PROGRESS REPORT FOR
Workshop on Energy Research for Physics Graduate Students and Postdocs
DOE Grant No.: DE-SC0009724

Workshop on the Web:
http://www.aps.org/units/gera/meetings/march15/index.cfm

Recipient Institution: American Physical Society
Recipient Address: One Physics Ellipse, College Park, Maryland 20740

Principal Investigator: Dr. Kate Kirby
PI Address: One Physics Ellipse, College Park, Maryland 20740
PI Telephone Number: (301) 209-3270
PI Email: kirby@aps.org

Budget Period Two: 01/01/2015 through 12/31/2015

Background and Overview

Today, more than ever, young people are concerned about the energy needs of our society and how our energy needs impact our environment. There is a growing interest in using emerging technology to improve energy efficiency and develop new energy sources. Many physics students share these concerns and would like to find ways to use their scientific and quantitative skills to help overcome the environmental challenges that the world faces. It is well documented that physics has much to contribute to solving energy and environment problems, and every effort should be made to attract the best and brightest new minds in physics to address these issues.

With these concerns in mind, the American Physical Society (APS) and more specifically, the APS Topical Group on Energy Research and Applications (GERA), organized and conducted a one-day workshop for graduate students and post docs highlighting the contributions that physics-related research can make to meeting the nation's energy needs in environmentally friendly ways. A workshop program committee met once by Blue Jeans videoconference and exchanged many email messages to determine session topics and to suggest appropriate presenters for each topic. Following feedback from similar workshops in preceding years, the program committee decided to provide a program that would cover a broader range of relevant topics rather than concentrating on one sector of the research in energy. The major concentrations of topics chosen were *Energy in Buildings, Energy Solutions in Transportation and the Power Grid,* and *Career Opportunities.* Speakers were selected not only for their prominence in their respective fields of energy research but also for their ability to relate their work to young people. The workshop was held the day before the APS March Meeting on Sunday, March 1, 2015 in San Antonio, TX. The workshop was restricted to approximately 80 young physicists to encourage group discussion. Talks were planned and presented at a level of

participants with a physics background but no special knowledge of energy research. Speakers were asked to give a broad overview of their area of research before talking more specifically about their own work. The format was designed with plenary talks but allowed significant time for questions and answers, and discussion. A panel discussion at the end of the day was designed to focus on the importance of looking at science policy in developing viable transportation solutions. All panelists were Ph.D. physicists who were currently working or had extensive experience working in public policy and Congressional/Federal Government arenas. Questions covered topics ranging from technical matters to career advice. A "Lunch with the Experts" and a "Networking Reception" were held specifically to provide opportunities for participants to interact with the presenters and to network with each other. These proved to be very successful activities, as noted in the follow-up participant survey that was conducted shortly after the workshop.

Program Committee

Susan Carter (*Chair)*
University of California, Santa Cruz
Email: sacarter@ucsc.edu

David Ginley
National Renewable Energy Laboratory
Email: david.ginley@nrel.gov

Rueben Collins
Colorado School of Mines
Email: rtcollin@mines.edu

Talat Rahman
University of Central Florida
Email: talat@ucf.edu

Participants

Email messages describing the workshop were distributed to all APS graduate student members and to APS members in the postdoctoral category. A website was created to provide detailed information about the conference and to enable interested people to apply and request travel grants. Because the Program Committee wanted to limit attendance to approximately 80, those wanting to attending were required to apply in advance and only applicants who had not attended previous workshops were considered. Applicants were asked to provide information regarding their current area of interest/study, how they thought they might benefit from attending the conference and were asked to submit a one or two page vitae. 207 applications to attend were received from graduate students and postdocs. Most requested varying amounts of travel assistance and 89 individuals were invited to attend. 72 were selected to receive travel assistance in amounts varying from $100 to $600, depending on applicant need.

Applications to attend:		189
Selected to attend:		81
Actual attendance:		75
Graduate Students:	59	
Postdocs	13	
Undergrads	3	
Selected for travel grants:		59

Budget Summary

	2015 Budget	**2015 Actual**
80 travel grants were anticipated in amounts of $100 to $600. 72 participants were selected to receive travel grants ranging from $50 to $600 to pay for travel expenses and hotel for one night. 54 attendees actually submitted claims for reimbursement.	$29,500.00	$18,725.59
Travel expense for 6 speakers was anticipated. 3 speakers actually applied for expense reimbursement	$4,800.00	$1,592.11
Audio/Visual	$850.00	$860.75
TOTAL	**$35,150.00**	**$21,178.85**

Room Rental:
There was no charge for room rental as the workshop is considered part of the larger APS March Meeting contract.

Honoraria:
There were no honoraria or stipends paid. Speakers were reimbursed for travel and expenses under the general APS reimbursement rules.

$13,971.15 of the FY15 budget was not spent.

2015 APS/GERA ENERGY RESEARCH WORKSHOP
ENERGY FOR TRANSPORTATION
San Antonio Convention Center
San Antonio, Texas
Sunday, March 1, 2015

Workshop made possible in part by a grant provided by the
US Department of Energy
and organized by the APS Topical Group on Energy Research and Applications (GERA).
Reception sponsored by the Journal of Renewable & Sustainable Energy.

8:30 WELCOME
Susan Carter, *Chair, Workshop Organizing Committee*
APS Topical Group on Energy Research and Applications (GERA)

8:40 WORKSHOP KEYNOTE
Dr. George Crabtree, *Argonne National Lab and Univ. of Illinois-Chicago*
Energy is undergoing an historic transition, from predominantly fossil to more diverse and sustainable sources including wind, solar, biofuels and nuclear and serving a variety of uses interchangeably including transportation, lighting, refrigeration, heating, entertainment, communication and industry. Science and technology lead the energy transition through discovery of new phenomena and development of new technologies for production, storage and use. The next fifty years of energy transition and innovation will be examined from the point of view of societal needs, international relationships, and promising science directions. The roles of electricity, chemical fuels and photons as sustainable and fungible energy carriers will be emphasized.

ENERGY IN BUILDINGS

10:00 Transforming Urban Landscapes with Adaptive Materials: Smart Windows & Beyond
Dr Sarbajit Banejee, *Texas A&M*

Buildings consume an inordinately large amount of energy across the world and are often static structures that interact little with their outside environment. A recent report from the United Nations estimates that 30-40% of primary energy usage across the world occurs within buildings. In the United States, the Department of Energy estimates that 41% of the total energy consumption occurs within buildings. Much of the energy consumed within buildings goes towards space cooling, space heating, lighting, and ventilation. There is increasing emphasis worldwide on the development of components of the building envelope that adaptively respond to changes of climate. I will review advances in thermochromics, electrochromic, and PV-integrated fenestration with an emphasis on the underlying physics of these active structures. Electron correlation, electron-phonon coupling, polaronic motion—foundational and beloved concepts in condensed matter physics underlie the design of these adaptive materials. Beyond describing the

fundamental physics and reviewing recent progress in the disciplines, I will make note of the regulatory environment and market considerations.

10:40 Renewable Approaches to Distributed Energy Storage
Dr. Eric Toberer, *CSM*

Development of a renewable, reliable electrical grid increasingly demands energy storage solutions. In this talk, we will explore routes to time-shift solar energy into the evening hours and how to convert this stored energy into electrical power. Techno-economic analysis suggests that thermal storage solutions and thermal-to-electric conversion are near-term solutions and will be the primary focus of this talk. Three key topics will be explored: First, the energy landscape for dispatchable electricity and a survey of possible solutions and their associated challenges. Second, we will explore how physicists can contribute to thermal energy storage challenges. Finally, we will look in depth at solid state thermal-to-electric conversion using thermoelectric materials. Emerging routes to control electron and phonon transport will be discussed and grand challenges that remain will be highlighted.

11:20 PANEL: Challenges for Distributed Energy
Crabtree, Banerjee, Toberer, Carter (Moderator)

11:50 LUNCH WITH THE EXPERTS

Box lunches provided by the APS and GERA with the opportunity to gather at tables with guest speakers and panelists for informal discussion and networking

ENERGY SOLUTIONS FOR TRANSPORTATION AND THE POWER GRID

1:00 Materials for Li-ion Batteries
Dr. Gerbrand Ceder, *MIT*

2:00 Status and Prospects for CO2 Capture and Storage
Dr. Sally Benson, *Stanford*

2:40 Magnetism in the Energy Sector
Dr Steve Constantinides, *Arnold Magnetic*

Energy is not only important to our quality of life, but to our very survival. Millennia ago, humankind depended upon fire for heat and light, for cooking food and for making articles of ceramic and of metal. We depend upon energy ever more greatly, but today it is made available in many ways, for example, fossil fuels for heating, transportation and generation of electricity and renewable electric generation via hydro, solar, biomass, and wind power. Electricity and magnetism are irrevocably linked—magnetism is more accurately called "electromagnetism". Some materials have useful (electro-)magnetic properties. What are these magnetic materials and what role do they play in the production, transmission and consumption of energy and how is that role changing?

3:20 Material Challenges for Photovoltaics
Dr. B. J. Stanbery, *Heliovolt*

4:00 PANEL: Material Challenges for the Energy Sector
Ceder, Benson, Stanbery, Constantinides, Ginley (Moderator)

4:30 PANEL DISCUSSION: Career Opportunities in the Energy Field

Focus of Discussion:

1. What is your educational/post doc/background, what are you doing now
2. Why did you decide to move into government/policy?
3. How does one enter field, find opportunities?
4. How do government policies affect career opportunities in energy? How can/should scientists and engineers engage in dialogue with policy makers?
5. What is the most surprising/exciting thing you have learned in your position?

5:00 – 6:00 RECEPTION

For registered participants.
This reception is to provide an opportunity for continued discussions and networking.
Open beer, wine, and soft drink bar with a variety of ice cream and toppings.
Hosted by the *Journal of Renewable and Sustainable Energy*

Follow-up

All of the speakers did an excellent job of planning their talks for physicists with little or no knowledge of energy research. The level of interest and excitement among participants was very high. Speaker presentation slides were posted on the workshop website and an email was sent to all applicants (not just attendees) inviting them to review the talks. The available talks can be seen at: http://www.aps.org/units/gera/meetings/march15/index.cfm.