Annual Report
(July 1, 2016 – June 30, 2017)

Richard G. Lugar Center for Renewable Energy (LCRE)
Representing the Indiana University System,
and administratively housed within the
Purdue School of Engineering and Technology
Indiana University-Purdue University Indianapolis
June 30, 2017

The mission of the Richard G. Lugar Center for Renewable Energy is to:

Address the societal needs for clean, affordable and renewable energy sources, improve the nation's energy security, and help mitigate the negative impacts of climate change.

Promote research excellence in the area of renewable energy through collaborative efforts among faculty in the disciplines of engineering, chemistry, physics, biology, environmental affairs, and public policy.

Promote renewable energy applications through teaching, learning, civic engagement, and synergistic partnerships with industry, government labs and local communities.

Please visit our website at www.lugarenergycenter.org There is a Give Now button for your convenience in making tax exempt donations to advance the goals and mission of the Center.
Introduction

The Richard G. Lugar Center for Renewable Energy (LCRE) is located on the campus of Indiana University Purdue University-Indianapolis (IUPUI), and is administratively housed in the Purdue School of Engineering and Technology, IUPUI. **The LCRE consists of 44 Research Members spanning multiple disciplines, 15 Advisory Board Members, and 12 Entrepreneurs-in-Residence, plus about 60 students, interns and post-doctoral researchers.**

The LCRE is an interdisciplinary research center, and strives to meet the societal and public needs and challenges in these key energy and environmental areas. The Center helps create a collaborative environment for solving these challenges. The following report summarizes these activities and represents the hard work and commitment of our Research Members, Advisory Board, staff, and entire LCRE family.

**Focus Areas – Renewable Energy**

- **Batteries**
  - Li-metal, Li-S
  - Anode/cathode/electrolyte chemistry
  - Seawater flow battery
- **Fuel Cells**
  - Non-Pt catalyst for PEM
  - Hydrogen storage
  - Hydrogen generation
  - SOFC for APU and home energy
- **Combustion Engines**
  - Advanced gas turbines
  - Internal combustion engines
  - Power and propulsion systems
- **MSW Energy from Waste**
  - Heat, oils for refining, electricity
  - Advanced gasification
  - Gas-to-liquids biofuels
- **Policy & Economics**
  - Urban, State, Federal
  - Energy forecasting and land use
  - Environment & Human health
- **Commercial/Institutional & Buildings**
  - Sustainable institutions
  - Energy and resource recovery
- **Traditional Renewables**
  - Solar power (including Space Solar)
  - Wind power (including hydraulic)
- **Installation & Maintenance**
  - Training
  - Automation
  - Diagnostics
- **Manufacturing Science**
  - Photovoltaic semiconductors
  - Nanotechnology
  - Fuel Cells
  - High temperature ceramics and coatings
- **Efficiency**
  - Industrial assessment
  - Curriculum development
  - Sustainable Technologies Certificate
- **Entrepreneurship**
  - Economic pro forma & business plans
  - Incubators and mentoring
  - Raising capital
- **Sustainability & Lifecycle Analysis**
  - Electric vehicles
  - Energy storage & management
  - Urban environment
- **Switchgear, Diagnostics & Cybersecurity**
  - Single transistor inverter
  - Synchronous distributed generation (patented)
  - Microgrids
  - Smart grid technology
  - Energy security methods
Summary of Research and Educational Activities

The LCRE is continuing to make progress and achieve results in its core research fields and to establish itself as a leader, especially with regards to fuel cells, lithium-based batteries; electric vehicle research; hydrogen generation, storage, and fuel cells; biomass conversion; policy; and education. Additionally, the capabilities of the LCRE are being expanded in these and new areas as evidenced by the induction of new Research Members.

Below is a summary of the latest updates with regard to existing and new research and educational programs at the LCRE:

Recent Publications

18. Jing Zhang, Yi Zhang, Hanyin Zhang, Michael Golub, Comparative study of mechanical properties of 3D printed plastic components, Materials Science & Technology 2016 (MS&T16), Salt Lake City, UT, USA, October 23-27, 2016
19. Linmin Wu, Yi Zhang, Louis Santodonato, Hassina Bilheux, Jing Zhang, Neutron Imaging of Lithium Distribution in LiNi0.33Mn0.33Co0.33O2 Cathode, Materials Science & Technology 2016 (MS&T16), Salt Lake City, UT, USA, October 23-27, 2016
20. Xingye Guo, Linmin Wu, Yi Zhang, Yeon-Gil Jung, Li Li, James Knapp, Jing Zhang, Tensile Strength, Shear Strength and Adhesion Energy of Al2O3(0001) / Ni(111) Interface: A First Principles Study, Materials Science & Technology 2016 (MS&T16), Salt Lake City, UT, USA, October 23-27, 2016
22. Xingye Guo, Zhe Lu, Sung-Hoon Jung, Yeon-Gil Jung, Li Li, James Knapp, Jing Zhang, Thermal and mechanical properties of novel multi-layer lanthanum zirconate based


- Featured in the AEM spotlight of issue 83 (4) with accompanying cover image.


33. Amardeep Sidhu, Afshin Izadian, and Sohel Anwar, "Model-Based Adaptive Fault Diagnosis in Lithium Ion Batteries: A Comparison of Linear and Nonlinear Approaches”, SAE World Congress and Exposition, Detroit, MI, April 4-6, 2017.


41. Cheolwoong Lim; Bo Yan; Huixiao Kang; Zhibin Song; Wen Chao Lee; Vincent J De Andrade; Francesco De Carlo; Leilei Yin; Young sik Kim; Likun Zhu, "Analysis of Geometric and Electrochemical Characteristics of Lithium Cobalt Oxide Electrode with Different Packing Densities", Journal of Power Sources, vol. 328, pp 46-55, 2016.

42. Cheolwoong Lim, Huixiao Kang, Melissa Meyerson, Charles Buddie Mullins, Likun Zhu, "In-Situ and in-Operando Investigation of the Morphology Evolution of Ge and Ge0.9Se0.1 Electrodes during (De)Lithiation", the 231st ECS Meeting in New Orleans, LA (May 28 – June 1, 2017).


44. Yufeng Zhang, Weiyuan Deng, Lifu Wang, Cheolwoong Lim, Likun Zhu, Andres Tovar, "Multi-objective optimization of cathode electrode for lithium ion batteries to maximize energy density and safety", ASME's International Mechanical Engineering Congress and Exposition (IMECE), 2016.


78. Amruth Bhargav, Shravan V. Patil, and Yongzhu Fu* “A Phenyl Disulfide@CNT Composite Cathode for Rechargeable Lithium Batteries”, Sustainable Energy Fuels 2017, 1, online.
85. Ming Liu, Dong Zhou, Yan-Bing He, Yongzhu Fu, Xianying Qin, Cui Miao, Hongda Du, Baohua Li, Quan-Hong Yang, Zhiqun Lin, Tianshou Zhao, and Feiyu Kang “Novel Gel Polymer Electrolyte for High-Performance Lithium-Sulfur Batteries”, Nano Energy 2016, 22, 278-289. (ESI highly cited paper).


Inventions Disclosed, Patents Applied for or Granted

1. US 9,469,837 “Materials and methods for identifying and using yeast strains that metabolize pentose sugars in the presence of D-glucose,” to Goebl, M., with co-inventors Woods, C., Cocklin, R., and Heyen, J.


Conferences attended, Invited Talks, Collaborations featuring LCRE


2. 2016 Austin Electricity Conference, University of Texas; U.S. Association of Energy Economics, dual plenary session on Transportation; South Carolina Journal of International Law and Business Symposium; University of Texas at Austin, Regional Challenges and Opportunities in Energy Transformations Workshop. S. Carley.

Research Grants and Milestones


13. IUPUI, Multi-Disciplinary Undergraduate Research Institute (MURI), "Investigation of non-thermal plasma for fuel pyrolysis and ignition," $8,000, 2016-17, R. Nalim.


Post-Graduate Student Completions (selected)

4. May 2016: Amruth Bhargav, M.S., (Y. Fu)
5. May 2016: Yi Cui, M.S., (Y. Fu)
6. May 2016: Min Wu, M.S., (Y. Fu)
8. April 2017: Tangirala Deepak Kumar, Thesis: Accurate location of tumor in head and neck cancer radiotherapy treatment with respect to machine isocenter, expected (A. Razban)

Awards, Honors, Recognitions

Prof. James ‘Jake’ McKinlay was awarded the 2017 Indiana University Outstanding Junior Faculty Award.

Prof. M. Razi Nalim was awarded the Alvin Bynum Mentorship Award for most outstanding mentoring of students beyond the classroom, Indiana University – Purdue University Indianapolis, IN, 2017.

Prof. Owen Wu was awarded the Paul Kleindorfer Award in Sustainability, Production and Operations Management (POMS) Society, 2017.
Service Activities

- Jake McKinlay, American Society for Microbiology, Council of Microbial Sciences, Division K Councilor – Microbial Physiology and Metabolism
- Jake McKinlay, Ad hoc reviewer for Journal of Bacteriology, Nature Communications, PLOS Genetics, and Environmental Microbiology
- Jake McKinlay, Ad hoc reviewer. 2 NSF Molecular and Cellular Bioscience grant proposals.
- Jake McKinlay, Abstract reviewer. 2017 ASM Microbe conference (38 abstracts)
- Jake McKinlay, Convener. ASM Microbe Poster Talk session on Metabolic Pathways, New Orleans, LA
- Peter Schubert, Reviewer for IEEE Transactions on Aerospace and Electronic Systems

Outreach

The 2017 Spring Forum topic was “Energy, Environment, Economics: The ThrEEEs,” with the following motivation statement, drawn from the Annual Retreat (held at the Nature Conservancy facilities at the Efroymson Center in downtown Indianapolis in January) including LCRE Research Members, Advisory Board Members, and Entrepreneurs-in-Residence:

The views on energy between the 44th and 45th President could hardly be more divergent. Why is this such a difficult topic? We all need energy to run our economy. We all want a clean environment in which to live our lives. Few issues are so close to us and yet cause us to be so divided. Every State in our nation, indeed every country on our planet, approaches this nexus of energy, environment, and economy differently. How can we tease out the key issues? What are the primary drivers? Who has figured all this out, if anyone? And, how do we bring it all home to Indiana?

The 2017 Spring Forum explores these inter-dependent issues broadly, seeking to inform and educate, and to identify good opportunities for research as we explore the intersection of the ThrEEEs in Indiana.

The event was held in the IUPUI Campus Center and had 104 registrants – a record turnout! The line-up included 25 speakers (5 of whom are LCRE members) starting with celebrated Purdue Agricultural Economist Wally Tyner, recently named a Fellow of the AAAS. A Catchbox® microphone was tossed around the audience to capture questions for speakers, panelists, and moderators. Lively discussions ensued during the networking breaks. Organization was split among Schubert, Dumortier, and Wu for this unique 3-topic conference. Presentation materials from selected speakers can be found in the Spring Forum archives at:

http://www.lugarenergycenter.org/index.php/events/archives-prior-years/
Other recent outreach activities include the following:

- Connected Dr. Ali Razban (RM) to Ms. Terry Hall (Advisory Board member) for a matter involving her client. Sept 2016.
- Invited talk at Great Decisions program, 7 March 2017, Dr. Peter Schubert “Brainwashed: The Zombie Apocalypse – How Half of Americans have Stopped Thinking”.
- Drs. Sanjeev Adhikari and Peter Schubert – US Green Building Council talk on “Green Constructions – the next 100 years” (photo below, presentation available on request).

![Photo of US Green Building Council talk](image)

Student Capstone Projects Mentored by LCRE Research Members:

• David Galloway, Mitchel Szazynski, Ali Alsulaiman, Adam Clarkson, ECE Capstone team working on CRADA with Crane NSWC on drone defense using phased array antennas, mentored by P. Schubert (*photo above*).

• Tanuj Thorat, "Dual-cycle thermodynamic modeling of diesel engine for pressure-wave supercharger integration," ME 597 project, Dec 2016, mentored by M.R. Nalim.

**Undergraduate Research at the LCRE:**

• Moumouni Ouedraogo, Nathanael Mawuli, Abdallah Tahir, Asel Liyanage, Yung Wei Chin working on the IU-patented biomass gasifier (*photo above*), mentored by P. Schubert. Students host a visit from visiting faculty from Newcastle University (UK).
• Jonathan Nderitu, Fatih Tokmo, Rudolfo Cofino, Javier Tandazo at the National Space Society’s International Space Development Conference were all expense-paid finalists in the International Space Solar Power Student Project Competition, St. Louis, MO, 26 May 2017 (*photo above*). Faculty advisor: P. Schubert.

• Morgan Mitchell, Commitment to Engineering Excellence (CTEE) Scholar in IUPUI’s School of Engineering & Technology taking 2nd Place for Undergraduate Student Poster at the Annual Conference & Expo of the Air & Waste Management Association, Pittsburgh, PA, 6 June 2017 (*photo above*). Faculty supervisor: P. Schubert

**New Personnel at LCRE**
The LCRE continues to rely upon its highly qualified Research Members and external Advisory Board Members. New additions during the 2016-2017 Academic Year are highlighted here.

**Robert S. Weissbach**

Our newest member Prof. Rob Weissbach, joined IUPUI in July 2016 as the Chair of the Department of Engineering Technology, responsible for 25 faculty, 7 staff, and about 900 students. Dr. Weissbach has experience in private industry as well as academia. His Ph.D. research from Arizona State studied flywheel energy storage systems. His published research includes studies of optimizing wind and solar power, and he is applying these in his role as a member of the thesis committee for an Energy Engineering Masters student.

**Jong E. Ryu**

We are delighted to welcome Prof. Jong Ryu who joined the Department of Mechanical Engineering as an Assistant Professor. He brings expertise in nanotechnology including nanocomposites, graphene, nano-imprinting and – lithography, and their applications to energy and sensing applications. He has applied these methods to biofuel cell electrodes and printed electronics on flexible circuits.
Outlook for AY 2017-2018

The change from the Obama Administration to the Trump Administration has shifted the federal focus on energy from renewables which address environmental and climate concerns to fossil fuels which are can be low in cost and support established business interests. The appointment of a Secretary of Energy who once spoke to abolish the agency, together with informal comments by Department of Energy scientists suggest reduced funding for the Energy Efficiency and Renewable Energy Office which is a key funding source for technologies of relevance to the LCRE. Coupled with reduced emphasis on emissions via cuts to the Environmental Protection Agency the federal support for LCRE’s mission will be significantly diminished. State level support has remained essentially unchanged in the transition from the Pence Administration to the Holcomb Administration with a primary emphasis on energy being ‘affordable and reliable’. Within the last few years energy efficiency programs were cut by the State of Indiana, and the Governor signed into law a bill reducing the payback terms for installations of solar energy, which limits local opportunities for support of the LCRE mission and goals.

A few investor-owned utilities and other energy companies have been investing in wind, solar, and landfill gas. Solarresourceguide.org lists Indianapolis as #6 in the US for most solar power installed, and Forbes recently listed Indy as #2 in a per capita measurement of solar – behind only Honolulu, Hawai’i. The Bean Center, which processes paychecks for most of the federal government has extensive rooftop solar, and numerous businesses across the state are installing solar at increasing rates. Thus, it is likely to be corporate adoption of renewable energy technologies which drives momentum in the near future. These will focus on technologies such as battery energy storage, hydrogen generation and fuel cells, building efficiency, microgrids, and power electronics for higher efficiency energy conversion. Indeed indications are that investors in the cleantech space are seeing solar become a commodity and are actively seeking new opportunities in system level energy resilience, independence, lower overall cost of ownership, plus less susceptibility to market price fluctuation and supply of energy primary sources. This suggests that LCRE technology focus may begin to pivot from sponsored research to commercialization. Federal programs less impacted by policy changes include the Small Business Innovative Research (SBIR) program. With the Entrepreneur-in-Residence program at the LCRE we have available seasoned professionals willing to work pro bono to develop business plans for faculty members with technologies disclosed to the technology transfer office of the university, and to help apply for SBIR grants. Two LCRE research members have received such grants recently, making this an exciting new avenue to pursue which resonates with the campus-level interest in entrepreneurship and innovation.

To learn more or to explore partnerships with our research members, visit our website at www.lugarenergycenter.org or contact us through the Lugar Center for Renewable Energy e-mail: lcre@iupui.edu. Your tax-exempt donations, through the web page, will help advance our work.
Appendix A

Executive Committee

1. Alan Jones, Ph.D., Assistant Professor of Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
2. Steve Rovnyak, Ph.D. Associate Professor of Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI
3. Mark Goebl, Ph.D., Professor of Biochemistry and Molecular Biology, Indiana University School of Medicine
4. M. Razi Nalim, P.E., Ph.D., Professor of Mechanical Engineering, Associate Dean for Research & Graduate Programs, Department of Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
5. Peter J. Schubert, Ph.D., P.E., Professor of Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI
Appendix B

Advisory Board

The LCRE AB meets quarterly on campus to review progress and provide strategic advice.

1. Dr. Seth W. Snyder, Argonne National Laboratory.
2. Robert Galyen, Chief Technology Officer, Amperex Technology Limited.
3. Doug Wasitis, Assistant Vice President for Federal Relations, Indiana University
4. Richard Benedict, Director of Project Development, Indianapolis Power and Light
7. Cary Aubrey, Manager, Bio-energy Development, Indiana State Department of Agriculture.
8. Steve Kozey, General Counsel, Midwest ISO.
13. Terry Hall, Partner, Faegre Baker Daniels.
15. Dustin “Dusty” Wilson, Vice President, SAIC
Appendix C

Research Members

1. Dr. Jie Chen, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
2. Dr. Hazim El Mounayri, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
3. Dr. M. Razi Nalim, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
4. Dr. Yaobin Chen, Electrical and Computer Engineering, Purdue School of Engineering and Technology at IUPUI
5. Dr. Sohel Anwar, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
6. Dr. David Goodman, Electrical and Computer Engineering Technology, Purdue School of Engineering and Technology at IUPUI
7. Dr. Stephen Hundley, Computer, Information, and Leadership Technology, Purdue School of Engineering and Technology at IUPUI
8. Dr. Afshin Izadian, Electrical and Computer Engineering, Purdue School of Engineering and Technology at IUPUI
9. Dr. Lingxi Li, Electrical and Computer Engineering, Purdue School of Engineering and Technology at IUPUI
10. Dr. Maher Rizkalla, Electrical and Computer Engineering, Purdue School of Engineering and Tech at IUPUI
11. Dr. Steven Rovnyak, Electrical and Computer Engineering, Purdue School of Engineering and Technology at IUPUI
12. Dr. Alan Jones, Mechanical Engineering, Purdue School of Engineering and Tech at IUPUI
13. Dr. Tamer Wasfy, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
14. Dr. Dong Xie, Biomedical Engineering, Purdue School of Engineering and Technology, IUPUI
15. Dr. Jian Xie, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
16. Dr. Likun Zhu, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
17. Dr. Mark Goebi, Biochemistry and Molecular Biology, IU School of Medicine at IUPUI
18. Dr. Gabriel Filippelli, Professor of Earth Sciences, Director Center For Urban Health, Earth Sciences Department, Purdue School of Science at IUPUI
19. Dr. Asok Sen, Mathematical Sciences, Purdue School of Science at IUPUI
20. Dr. Xianzhong Wang, Biology, Purdue School of Science at IUPUI
21. Dr. Ken Richards, Public and Environmental Affairs/Law, IU School of Public & Environmental Affairs/IU Maurer School of Law
22. Dr. Pierre Atlas, Political Science, Marian University
23. Dr. Carol Rogers, Indiana Business Research Center, Kelley School of Business, IUPUI
24. Patricia Fox, Organizational Leadership and Supervision, Purdue School of Engineering and Technology at IUPUI
25. Dr. Jerome Dumortier, Public and Environmental Affairs, IU School of Public and Environmental Affairs
26. Dr. Peter J. Schubert, Electrical and Computer Engineering, Purdue School of Engineering and Technology at IUPUI
27. Dr. Jing Zhang, Mechanical Engineering, Purdue School of Engineering and Technology at IUPUI
28. Dr. Stephen K. Randall, Department of Biology, School of Science, IUPUI
29. Andres Tovar, Ph.D., Assistant Professor, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
30. Sanya Carley, Ph.D., Associate Professor, School of Public and Environmental Affairs (SPEA), Indiana University
31. Euzeli C. Dos Santos, Jr., Ph.D., Assistant Professor, Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI
32. Huidan “Whitney” Yu, Ph.D., Assistant Professor, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI
33. Dr. Elaine Cooney, Professor of Electrical and Computer Technology, Department Head, Technology, IUPUI.
34. Dr. E. Jane Luzar, Professor of Economics, Professor of Public and Environmental Affairs, Dean, IUPUI Honors College.
35. Dr. Paul E. Sokol, Professor of Experimental Physics, Department of Physics, IU-Bloomington.
36. Dr. Ali Razban, Senior Lecturer, Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI.
37. Dr. Yongzhu Fu, Assistant Professor, Dept. of Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI.
38. Dr. Lyudmila Bronstein, Research Scientist, IU Dept. of Chemistry
39. Dr. David Baxter, Research Scientist, IU Dept. of Physics
40. Dr. James “Jake” McKinlay, Asst. Prof, Dept. of Biology
41. Dr. Todd Saxton, Associate Professor, Management and Entrepreneurship, Kelley School of Business, Indiana University.
42. Dr. Owen Q. Wu, Associate Professor, Kelley School of Business, Indiana University
43. Dr. Robert S. Weissbach, Associate Professor, Chair, Department of Engineering Technology, IUPUI.
44. Dr. Jong Eun Ryu, Assistant Professor, Department of Mechanical Engineering, IUPUI.
Appendix D

Entrepreneurs-in-Residence

The EIR program was initiated in December 2011 in cooperation with the Indiana University Research and Technology Corporation (IURTC) – the technology transfer organization for the IU system. IURTC’s Spin-Up program aids faculty to create business opportunities and funding based on their intellectual property. The most crucial role for the EIRs is to serve as PI for federal Small Business Innovation Research (SBIR) or Small Business Technology Transfer (STTR) grants made by spIn-Up companies which can then subcontract to university faculty. This allows faculty members to retain 100% appointments while benefiting from the entrepreneurial experience of the EIR and avoiding the federal requirement that the PI be 51% or more associated with the small company. In addition to SBIRs, EIRs help develop business plans, often in concert with students from the Kelley School of Business and the School of Public and Environmental Affairs, and they bring networking opportunities to LCRE. The following individuals provide pro bono work on behalf of the university with the hope and expectation that, upon receiving funding, they can begin to draw a salary commensurate with their level of interest and availability, while creating commercially-viable going concerns based on research from LCRE Research Members:

1. Mr. John Craun
2. Dr. Randall Gatz
3. Dr. Shashikala Kollur
4. Dr. James Logsdon
5. Mr. Joe Paganessi
6. Mr. Edward F. Plocharczyk
7. Dr. Clara Deal
8. Mr. Peter Price
9. Dr. Bob Rosenstein
10. Mr. Lee Saberson
11. Mr. Morris Stillabower
12. Dr. Sy Ali
Appendix E

Director’s Afterward

During this year, my fifth as Director, I invited the Dean and the Vice Chancellor for Research to conduct a review of activities, initiatives, efforts, strategies, membership, and other salient aspects of the Center. This process resulted in a number of valuable insights and excellent suggestions which are now being worked on by the Executive Committee and with guidance from the Advisory Board. Both of these groups are at historic lows which was done in part to prepare for shifts in the nature of the renewable energy space in academic, government, and industry. One new direction was to offer testimony and analysis to State elected officials when considering legislation. Another is to celebrate the 10th anniversary of the LCRE to raise awareness and recognize contributions to the field – plans for such are on-going. A greater emphasis on private industry and the investment community is also underway as this appears to be the quarter from which increased funding is likely to arise over the next four years. As our research members develop economical new technologies our EIRs can help catapult them to commercialization, answering the challenge laid down by Senator Lugar in 2011 (paraphrased): “University research is great, but it needs to translate to jobs and revenue”. I endeavor to help make that happen by providing advice, resources, and connections to the excellent Research Members of the LCRE. I hope you will help me to help them succeed!

A great many people contribute to the Lugar Center for Renewable Energy. We are privileged to be administratively housed within the School of Engineering and Technology at IUPUI and to have the support of Dean David Russomanno and his staff, plus helpful staffers in the ECE and ME departments. Administrators and facility services people from all across the Indianapolis campus have worked hard in creating an environment conductive to research and learning. Thanks to all of you who help make this important work possible.

Peter J. Schubert
Director, LCRE