Bill Kirchhoff, DOE-BES
Paul Lessing, INEEL
Paul Miles, SNL
Kevin Ott, LANL
Matesh Varma, DOE- BES

Renewable and Solar Energy

**George Crabtree, Chair
Senior Scientist and Director
Materials Science Division
Argonne National Laboratory**

Sam Baldwin, DOE-EE

John Cooke, ORNL

Jerry Hunt, ANL

Lonnie Ingram, U. of Florida

Larry Kazmerski, NREL

Jeff Mazer, DOE-EE

Arthur Nozik, NREL

Jay Spivack, GE

Tom Baker, LANL

Dan Ginosar, INEEL

Mack Kennedy, LBNL

Nate Lewis, Cal. Tech.

Joe Paladino, NETL

Sharlene Weatherwax, DOE-BES

Jane Zhu, DOE-BES

Fusion Energy

**Charles Baker, Chair
Virtual Laboratory for Technology
University of California, San Diego**

Mohamed Abdou, UCLA

Roger Bangerter, LBNL

Jill Dahlburg, General Atomics

Phil Efthimion, Princeton

Neil Morley, UCLA

Steve Zinkle, ORNL

Sam Berk, DOE-Fusion

Russ Jones, PNNL

John Lindl, LLNL

Eric Rohlfing, DOE-BES

Kurt Schoenberg, LANL

Scott Willms, LANL

Cross-Cutting Research

**Rick Smalley, Chair
Professor of Chemistry
Rice University**

Ivan Bekey, Bekey Designs
Kwan Kwok, DARPA
Gerry Lavin, DuPont
John Mankins, NASA
Yoram Shoham, Shell
Jeff Tester, MIT
Nate Lewis, CalTech
Art Green, ExxonMobil

All Topical Team Chairs
John Stringer, EPRI
Linda Horton, ORNL

Schedule

**Monday, October 21st
Presentations from
DOE's SC, EE, FE, and NE**

Overview of the Office of Science, James Decker, Deputy Director

Overview of the Office of Basic Energy Sciences, Patricia Dehmer, Director

Overview DOE's Office of Fossil Energy Programs, Rita A. Bajura, Director, NETL

Basic Research Needs in Support of Advanced Nuclear Reactor and Fuel Cycle Technologies, R. Shane Johnson, Associate Director for Advanced Nuclear Research, Office of Nuclear Energy, Science and Technology

Science Issues in the Office of Energy Efficiency and Renewable Energy, Sam Baldwin Chief Technology Officer and Member, Board of Directors Office of Energy Efficiency and Renewable Energy

Schedule

Tuesday and Wednesday October 22nd and 23rd Breakout Sessions

1. Fossil Energy
2. Distributed Generation
3. Nuclear Energy
4. Industrial, Residential, Commercial
5. Transportation
6. Renewable Energy
7. Fusion Energy

Schedule

Thursday, October 24th Morning Closing Topical Area Summaries

Thursday, October 24, 2002			
8:30am - 11:30am	Closing Plenary Session -- Team Reports (15 minutes) 1. Fossil Energy 2. Distributed Generation 3. Nuclear Energy 4. Industrial, Residential, Commercial 5. Transportation 6. Renewable Energy 7. Fusion Energy	All Invited 1. Marvin Singer 2. Lutgard DeJonghe 3. TBD 4. Millie Dresselhaus 5. Jan Herbst 6. George Crabtree 7. Charles Baker	Salons E, F&G
11:30am - 12:00pm	Open Discussion	John Stringer	

Thursday morning concluded the workshop for most attendees.

Schedule

Thursday, October 24th
Afternoon

Topical Chairs and Crosscutting Team assembled for Crosscutting Research Topical Area

Thursday, October 24, 2002				
1:00pm - 4:00pm	Meeting of the Cross-Cutting Research Team	Rick Smalley, Rice University Representatives from Topical Groups Cross-Cutting Research Group Members	Salon D	
4:00pm - 4:30pm	Close of Cross-Cutting Research Team	All Invited	Salons E, F&G	
4:30pm - 5:00pm	Closing Remarks and Expectations for Friday	John Stringer	Salons E, F&G	
7:00pm	Dinner		TBD	

Schedule

Friday, October 25th
The beginning of Phase III

Stringer, Horton, Topical Team Chairs, BES Planning Staff

- Summarize proposed research directions and identify overlapping topics
- Discuss logistics for coordination/assembly of results
- Identify needs for expansion of information
- Define schedule and template for documentation

Follow up Workshop: Energy Biosciences

- Held January 12-14, 2003 in Palo Alto, CA
- Introductory Presentations on:
 - The Need for a Research Plan for a Secure Energy Future**
John Stringer
 - Summary of the October 21st – 25th Workshop Results**
Linda Horton
 - Current Status of Biochemical and Biotechnology Research in the Office of Basic Energy Science**
Walter Stevens
- Balance of time spent on discussions of research directions related to Energy Biosciences

Energy Biosciences Research

Mark Alper, LBNL

Heinz Frei, LBNL

Evan Hughes, EPRI

Laurie Mets, Univ. Chicago

John Shanklin, BNL

Chris Somerville, Stanford Univ.

Walt Stevens, BES

Lut De Jonghe, UCB

Other Attendees:

John Stringer, EPRI

Linda Horton, ORNL