

The “Basic Research Needs” Workshop Series

Workshops that engage the Nation’s basic research communities to help provide solutions for the pressing energy challenges of the 21st century

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Executive Summary

Goals

In 2001, the Office of Basic Energy Sciences (BES) in the Department of Energy's (DOE's) Office of Science (SC) created the concept for a "Basic Research Needs" series of workshops to identify the basic research needed to assure a secure energy future. These workshops have become a model of how to engage the basic research community in the problems associated with our Nation's energy agenda.

Each workshop has three common goals: (1) to summarize, prior to the workshop, the current state of technology and the associated R&D challenges in a Technology Perspectives Factual Document, which is used as a resource document for the basic research community at the workshop and well into the future; (2) to define a set of Proposed Research Directions that address the technology R&D challenges, the so-called technology show stoppers; and (3) to define a set of Science Grand Challenges that, if solved, might result in transformational changes in energy technologies.

The Basic Research Needs workshops must accomplish a great deal in a short time and their output must be authoritative, influential, and enduring. To accomplish the goals, the workshop planning, execution, and output stages are defined and structured. The workshop reports are of interest to scientists, to program managers, and to policy makers. Ideally, each workshop report should serve as a reference document with a long shelf life. Additionally, the reports should be readily accessible. All reports are available on the BES website (<http://www.sc.doe.gov/bes>), usually within 60-75 days of the workshop.

Progress to Date

The first workshop, *Basic Research Needs to Assure a Secure Energy Future*, was held in October 2002 under the auspices of the Basic Energy Sciences Advisory Committee (BESAC). That workshop looked broadly at energy supply, distribution, consumption, and carbon management. As part of this broad overview, the workshop also considered aspects of energy conservation, energy efficiency, and environmental stewardship. The 37 Proposed Research Directions and the crosscutting research topics that emerged formed the basis for a continuing series of follow-on workshops supported by BES.

The subsequent workshops underscore the urgency and demonstrate the commitment of BES to address the single major recommendation of the foundation report *Basic Research Needs to Assure a Secure Energy Future*:

“Considering the urgency of the energy problem, the magnitude of the needed scientific breakthroughs, and the historic rate of scientific discovery, current efforts will likely be too little, too late. Accordingly, BESAC believes that a new national energy research program is essential and must be initiated with the intensity and commitment of the Manhattan Project, and sustained until this problem is solved.”

Several follow-on Basic Research Needs workshops have been completed or are scheduled:

Basic Research Needs for the Hydrogen Economy, May 2003

Basic Research Needs for Solar Energy Utilization, April 2005

Basic Research Needs for Superconductivity, May 2006

Basic Research Needs for Solid-State Lighting, May 2006

Basic Research Needs for Advanced Nuclear Energy Systems, July-August 2006

Basic Research Needs for Combustion of 21st Century Fuels, October-November 2006

Basic Research Needs for Electric Energy Storage, Spring-Summer 2007

Basic Research Needs for Geosciences: Scientific Challenges for Measurement, Monitoring and Verification, Spring 2007

More Basic Research Needs workshops are in the planning stages.

Workshop Structure and Methods

The workshops are structured so that the participants learn about the status and challenges of a particular energy technology, generate proposed basic research directions to address short-term technology showstoppers, and articulate basic research grand challenges that might lead to transformational changes in energy technologies for the 21st century and beyond. The workshop reports that result from this process can help define the basic research agenda for a “decades-to-century” national energy agenda.

Workshop planning begins many months in advance and is performed by the workshop executive group, which is led by strong scientist chairs and co-chairs from academia and/or national laboratories. The executive group is made up of the workshop chair, co-chair(s), and panel leads. Attendance at the workshops is by invitation, and participants are selected for their depth and breadth of scientific expertise. Participants come primarily from the scientific community and include the workshop chair(s), plenary speakers, panel leads, panelists, and writers. Each role is assigned tasks to complete before, during, and after the workshop. Non-participating observers from stakeholder organizations are also invited to attend. Technology experts serve as plenary speakers to provide applied perspectives to the scientific community.

A hallmark of the Basic Research Needs workshops is the production of the Technology Perspectives Factual Document. This feature describes the current status of technology development and is prepared prior to the workshop. It provides a common context and language for workshop discussions, it is used to educate workshop participants, and it becomes part of the workshop report. The Technology Perspectives Factual Document is written by technology experts from inside and outside DOE. If existing material is available (for example, technology roadmaps), it is included either explicitly or by reference. The Technology Perspectives Factual Document is not meant to provide the perspectives of the science community. Instead, science perspectives are garnered as an outcome of the workshop.

The workshops have several common elements: (1) an opening plenary session, in which the current state of technology is addressed by distinguished speakers from the basic research, applied research, and industrial communities, (2) panel breakout sessions, in which the current state of science is shared and ideas are expressed on recommended priority science research topics, (3) a closing plenary session, in which the findings of the workshop are communicated in a series of oral presentations, and (4) a writing session, in which a draft of the report is completed before participants depart.

The outputs of the workshop are organized as (1) Panel Surveys describing the current state of science for each panel theme, (2) Priority Research Directions and Cross-Cutting Research Directions listed by each panel, (3) Science Grand Challenges outlined by all participants, and (4) Science and Technology Relationships Charts completed by the participants.

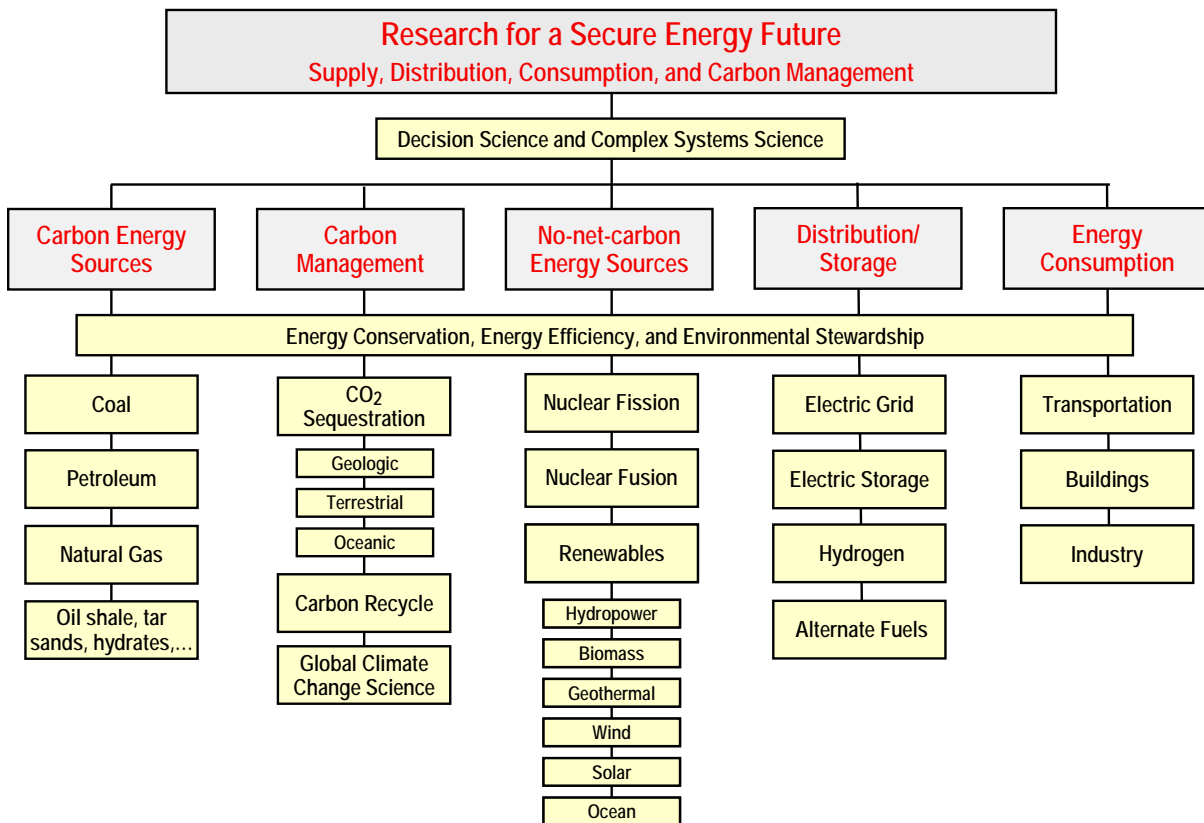
The result is a prioritization of the discovery-class and use-inspired basic research pertinent to energy technologies, obtained through a documented process. Often after the workshop, the chair and co-chair(s) and BES federal staff members participate in outreach activities to communicate the results of the workshop to the scientific community. Additionally, BES federal staff members brief other interested parties in the federal system, both inside and outside of DOE.

This document provides detailed information on the philosophy, planning, execution, and report production for the Basic Research Needs workshops and thus serves as a “how-to” manual for future workshop planning teams.

Workshop Goals

In October 2002, a Basic Energy Sciences Advisory Committee (BESAC) workshop was held to assess the basic research needs for energy technologies to assure a reliable, economic, and environmentally sound energy supply for the future. Over 100 scientists and engineers from academia, industry, and federal laboratories and agencies participated. The workshop identified the 21st century fundamental scientific challenges that BES must consider in addressing the Department of Energy (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. Workshop discussions produced a total of 37 proposed research directions grouped into ten general, multidisciplinary research areas. The workshop report, "Basic Research Needs to Assure a Secure Energy Future," recommends that a new national energy research program with the intensity and commitment of the Manhattan Project be initiated and sustained until the energy problem is solved.

The 2002 BESAC workshop inspired the comprehensive decades-to-century energy plan shown schematically below. BES has since held (and is holding) a series of workshops, referred to as the Basic Research Needs (BRN) workshops and modeled after the 2002 BESAC meeting, to examine in detail the research directions necessary for a decades-to-century energy strategy. Top scientists from around the world have come together to identify areas of scientific opportunity relevant to energy technologies. By effectively linking discovery and use-inspired sciences with energy technology goals, the reports from these workshops have generated great interest in the science and technology research communities. In



Elements Required for a Decades-to-Century Energy Strategy. (inspired by "Basic Research Needs to Assure a Secure Energy Future", BESAC, 2002)

many cases, these are the first comprehensive studies devoted entirely to the basic research needs associated with specific energy technology areas. The product of the workshops, a series of workshop reports, has been accepted and widely recognized by scientists as the best path forward. The demand for additional workshops is high, and other agencies and organizations are interested in sponsoring similar workshops. Thus, there is a need to document the methods used to plan and conduct the workshops. The present document expresses the philosophy behind the workshops and delineates the steps in organizing such workshops.

The goal of each BRN workshop is to mine facts and information from the scientific research community. Emphasis is on identifying fundamental knowledge, not technology gaps. The research discussed is often highly multi-disciplinary, and the workshops identify technical barriers that can be overcome only with high risk/high payoff scientific research.

There are several goals of each BRN workshop (Key terms are defined in Appendix A):

- (1) Identify research topics that address both short-term technology showstoppers and long-term grand challenges that may well produce disruptive changes in technologies.
- (2) Identify a set of Priority Research Directions having a format defined by the workshop organizers.
- (3) Identify Cross-Cutting Research Directions that may impact some or all workshop themes.
- (4) Identify Science Grand Challenges pertaining to the workshop topic.
- (5) Create one or more Science and Technology (S&T) Relationships Charts (see Appendix B) that delineate a spectrum of topics under the headings of Discovery Research, Use-Inspired Basic Research, Applied Research, and Technology Maturation & Deployment Research.

The workshop output is a concise and authoritative report suitable for wide distribution and available on the BES website (<http://www.sc.doe.gov/bes>).

The BRN workshops are not usual scientific conferences, and attendance is by invitation. The meeting topics are targeted, and the participants (some of whose travel and expenses are paid by BES) are asked by the organizers to work very hard. Participants are primarily from the scientific community, and they are involved based on their scientific contributions to and visionary perspectives of the field. Applied technology and industry representatives are invited to provide background, but the output of the BRN workshop is created primarily by the scientific community.

Workshop Topic Selection and Workshop Planning

A topic is chosen by BES in the area of an energy technology based on both mission need and scientific opportunity. Mission need is defined by Presidential or DOE initiatives, by BESAC studies, or by BES studies. BES welcomes suggestions for topics from other sources, but the ultimate decision by BES is based on a balance between mission importance and the prospects for world-class scientific advances.

Workshop planning begins nine months to a year before the date of the workshop to allow time for booking facilities and handling administrative details. A sample planning task list is provided in Appendix C. Six to nine months before the workshop, BES management issues the general workshop charge, selects the workshop chair and co-chair(s), and appoints one or more BES program managers to guide the efforts.

The chair and co-chair(s) are selected for their abilities to see the relevant research fields from a high level with depth and breadth of expertise. They usually come from DOE national laboratories and/or universities. It is not necessary that their research be funded by BES; however, they must be dedicated to serving the scientific community because chairing or co-chairing requires a substantial time commitment.

Once the chair(s) are selected, they work to define a few themes (usually two or three but sometimes as many as six for the largest workshops), including the crosscutting theme, and to solidify the workshop charge. Themes are chosen to convey challenges succinctly and to be suitable as “headers” in presentations to both scientific and policy audiences. Examples are (1) Hydrogen Production, Storage, and Use and (2) Solar-electric, Solar-fuels, and Solar-thermal Conversion. Additionally, a crosscutting theme is chosen. The specific workshop charge usually begins with, "To identify basic research needs and opportunities in..." followed by a description of the workshop themes.

Each workshop theme is assigned a dedicated panel. The workshop chair and co-chair(s) identify the appropriate panel leads. Panel leads are invited for their technical expertise and visionary viewpoints on the field, their abilities to distill input and extract key challenges, and their skills in writing about science in a way that can be understood by a general audience. One to three panel leads per panel are selected. Each panel may be broken into several sub-panels as necessary based on the science. The workshop chair, co-chair(s), and panel leads make up the executive group.

The next step is panelist selection by the panel leads. Usually, no more than 10-12 panelists per panel (or per sub-panel, if used) are included to facilitate discussion, but this number is flexible and has been as high as 18-20 for larger workshops. Panelists are assigned to thematic panels and/or the crosscutting panel prior to the workshop. Participants from the crosscutting panel usually move into and out of the other panels as needed.

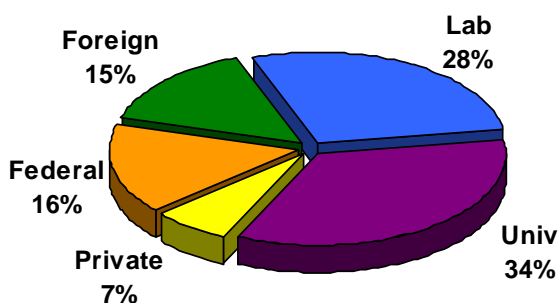
Panelists are selected for their abilities to provide wide-ranging views beyond their own research results. Panel groups are encouraged to be active and creative. A few panelists from outside the U.S. are usually invited to bring unique perspectives and background to the meeting. Sub-panel leads and core writers are selected from the group of panelists. One good idea is to designate at least one writer for each planned Priority and Cross-Cutting Research Direction.



Organizers of Workshop on Basic Research Needs for the Hydrogen Economy, May 13-15, 2003: (left to right) Michelle Buchanan (ORNL, Co-Chair), Millie Dresselhaus (MIT, Chair), and George Crabtree (ANL, Co-Chair).

Invited plenary speakers are representatives of the relevant DOE technology programs, industry, applied scientists, and/or visionary leaders in fundamental science. Each speaker is selected for his or her knowledge and ability to energize people and set the tone for the entire workshop.

The workshop is attended by participants and observers. Participants are largely representatives of the scientific research community. The participants, whose travel and expenses are generally supported by BES (with the exception of those from national labs and federal agencies), include the workshop and panel leads, plenary speakers, and panelists (including sub-panel leads and core writers). Observers can include representatives from DOE technology program(s) (usually one to five people selected by the technology program staff), BESAC, the Office of Management and Budget (OMB), the Office of Science and Technology Policy (OSTP), the National Academies, congressional science committees, BES, industry, DOE site offices, and/or the scientific press. Each DOE national laboratory is invited to send one or two observers. Observers do not generally participate in the breakout session discussions. Designated BES program managers are encouraged to observe breakout sessions pertinent to their portfolios to clarify policy when called upon by panel leads. While participants are identified by the executive group, all formal invitations to participate or observe are issued by the BES Director.



The number of workshop participants can range from about 100 to more than 200 people (e.g., 100 for Secure Energy Future, 125 for Hydrogen, 200 for Solar). Because of space limitations and the need to keep the workshop small, every participant has an assigned and active workshop role. The number of participants is determined by the number of panels and sub-panels and by the complexity of the panel topical areas. The workshop is kept small enough to facilitate productive discussions but large enough to span the full range of the topic.

Demographics of the approximately 200 people who attended the Basic Research Needs for Solar Utilization Workshop, April 21-24, 2005.

A Technology Perspectives Factual Document that describes the current status of technology development is prepared prior to the workshop.

This document provides a common context and language for the workshop discussions. It serves as part of the workshop report, and it educates participants prior to the workshop. The Technology Perspectives Factual Document is usually no more than 50 pages long, and it can be produced in different ways. For example, BES may support outside experts to write it, or it can be written by the panel leads in concert with technology experts. The factual document is not meant to provide the perspectives of the science community. Instead, science perspectives are garnered as an outcome of the workshop. The factual document is provided to participants one to two weeks in advance.

Weekly one-hour conference calls are held for several months prior to the workshop. The workshop executive group participated in the phone calls to build momentum and continuity for the workshop. BES staff members participate in the phone calls to answer policy questions as they arise. Panel leads may also schedule regular panel phone calls prior to the workshop.

The workshop planners keep an eye toward writing the final report while planning the event. The report is written by the writers, the panel leads, and the workshop chair and co-chair(s). Panelists are asked to support the writing group as needed. All participants are provided with a clear idea by the executive group of what is wanted from them before the workshop.

Workshop Structure

There is no formula for organizing the technical portion of the workshops. Flexibility in defining panel structures, invitee lists, and workshop length must be allowed to depend on the topical area. The common workshop features are described here.

Each workshop consists of a half-day plenary opening session, one or two days of panel breakout sessions, a half-day plenary closing session, and a one-day report writing session. The workshop agenda is designed by the executive group. Meetings typically begin around 8 a.m. and continue until 9 p.m. or later each day of the workshop. The night before the workshop begins, a meeting is held of the workshop executive group, panelists, and selected BES staff members to review all documents and procedures.

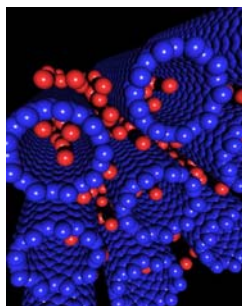
Opening Plenary Session

In the half-day opening plenary session, speakers present their high-level views of the relevant technologies and the scientific challenges that need to be addressed for technology to advance. The plenary opening session consists of a welcome from the BES Director, brief perspectives from the workshop chair and co-chair(s), and talks by plenary speakers. The DOE technology speakers provide overviews of their programs along with their targets, goals, and milestones. At the end of the opening plenary session, each panel lead gives a talk that provides overview material to the entire audience to set the stage for his or her panel, lists the sub-panels within the panel, and introduces the speakers and panelists within each panel and/or sub-panel. Alternately, for the largest workshops (e.g., six panels), discussion of the panels may be combined into a small number of overview presentations.

Breakout Sessions

The panel breakout sessions can last from one and a half to three days, depending on the workshop science. Breakout sessions consist of informal presentations made by panelists interspersed with targeted discussions facilitated by the panel leads. Each thematic or cross-cutting panel is tasked with generating a Panel Survey and three to five Priority Research Directions. The Panel Survey is a narrative that provides an introduction to the field, its current status, its science challenges, its opportunities, and its research needs. The Priority (and Crosscutting) Research Directions are the panelists' views of the basic research advances that would enable revolutionary progress in the field.

The selection of Priority Research Directions requires a delicate balance between the potential for scientific advances and the possibility of impacting specific technologies, but the science should be the most important consideration during prioritization. Scientific breakthroughs may open new



Study of nanostructured / novel hydrogen storage materials (such as carbon nanotubes) was selected as a Priority Research Direction during the Basic Research Needs for the Hydrogen Economy Workshop, May 13-15, 2003. (K. Johnson et al)

technology avenues that have not yet been explored or even conceived. Examples of Cross-Cutting Research Directions include science at the nanoscale; methods to control photon, electron, ion, and phonon transport in materials; designer catalysts; and advancement of new experimental, computational, or theoretical tools. Panels also generate ideas for Science Grand Challenges and S&T Relationships Charts; panel and sub-panel leads schedule deliberate discussion and brainstorming around these items

and communicate the ideas generated to the workshop chair and co-chair(s). The panels need not reach consensus, but the ideas they generate should be distilled to short lists.

Working lunches and dinners are scheduled during active panel times to keep the panels focused. At the end of each day, the executive group meets to synthesize the information generated that day. Common break times can be scheduled for all panels to encourage cross-germination of ideas between the panels.

To prepare for the plenary closing session, each panel produces a set of viewgraphs describing its Panel Survey and a set of viewgraphs for each Priority Research Direction. For each Priority Research Direction, viewgraphs include a one-paragraph (three-sentence) description, a list of science questions and opportunities, a delineation of potential research approaches, and a prediction of the impacts of research success on energy technology. The panels also begin to draft one-paragraph Executive Summaries and narrative descriptions of each Priority or Crosscutting Research Direction for the report. The panelists collect and contribute visual images for the report. Sample panel viewgraph templates are shown in Appendix D. The viewgraphs serve as a starting point for the final report write-up. For example, the images and research examples featured in the viewgraphs can be used in the report.

One strategy for generating the Panel Surveys and Research Directions is to start with general brainstorming sessions and progressively narrow the choices at subsequent sessions. If sub-panels are used, full panel or workshop meetings may be held at a midpoint session to coordinate and condense the sub-panel findings.

The core writers and panel leads for each panel will ultimately be responsible for turning the panel findings into a 3,000-5,000 word Panel Survey and 1,000-3,000 word descriptions of each Priority or Cross-Cutting Research Direction. During panel discussions, the core writers take notes in anticipation of capturing the findings in the report.

All panels may meet together in a large session prior to the plenary closing session. In this meeting, all panels brainstorm together to identify Science Grand Challenges, to complete the Science and Technology Relationships Chart(s), and to coordinate their Priority and Cross-Cutting Research Directions. For some workshops, the closing plenary presentations are practiced during this joint session.

Closing Plenary Session

In the plenary closing session, the workshop chair and co-chair(s) jointly give an overview presentation describing the panel findings at a high level. The workshop chair and co-chair(s) also identify the Science Grand Challenges and discuss the S&T Relationships Chart(s) generated at the workshop (a sample set of workshop chair viewgraphs is shown in Appendix E). The panel leads then each report the panel findings to the larger group in short presentations. The chairs provide closing remarks, and the BES Director provides final thoughts. One helpful suggestion is to have the closing plenary session transcribed to help later with report writing.

Report Writing Session

For an entire day after the workshop, the executive group and writers convene to produce the first draft of the workshop report. At the beginning of the writing session, the writing assignments are clarified by the workshop chair(s). The writing team captures as much important material as possible in the draft report before everyone leaves.

Workshop Output: The Report

A tangible outcome of every BRN workshop is a bound report that is widely distributed. The audience for the workshop report is very broad. Some sections are readable by a general, non-scientific audience, but the science is not trivialized. The report reflects the complexity and detail inherent in world-class science. Scientists in the field may use the report to guide their selection of research directions. Upper BES managers may use the report to respond to inquiries. BES program managers may use it to inform their work. Balancing such varied end uses can be a challenge, but the final product is a diverse, agile document that can be used by many stakeholders.

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Table of Contents for the Solar Energy Utilization BRN workshop report.

The total report is usually about 200 pages long (but could be longer, depending on the science). A sample report outline follows:

Executive Summary

Introduction (Science Challenges, Knowledge Gaps, Technology Challenges)

Science Grand Challenges

Reports of the Panels and Cross-Cutting Panel on Basic Research Needs

 Panel 1 (Panel Survey + 3-5 brief Priority Research Directions)

 ...

 Panel N (Panel Survey + 3-5 brief Priority Research Directions)

Priority Research Directions and Cross-Cutting Research Directions (detailed)

Science and Technology Relationships Chart(s)

Conclusions

Appendix 1: Technology Perspective (Technology Perspectives Factual Document)

Appendix 2: Workshop Program

Appendix 3: Workshop Participants

During report writing, plans are made for sidebars in the report that may provide basic, textbook-like material (e.g., "Conversion of Sunlight into Electricity," "What is a Fuel Cell?") or may highlight a significant recent research result. Sidebars include a paragraph, an image, and perhaps a reference.

In the weeks after the meeting ends, the draft report is sent to all participants for approval and editing before submission to BES. The chair and co-chair(s), with input from BES, select an appropriate image for the report cover art. The cover art should be a simple and elegant single image that conveys a message about science. The Technology Perspectives Factual Document is usually included as an appendix to the workshop report, although it may be used in the introductory material as well.

Prior to report publication, permission from journals to reprint any images that have been previously published in the archival literature must be obtained.

A report draft is completed on the last day of the workshop, and the final report is due to BES two to three months after the workshop. BES is not involved in the report writing, since it is meant to be a reflection of the scientific community's ideas.

Workshop Participant Roles and Responsibilities

The following roles are assigned for each workshop:

- Workshop Chair and Co-Chair(s)
- Opening Plenary Speakers (2-5)
- Panel and Sub-panel Leads (1-3 per panel and 1 per sub-panel)
- Panelists (usually 10-12 per panel or sub-panel)
- Writers (3-4 per panel or sub-panel)
- Webmaster (1)
- BES Staff Participants

The workshop executive group (chair, co-chair, and panel leads) can expect to spend about a day per week on planning the workshop for the first few months. As the workshop date nears, more and more time is needed. In return, the workshop organizers gain visibility, develop leadership skills, build networks, and have a unique chance to serve the scientific communities.

Workshop Chair and Co-Chair(s)

The responsibilities of the chair and co-chair(s) are to lead the entire workshop planning process. The chair and co-chair(s) interact with experts from across the field to plan activities. They develop the high level workshop structure, including deciding on the number and focus of the panels. Once the panel structure is identified, the chair and co-chair(s) identify panel leads. They work with the panel leads to decide on the number and topical areas of the sub-panels within each panel and to identify panelists. The workshop chair and co-chair(s) also may coordinate the Technology Perspectives Factual Document. On the first day of the workshop, they open the workshop with informational plenary presentations. During the workshop, they help to synchronize the panels' ideas and to guide the preparation of Science Grand Challenge lists and S&T Relationships Charts. They also coordinate and present an oral report to the full workshop at the plenary closing session that consists of the Science Grand Challenges identified during the workshop, a survey of the workshop results, and the S&T Relationships Chart(s) developed by the participants. Finally, the chair and co-chair(s) coordinate and integrate the topical narratives provided by the core writers into a final report. They edit the report and submit it to BES. After the workshop, the chair and co-chair(s) may perform outreach to publicize the workshop results.



Nate Lewis (Caltech), Chair of the Solar Energy Utilization BRN workshop, delivers a post-workshop outreach talk at an OSTP Hot Topics in Science and Technology seminar August 10, 2005.

Plenary Opening Speakers

The responsibilities of the opening plenary speakers are to provide perspectives on current and future energy technologies relevant to the workshop topic. Speakers from the DOE Technology Offices describe their programs and provide their milestones and goals. Plenary speakers may also provide overview information on the status of scientific achievement relative to the workshop topic. Plenary speakers are asked to work with the workshop chairs to develop the overall themes of their talks to ensure a logical information flow in the session as a whole. This may entail submitting presentation materials to the chairs a few weeks before the workshop to receive feedback, depending on the preferences of the chairs. Close adherence to the timing and schedule in the plenary open session is very important.

Panel and Sub-Panel Leads

The panel leads are responsible for planning and coordinating the activities of the panel and/or sub-panels pertaining to their themes. First, they work with the workshop chairs to outline the scientific themes and panel format. Each panel lead identifies and informally invites a few proposed panelists (speakers and writers) for their panel or for each sub-panel within their panel. They ask one panelist from each sub-panel to lead the sub-panel. The panel leads sometimes organize pre-workshop conference calls for their panel or sub-panel(s). Panel leads and sub-panel leads sometimes write discussion questions to guide the composition, structure, and agendas of the sub-panels. The panel leads may also be asked to contribute to the Technology Perspectives Factual Document as needed. At the workshop, the panel breakout sessions focus on generating Panel Surveys and identifying Priority Research Directions, and the panel or sub-panel leads facilitate the discussions. The panel and sub-panel leads also facilitate discussion of Science Grand Challenges and S&T Relationships Charts if requested to do so by the workshop chair(s). The panel leads create an oral report to the full workshop to be delivered at the plenary closing session. They also coordinate the panel input to the final report and work with the workshop chair and co-chair(s) to produce the final report.

Panelists

The panelists' responsibilities are to provide broad perspectives on the topic of the sub-panel or crosscutting panel to which they are assigned. Some panelists are scheduled to speak in the breakout sessions. The speakers talk about more than their own research topic, and they are encouraged to be broad and inclusive. They take wide-ranging views of the field and of the future needs and opportunities of the field. The speakers and panelists are prepared in advance to brainstorm about Priority Research Directions or Cross-Cutting Research Directions, to help the panels narrow them, and to describe them in narratives. Panelists also contribute to the preparation of viewgraphs for the oral presentation to the full workshop and written input for the workshop report. They may also develop a collection of compelling visual images and references for use in the report.

Writers

The responsibilities of the core writers, a subset of the panelists, include staying until the last moment of the workshop to create the first draft of the report. In particular, the writers produce the 3,000 to 5,000 word Panel Surveys, contribute to the 1,000 to 3,000 word write-ups on the Priority and Cross-Cutting Research Directions, and provide input for the report executive summary and introduction.

Observers

Observers are invited guests who observe but do not participate in the workshop. They generally attend the opening and closing plenary sessions. If they attend a breakout session, they usually do not participate in the panel discussion unless invited to do so by the panel lead.

Webmaster

The webmaster maintains a password-protected internet website used to facilitate event coordination. The password is initially only provided to the organizing team, and it is ultimately only provided to workshop participants. A sample website is provided in Appendix F. The workshop charge is displayed in a prominent location on the website. The information on the website varies from workshop to workshop, but it may include travel information, attendee lists (participants, leaders), lists of responsibilities by participant type, planning timelines, workshop schedules (at-a-glance and detailed), plenary and panel presentations (if presenter permission is provided), the Technology Perspectives Factual Document working draft, relevant web links, a running bibliography of key references, and/or panel discussion questions. Templates and/or style sheets for the Technology Perspectives Factual Document, the plenary closing session presentations, and the final report can be included on the website. After the workshop, interesting articles from the press about the workshop and outreach presentations are sometimes added to the site.

With wireless internet access provided at the workshop site, participants are able to visit the website regularly to read documents (Technology Perspectives Factual Document, presentation materials, etc.). For some workshops, the website is updated frequently during the workshop with panelist viewgraphs and other information useful to the participants. The website is a working portal that is made available indefinitely after the workshop to those who have the user name and password, but it is not made broadly and publicly available. Sometimes, the username and password are changed after the workshop as a security measure. Report readers who do not have access to the website can request presentation material copies directly from the presenters.

BES Staff

The BES Director issues the workshop charge, helps select the workshop chair and co-chair(s), interacts with high-level DOE technology program officials as needed, issues all formal invitations to participants and observers, and provides plenary opening and closing comments. BES management participates in the workshop planning as needed, while BES support staff members provide key administrative support for local arrangements and for interactions with contractors. BES technical leads provide guidance and answer questions as needed throughout the process of planning the workshop.

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Workshop Administrative Logistics

BES provides some administrative support for all workshops. In some cases, the workshop chairs or their institutions provide additional administrative support. Workshop costs vary. Travel costs and expenses for invited participants (chairs, panel leads, panelists, non-federal plenary speakers) who are not from national laboratories or federal agencies are paid by BES (subject to budget availability). A BES Program Analyst usually coordinates activities such as finding a hotel in the Washington D.C. metropolitan area, reserving a block of rooms for guests, arranging for meeting rooms, break refreshments, and meals, and creating and making the handouts for the meeting. BES engages a contractor to handle registration, make nametags and panel room signs, and assist with planning as needed. Since there are special procedures for foreign attendees (e.g., visas, DOE approval paperwork), the attendee list is finalized early. There is no registration fee, but all workshop participants formally register.

At the meeting, information packets are provided to each attendee. Handouts can include, for example, the agenda, schedule-at-a-glance (including breakout session topics, speakers, and moderators), breakout session schedules, executive committee roster, invited guest list, BES staff member list, assignment chart(s) for panelists, writer list, workshop charge, report preparation timeline, and/or participant responsibility lists. Workshop chairs, panel leads, and panelists are given name tents to use for identification during plenary sessions and panel discussions.

Paper copies of the Technology Perspectives Factual Document are made available at the workshop in each panel meeting room for reference. Paper copies of sample viewgraph templates and/or sample S&T Relationships Charts may also be placed in the panel rooms. Easels with flip charts, laptop computers, printers, and/or digital projectors are provided in the breakout rooms, and the tables are arranged in boardroom style to facilitate discussion.

Photographs are taken of the workshop chairs, panel leads, and other participants to document the workshop.

Final report editing, layout, and printing are usually handled by the home institution of the chair or co-chair(s) (based on mutual agreement with BES). About 250 final paper workshop reports are printed, and a paper copy is sent to each workshop attendee. The report is also widely distributed during workshop outreach. Additionally, all reports are made available electronically on the BES open website (<http://www.sc.doe.gov/bes>). Second printings of the reports can be necessary, and revised reports are sometimes issued after the workshop to correct technical errors in the first printing.

After the event, the workshop chair and co-chair(s) participate in outreach activities at technical meetings to publicize the workshop results.

A list of technical and administrative contacts from previous workshops is provided in Appendix G.

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Appendices

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Appendix A. Definition of Workshop Output Terminology

Technology Perspectives Factual Document - A document describing the current status of technology development related to the workshop topic.

Panel Survey - A narrative describing the current status of science related to the theme of a given panel.

Priority Research Direction (PRD) - A high-priority research direction with high potential for producing revolutionary scientific breakthroughs that could dramatically advance the workshop technology.

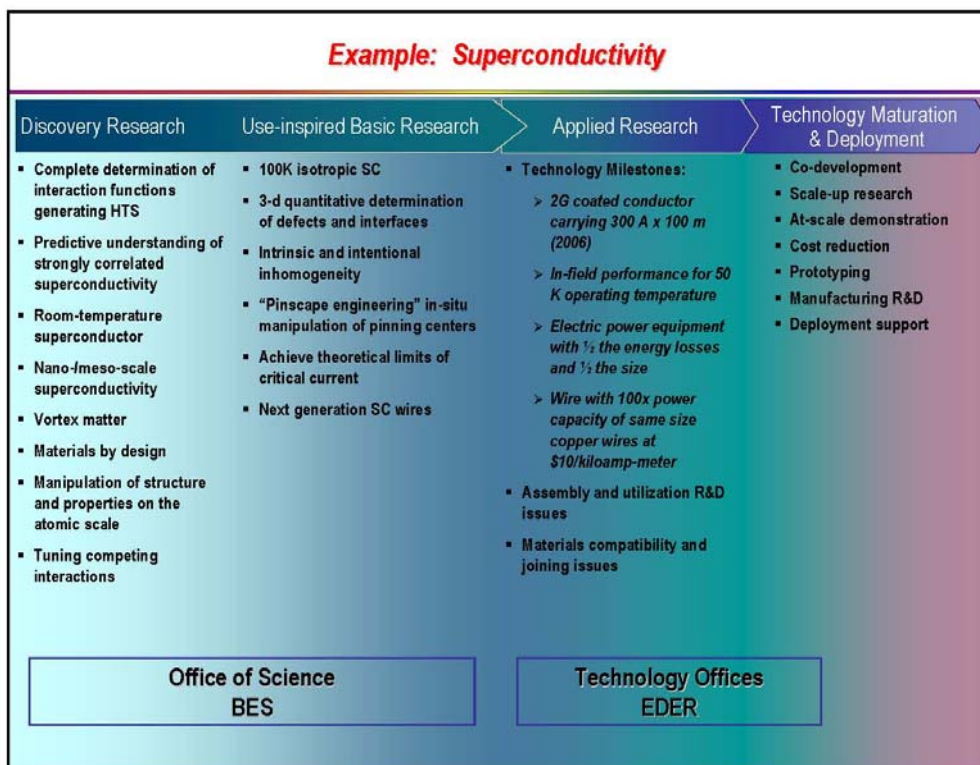
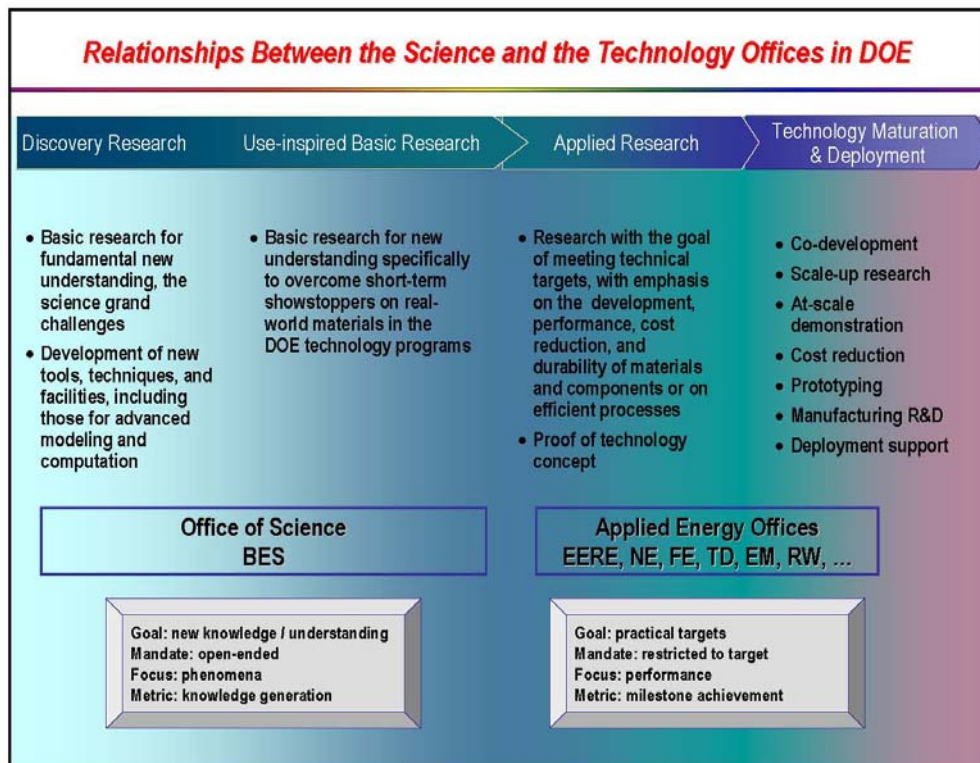
Cross-Cutting Research Direction (CCRD) - A high-priority research direction that addresses issues of concern to more than one approach or technology of interest in the workshop. This category may also include "out-of-the-box" science that is separate from the other panels.

Science Grand Challenge - A scientific problem, the solution to which is not presently clear, that would significantly impact the energy future if it were solved.

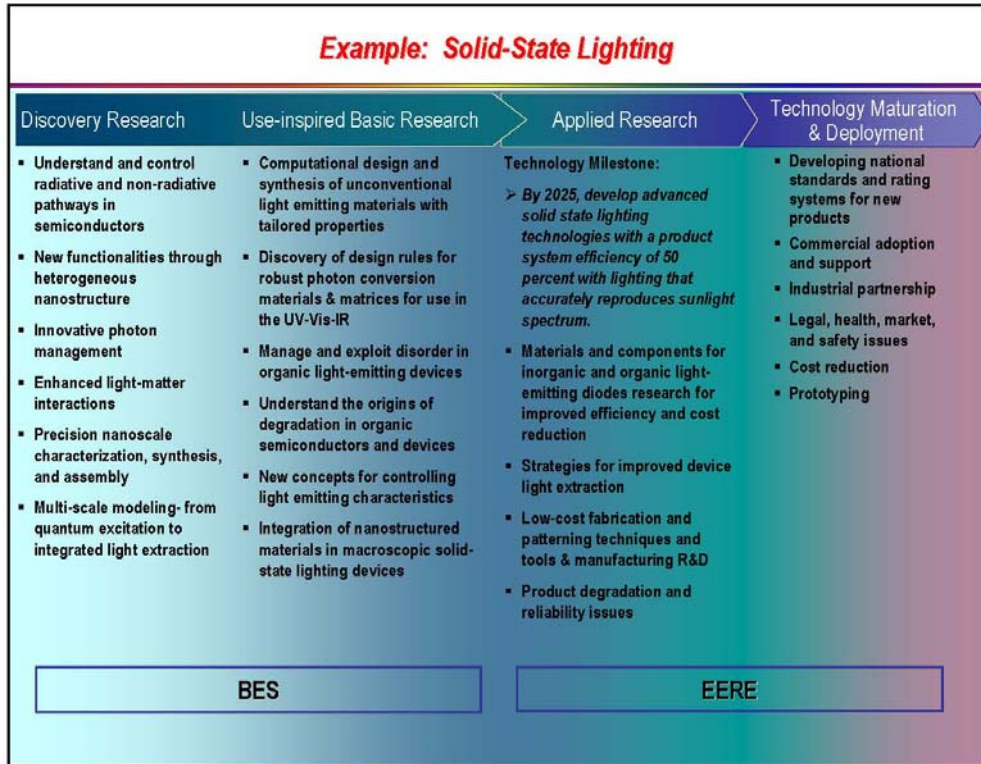
Science and Technology (S&T) Relationships Chart - A four-column table showing the relationship between discovery and other kinds of research. Includes columns for discovery research, use-inspired research, applied research, and technology maturation and deployment research. BES would fund the first two categories, while the DOE Technology programs would fund the third and perhaps a portion of the fourth category.

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Appendix B. Sample S&T Relationships Charts



Example: Solid-State Lighting



Appendix C. Workshop Planning Task List with Target Dates


Task	BES Director	BES Management	BES Support Staff	BES Technical Lead	Chair & Co-Chair(s)	Panel Leads	Writers	Panelists	DOE Technology Offices	Target date (relative to workshop date) - = before + = after
Issue workshop charge/scope	√									- 6 months
Confirm workshop chair/co-chair(s)		√								- 6 months
Appoint BES Technical Lead		√								- 6 months
Select workshop dates and location		√	√							- 6 months
Start identifying panel structure and panel leads				√	√					- 6 months
Contact DOE Technology Offices	√	√		√						- 5.5 months
Start preparing Technology Perspectives Factual Document					√					- 5.5 months
Start identifying panelists and plenary speakers				√	√					- 5.5 months
Confirm major panel leads				√	√					- 5 months
Start recruiting core writers				√	√	√				- 5 months
Start plenary speaker invitations				√	√					- 5 months
Confirm core writing group				√	√	√				- 4 months
Finalize workshop report template and outline					√	√	√			- 4 months
Start panelist invitations	√			√						- 4 months
Start panel conference calls						√		√		- 4 months
Confirm plenary speakers				√	√					- 4 months
Submit draft agenda to BES					√					- 3.5 months
Notify DOE Office of Science (SC-1) for approval	√									- 3.5 months
Finalize all panelists/invitations				√	√	√				- 3 months
Finish pre-workshop briefings								√		- 3 months
Finalize workshop panel breakout sessions agenda				√	√	√				- 3 months
Finalize workshop agenda					√					- 3 months
Issue observer invitations to BESAC, labs, OMB, OSTP, Congress, etc.	√	√		√						- 3 months
Confirm observer attendees list				√						- 2 months

Task	BES Director	BES Management	BES Support Staff	BES Technical Lead	Chair & Co-Chair(s)	Panel Leads	Writers	Panelists	DOE Technology Offices	Target date (relative to workshop date) - = before + = after
Finalize foreign participants logistics			√							- 6 weeks
Finalize Technology Perspectives Factual Document					√	√				- 6 weeks
Send participant list to contractor (for name tags)			√							- 3 weeks
Hold core pre-workshop meeting				√	√	√				- 1 week
Conduct workshop	√	√	√	√	√	√	√	√	√	workshop date
Identify PRD's (including CCRD's), Science Grand Challenges, & S&T Relationships Chart(s)					√	√	√	√		workshop date
Finish 1st draft of PRD documents						√	√			+ 1 week
Select cover art for report					√	√	√			
Finalize 1st draft of panel reports						√	√			+ 2 weeks
Finalize PRD documents					√	√	√			+ 3 weeks
Finalize breakout session reports					√	√	√			+ 4 weeks
Finish 1st draft of Preface, Executive Summary, Science Grand Challenges, Intro, and Conclusions					√		√			+ 4 weeks
Finalize Preface, Executive Summary, Science Grand Challenges, Intro, and Conclusions							√			+ 6 weeks
Finalize compiling and editing					√					+ 7 weeks
Submit draft report to BES					√					+ 2 months
Release final workshop report				√						+ 2 months
OMB/OSTP/SC briefings	√			√	√					+ 2.5 months
Engage scientific community through professional society meetings				√	√	√				+ 2.5 months

Appendix D. Sample Templates for Panel-Generated Closing Session Viewgraphs

Panel 1: Theme

- Chair(s):
- Panelists:




Basic Energy Sciences Workshop Title and Date

Panel 1: Theme

- Panel Survey describing the current status of science related to the panel theme.


(may be several viewgraphs)



Basic Energy Sciences Workshop Title and Date

Panel 1: Theme

- List of PRDs (Three to Five)
 - PRD 1.1:
 - PRD 1.2:
 - PRD 1.3:
 - PRD 1.4: (if needed)
 - PRD 1.5: (if needed)




Basic Energy Sciences Workshop Title and Date

PRD 1.m: Short Title of PRD

- One paragraph (three-sentence) description
- Science Questions and Opportunities
- Potential Research Approaches
- How and When Will Success Impact Technology?

(may be several viewgraphs)



Basic Energy Sciences Workshop Title and Date

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Appendix E. Sample Templates for Chair/Co-Chair Closing Session Viewgraphs

Science Grand Challenges

- List of GCs - Overarching Science Questions and Opportunities

(may be several viewgraphs)

Basic Energy Sciences Workshop Title and Date

Science GC m: Short Title of GC

- One paragraph (three-sentence) description
- Science Questions and Opportunities
- Potential Research Approaches
- How and When Will Success Impact Technology?

(may be several viewgraphs)

Basic Energy Sciences Workshop Title and Date

Priority Research Directions

- List of PRD's

(may be several viewgraphs)

Basic Energy Sciences Workshop Title and Date

S&T Relationships Chart

Discovery Research	Use-inspired Basic Research	Applied Research	Technology Maturation & Deployment
<ul style="list-style-type: none"> Basic research for fundamental new understanding, the science grand challenges Development of new tools, techniques, and facilities, including those for advanced modeling and computation 	<ul style="list-style-type: none"> Basic research for new understanding specifically to overcome short-term showstoppers on real-world materials in the DOE technology programs 	<ul style="list-style-type: none"> Research with the goal of meeting technical targets, with emphasis on the development, performance, cost reduction, and durability of materials and components or on efficient processes Proof of technology concept 	<ul style="list-style-type: none"> Cost reduction Scale-up research Prototyping Manufacturing R&D Deployment support
<p>Office of Science BES</p>		<p>Technology Offices EERE, NE, FE, TD, EM, RW, ...</p>	

Basic Energy Sciences Workshop Title and Date

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Appendix F. Sample Website

<p style="text-align: center;">basic research needs for Solid-State lighting workshop</p>	<p>Chair: Julie Phillips (Sandia National Labs) Co-Chair: Paul Burrows (Pacific Northwest National Lab) May 22-24, 2006 Bethesda Marriott Washington DC</p> <p style="text-align: right;">Sponsor: U.S. Department of Energy Office of Basic Energy Science</p>
----------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

This website is a repository for working documents associated with the workshop and its report. Workshop participants may download documents, then edit off-line and send to Jeff Tsao (jeff.tsao@science.doe.gov) for integration and re-posting. Dates/times of postings correspond to U.S. Eastern Standard Time. The website will continue to be updated (in near-real-time) during, and will be accessible through WiFi at, the workshop.

GENERAL INFORMATION

Workshop Outline 4/12

Workshop Charge

To identify basic research needs and opportunities underlying light emitting diode and related technologies, with a focus on new or emerging science challenges with potential for significant long-term impact on energy-efficient and productivity-enhancing solid state lighting. Highlighted areas will include organic and inorganic materials and nanostructure physics and chemistry, photon manipulation, and cross-cutting science grand challenges.

Sketch of DOE's View of "Science" 5/12

Bethesda Marriott Hotel Information

Group rates available through May 7 under "Solid State Lighting" at (301) 897-9400

Shuttle service times between hotel and medical center [metro station](#)

Driving directions between hotel and airports

Final attendee list 5/31 10p

Wifi Instructions 5/20

Chair/Panelist/Writer

Responsibilities

by **Role** 4/13 and by **Event** 4/13

KEY DATES

May 22-24: Workshop

May 25: Writing

Jun 2: Drafts of individual sections for review by chairs

Jun 16: Individual sections to technical editing

Jun 30: Complete document ready for review by chairs

Jul 7: Document frozen and ready for final layout

Jul 28: Galleys ready for review by chairs

Aug 4: Report sent to printers

PANEL 1: LED SCIENCE

Potential Big Questions 5/10

Chairs

Bob Davis (Carnegie Mellon U)

Jerry Simmons (SNL)

Panelists 4/11 1p

Hiroshi Amano (Meijo U)

Tony Cheetham (UCSB) (**Writer**)

George Craford (LumiLeds)

Mary Crawford (SNL) (**Writer**)

Dan Dapkus (USC)

Eugene Haller (LBNL)

Andreas Hangleiter (Techn U)

AGENDAS

Workshop-at-a-glance 5/16

Plenary opening and closing session detail 5/16

Breakout session detail 5/16

WORKSHOP WORKING DOCUMENTS

Plenary Opening Session Presentations

Jim Brodrick "Program Overview of the DOE-EERE Solid-State Lighting Portfolio" [ppt](#) 1MB 5/25 10a

Fred Schubert "Solid-State Lighting – Opportunities for Fundamental Innovation" [ppt](#) 15MB [pdf](#) 6MB 5/22 9a

George Craford "Perspectives on Light Emitting Diodes" [ppt](#) 19MB [pdf](#) 2.2MB 5/22 8a

Alan Heeger "Organic Light Emitting Diodes for Solid State Lighting: Opportunities and Challenges" [ppt](#) 4MB [pdf](#) 0.6MB 5/20 11p

Paul Burrows "Workshop Overview" [ppt](#) 0.5MB 5/21 11p

Jerry Simmons "LED Science Panel Preview" [ppt](#) 5MB [pdf](#) 5MB 5/22 11a

Franky So "OLED Science Panel Preview" [ppt](#) 0.7MB [pdf](#) 0.3M 5/22 9a

Jim Misewich "Cross-Cutting Science Panel Preview" [ppt](#) 3MB [pdf](#) 0.6MB 5/22 9a

Eli Yablonovitch (with contributions from Claude Weisbuch) "Light Extraction from LED's versus Light Absorption into Solar Cells" [ppt](#) 1.9MB 5/22 3p

Panel 1 Breakout Sessions

Hiroshi Amano "Low-dimensional light-emitting structures: light-emitting volume, defects, injection" [ppt](#) 3MB 5/24 8a

Tony Cheetham "Photon Conversion Materials for Solid State Lighting" [ppt](#) 5.5MB 5/24 8a

Mary Crawford

"InGaN materials growth and properties" [ppt](#) 3MB 5/24 8a

"Lasers for Solid State Lighting" [ppt](#) 0.1MB 5/24 8a

Dan Dapkus

"Novel device physics and architectures" [ppt](#) 5MB 5/23 8a

"Recombination" [ppt](#) 5MB 5/23 8a

Eugene Haller "InN and In-rich InGaN: fundamental properties" [ppt](#) 8MB 6/1

Andreas Hangleiter

"Defects and recombination" [pdf](#) 0.8MB 5/22 5p

"Dimensionality uses" [pdf](#) 0.1MB 5/22 5p

"Polarization fields" [pdf](#) 0.1MB 5/22 5p

"Limits on green" [pdf](#) 0.1MB 5/22 5p

Mike Krames "Light extraction" talk [pdf](#) 0.8MB 5/22 9a

"Defects and recombination" talk [pdf](#) 0.4MB 5/22 9a

"InN" talk [pdf](#) 0.8MB 5/22 9a

David Norton "Alternative inorganic semiconductor materials" [ppt](#) 0.6MB 5/23 12p

Jaspri Singh "Doping and transport issues in nitride LEDs" [ppt](#) 0.6MB [pdf](#) 0.5MB 5/21 6:30p

Jim Speck "State-of-the-Art in Nitride Materials Synthesis" [ppt](#) 5MB 5/22 5p

Stephen Streiffer "In situ characterization of epitaxial growth" [ppt](#) 5MB 5/22 5p

Christian Wetzel

"Polarization/Piezo-optoelectronic phenomena" [pdf](#) 3MB 5/23 12p

"High In InGaN" [pdf](#) 0.2MB 5/23 12p

Panel 2 Breakout Sessions

Paul Barbara "SMS Probed Electrode Induced Oxidation of Single Conjugated Polymers Nanoparticles" [ppt](#) 3MB 5/23 10a

Brian Crone "Polymers for Solid-State Lighting" [ppt](#) 1MB 5/22 3p

Steve Forrest "Progress in Electrophosphorescent WOLEDs" [ppt](#) 2MB 5/22 3p

Mary Galvin [ppt](#) 1MB 5/23 6p

REPORT WORKING DOCUMENTS

Reports from previous BES workshops in "basic research needs" series:

[Secure Energy Future](#) 13MB

[Hydrogen Economy](#) 7MB

[Solar Energy Utilization](#) 7MB

Template 5/10

Style Sheet 5/3

Timeline 5/17

Detailed Outline 5/17

Cover (Julie, Paul)

Exec Summary (2pp) (Julie, Paul)

Introduction (5pp) (Julie, Paul)

Possible Sidebars for Intro and GCs

What is an LED

What is an OLED

RGB vs Phosphors

What is a dislocation

Conventional lighting

Survey of Grand Challenges (3pp) (Julie, Paul)

[GC A](#) Rational design of solid-state-lighting structures (6pp) (Misewich* Shinar Singh Smith Littlewood Levi) draft to So Simmons Davis Littlewood Smith for comments 5/25 9a

[GC B](#) (with Vardeny [notes](#))

Understanding of radiative and non-radiative pathways (6pp) (Simmons* Hangleiter Crawford Haller Vardeny Burrows Shinar) rough draft to Crone Smith Nurmikko for comments 5/25

Survey of LED Science (5pp) (Bob, Jerry) (possible sidebar on LED operation) (**no draft yet**)

[PRD 1.1](#) Computational design and/or synthesis of unconventional light emitting semiconductors with tailored properties (5pp) (Norton* Littlewood Levi) draft to Davis for comments 5/25

[PRD 1.2](#) Photon conversion materials (5pp) (Cheetham*) draft to Craford Krames for comments 5/25

[PRD 1.3](#) Polar materials and heterostructures for solid-state lighting (5pp) (Davis* Dapkus Singh) draft to Dapkus Singh for comments 5/25

[PRD 1.4](#) What limits the light emission in InGaN? (5pp) (Hangleiter* Wetzel) draft to Simmons Davis for comments 5/25

Survey of OLED Science (5pp) (George, Franky) (possible sidebars on spin, on OLED complexity, on small/large

<p>Braunschweig) (Writer) Mike Krames (LumiLeds) David Norton (U of Florida) (Writer) Jasprit Singh (U of Michigan) Jim Speck (UCSB) Stephen Streiffer (Argonne) (Writer) Christian Wetzel (RPI) (Writer)</p> <p>PANEL 2: OLED SCIENCE Potential Big Questions 5/15</p> <p>Chairs George Malliaras (Cornell) Franky So (U of Florida)</p> <p>Panelists 5/20 Paul Barbara (UT Austin) Brian Crone (LANL) (Writer) Steve Forrest (U of Michigan) Mary Galvin (Air Products) (Writer) Zakya Kafafi (NRL) Jianmin Shi (Army Research Laboratory) Joseph Shinar (Ames Laboratory) (Writer) Zoltan Soos (Princeton) (Writer) Ching Tang (Kodak) Mark Thompson (USC) Valy Vardeny (U of Utah)</p> <p>PANEL 3: CROSS-CUTTING AND NOVEL MATERIALS SCIENCE / OPTICAL PHYSICS Potential Big Questions 5/10</p> <p>Chairs Jim Misewich (BNL) Arto Nurmikko (Brown U) Darryl Smith (LANL)</p> <p>Panelists 5/12 Marc Achermann (U Mass Amherst) Vladimir Agranovich (Russian Academy of Science) Len Buckley (NRL) Vladimir Bulovic (MIT) Francois Leonard (SNL) Tony Levi (USC) Shawn Lin (RPI) Peter Littlewood (U of Cambridge) Lukas Novotny (U Rochester) Garry Rumbles (NREL) Peidong Yang (UC Berkeley) Rashid Zia (Brown U)</p> <p>-</p> <p>Questions and Comments Privacy and Security</p>	<p>Zakya Kafafi Linda Sapochak ppt 5.4MB 5/23 6p Jianmin Shi "Organic Materials Related to OLED Efficiency and Stability" ppt 0.7MB 5/23 10a Joseph Shinar "Bimolecular) Nonradiative Quenching Processes & the Singlet/Triplet Branching Ratio in OLEDs" ppt 0.2MB 5/23 6p Darryl Smith "Charge Transport in Organic Semiconductors" ppt 4MB 5/23 6p Zoltan Soos "Organic Electronics: Theory and Modeling" ppt 1.2MB 5/23 10a Ching Tang ppt 6.4MB 5/22 3p Mark Thompson ppt 4.4MB 5/23 10a Valy Vardeny "Excitons, polarons and spin dynamics in π-conjugated films" ppt 2.5MB 5/23 6p</p> <p>Panel 3 Breakout Sessions Marc Achermann "Hybrid light-emitting devices based on 'soft' emitters and 'hard' epitaxial injection structures" talk (ppt 11MB) 5/22 5p Vladimir Agranovich "Hybrid resonant organic-inorganic nanostructures: new physics and new devices" abstract 5/12 talk (pdf 2MB) 5/20 Len Buckley "Optics in a new light: inspired by nature, enabled by chemistry" abstract 5/12 talk (pdf 1.5MB) 5/20 Vladimir Bulovic "Quantum Dot LEDs for Solid State Lighting" abstract 5/12 talk ppt 10MB 5/23 10a Francois Leonard "Nanowire optoelectronics" abstract 5/12 talk (ppt 3.6MB) 5/22 10p Tony Levi "Adaptive quantum design for photon creation and manipulation" abstract 5/12 talk (pdf 1.6MB) 5/22 5p Shawn Lin "Photonic-Crystals for Photon Management" talk ppt 16MB 5/23 10a Peter Littlewood abstract 5/12 talk ppt 2.5MB 5/22 5p Lukas Novotny "Enhancing light emission with optical antennas" abstract 5/12 talk ppt 10MB 5/23 10a Garry Rumbles "Organic-inorganic hybrids or The role of chemistry in SSL" abstract 5/12 talk ppt 20MB 5/23 10a Peidong Yang "Nanowire array based solid-state lighting" abstract 5/12 talk ppt 10MB 5/23 4p Rashid Zia abstract 5/12 "Plasmon-Enhanced Light Emission: Engineering the Local Density of States, and perhaps Modifying the Selection Rules" ppt 2MB 5/23 10a</p> <p>Draft Table of GCs and PRDs with designated writers 5/24 1p</p> <p>Plenary Closing Session Presentations (template 5/19) Julie Phillips Introduction and Conclusions ppt 0.2MB 5/24 1p Grand Challenge A "Rational design of solid-state lighting systems" ppt 0.1MB 5/24 1p Grand Challenge B "Understanding radiative and non-radiative pathways" pdf 2.6MB 5/24 1p Panel 1 LED Science Survey and PRDs pdf 3MB 5/24 1p Panel 2 OLED Science Survey and PRDs ppt 0.3MB 5/24 1p Panel 3 Cross-Cutting Science Survey and PRDs ppt 10MB 5/24 1p</p>	<p>molecules, and on analytical distinguishing of isomeric molecules) (no draft yet) PRD 2.1 Managing and exploiting disorder in OLEDs (5pp) (Soos*) draft to Malliaras So Burrows for comments 5/25 PRD 2.2 Understanding degradation in OLEDs (5pp) (Galvin*) draft to Malliaras So Burrows for comments 5/24 PRD 2.3 Integrated approach to OLED design (5pp) (Crone*) draft to Malliaras So Burrows for comments 5/30</p> <p>Survey of Cross-Cutting Science (5pp) (Jim, Arto, Darryl) (no draft yet) PRD 3.1 5/31 New functionalities through heterogeneous nanostructures (5pp) (Bulovic* Achermann Leonard Rumbles Yang Amano) draft to ? for comments 6/1 PRD 3.2 5/31 Innovative photon management (5pp) (Lin Krames Buckley Vardeny) draft to ? for comments 6/1 PRD 3.3 Enhanced light-matter interactions (5pp) (Nurmikko* Agranovich Zia Levi) draft to ? for comments 6/3 PRD 3.4 Multiscale modeling for solid-state lighting (5pp) (Smith* Levi Littlewood Singh Soos) (possible sidebars on quantum design principle, hierarchical design principles and block diagram design methodologies) draft to ? for comments 5/24 9a PRD 3.5 Precision nanoscale characterization for SSL (5pp) (Streiffer* Haller Barbara Novotny) (no draft yet)</p> <p>Appendix 1: Technology Perspective 25p (Mike) (work with Jeff and Paul on proposals for tutorial sidebars on LED operation, OLED operation (Paul), conventional lighting, what is white light, circadian rhythm, CRI) pdf 5Mb 5/13 doc 11Mb (with track changes on) 5/13</p> <p>Appendix 2: Workshop Participants (2pp) (Christie)</p> <p>Appendix 3: Workshop Program (6pp) (Jeff)</p> <p>Appendix 4: Additional Reading (2pp) (Jeff)</p>
	<p>This website is hosted courtesy of</p>	

Appendix G. List of Contacts for Planning Workshops

Updated April 2007

Workshop Chairs* and/or Co-Chairs⁺ -

- Secure Energy Future: John Stringer* (EPRI), Linda Horton⁺ (ORNL)
- Hydrogen Economy: Mildred Dresselhaus* (MIT), George Crabtree⁺ (ANL), and Michelle Buchanan⁺ (ORNL)
- Solar Energy Utilization: Nate Lewis* (Caltech) and George Crabtree⁺ (ANL)
- Superconductivity: John Sarrao* (LANL) and Wai-Kwong Kwok⁺ (ANL)
- Solid State Lighting: Julia Phillips* (SNL) and Paul Burrows⁺ (PNNL)
- Advanced Nuclear Energy Systems: Jim Roberto⁺ (ORNL) and Tomas Diaz de la Rubia⁺ (LLNL)
- Clean and Efficient Combustion of 21st Century Transportation Fuels: Andy McIlroy⁺ (SNL) and Greg McRae⁺ (MIT)
- Geosciences: Enhancing 21st Century Energy Systems: Don DePaolo⁺ (LBNL and UC Berkeley) and Lynn Orr⁺ (Stanford University)
- Electrical Energy Storage: John Goodenough* (UT-Austin), Hector Abruna⁺ (Cornell), and Michelle Buchanan⁺ (ORNL)
- Catalysis for Energy: Alexis T. Bell⁺ (UC Berkeley), Bruce C. Gates⁺ (UC Davis), and Douglas Ray⁺ (PNNL)
- Materials Under Extreme Environments: Jeff Wadsworth* (ORNL), George Crabtree⁺ (ANL), and Russel Hemley⁺ (Carnegie Institute of Washington)

BES Technical Leads* and Participants -

- Hydrogen Economy: Harriet Kung*, Jane Zhu
- Solar Energy Utilization: Harriet Kung*, Mary Gress, James Horwitz, Jeff Tsao (on detail from SNL), Mark Spitler (on detail from NREL)
- Superconductivity: James Horwitz*, Gary Kellogg (on detail from SNL), Douglas Finnemore (on detail from Ames Laboratory)
- Solid State Lighting: Harriet Kung*, Tim Fitzsimmons, Aravinda Kini, Jeff Tsao (on detail from SNL)
- Advanced Nuclear Energy Systems: John Miller*, Lester Morss, Tim Fitzsimmons
- Clean and Efficient Combustion of 21st Century Transportation Fuels: Eric Rohlfing*, Frank Tully, Dick Hilderbrandt
- Geosciences: Enhancing 21st Century Energy Systems: Nick Woodward,* Pat Dobson (on detail from LBNL), and Marsha Bollinger (AAAS Fellow from Winthrop University)
- Electric Energy Storage: Dick Kelley*, Paul Maupin, John Vetrano
- Catalysis for Energy: Raul Miranda*, John C. Miller, Aravinda Kini
- Materials Under Extreme Environments: Tim Fitzsimmons*, John Vetrano, Michael Casassa

BES Administrative Experts -

- Christie Ashton, Program Analyst for Materials Sciences and Engineering
- Karen Talamini, Program Analyst for Basic Energy Sciences
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