Director’s Message

Welcome to the 2014-2015 Annual Conference of the Center for Future Energy Systems! With the support of CFES researchers and partners, we have again put together a very strong program for you. This handout is your “guide book” for the event, so please take a moment to look through it and be familiar with the program. Following are a few highlights.

The conference starts with three oral presentation sessions each highlighting the latest development and industry collaboration in a core area of CFES research: a) energy storage and fuel cells; b) power electronics, photovoltaics and energy efficiency; and c) renewable energy systems and grid resiliency. Each session consists of seven presentations by CFES researchers as well as industry partners, and is divided into two parts: Part 1 in the morning and Part 2 after lunch. These sessions run in parallel in different conference rooms. Please pick the one that interests you the most and feel free to switch to a different one during the break between presentations.

We are excited to have Mr. Richard Kauffman, Chairman of Energy and Finance of the Office of Governor Andrew M. Cuomo as our keynote speaker this year. Mr. Kauffman will speak during the luncheon, to which all of you are invited.

Following the luncheon and Part 2 of the oral sessions, the poster and industry exhibition session will open in the foyer and ballroom area on the 1st floor. The posters are primarily presented by CFES researchers and graduate students, and cover a wide range of topics related to energy technology and application. Based on industry feedback, we expanded the industry showcase program initiated last year into an Industry Exhibition session that will run in parallel with the poster session. The exhibition tables are mixed with posters according to their technical areas.

This handout also includes a bio of our keynote speaker and each of the three oral session chairs, as well as a printout of the majority of the posters. Oral presentations will be posted on CFES webpage after the conference – please check back in a couple of weeks.

I would like to take this opportunity to thank NYSTAR for its continuous support of CFES. I would also like to thank our industry partners, especially those presenting today in the oral sessions and as exhibitors, for their partnership and collaboration with CFES. It would not have been possible to put together such an extensive program without the support and dedication of CFES researchers and staff, including our colleagues at Cornell University – thank you all!

I wish you a productive and enjoyable conference!

Jian Sun, Ph.D.
Director, Center for Future Energy Systems
Professor, Department of Electrical, Computer and Systems Engineering
Rensselaer Polytechnic Institute
(518) 276-8297; jsun@rpi.edu
Check In: 9:00am – 10:00am

Parallel Oral Sessions – Part 1 (10:00am – 11:40am)

**A1: Energy Storage and Fuel Cells**
Room: Ferris Ballroom A
Session Chair: Andrew Naukam, Eastman Business Park

a1. *Photo-Thermally Reduced Graphene Anodes for High-Performance Lithium-Ion Batteries*, Rahul Mukherjee and Nikhil Koratkar, RPI

a2. *Operando X-Ray Scattering and Spectroscopic Analysis of Germanium Nanowire Anodes in Lithium-Ion Batteries*, Katharine Silberstein and Hector Abreuña, Cornell

a3. *Stabilizing Electrodeposition of Metals in Batteries*, Lynden Archer, Cornell

a4. *Scalable Fabrication of Si Nanowire Anodes*, Ben Richards and Tobias Hanrath, Cornell

**B1: Power Electronics, Photovoltaics and Energy Efficiency**
Room: Sage II Conference Room
Session Chair: Adam Todorski, DEMANSYS

b1. *4H-SiC P-i-N Diodes on Lightly Doped Free-Standing Substrates*, Sauvik Chowdhury and T. Paul Chow, RPI

b2. *Industrial Readiness of SiC Power Devices*, Ljubisa Stevanovic, GE Global Research Center


**C1: Renewable Energy Systems and Grid Resiliency**
Room: Osborn Amphitheatre
Session Chair: Hugo Raul Bashualdo, Siemens PTI

c1. *A Fundamental Study of Applying Wind Turbines for Power System Frequency Control*, Felipe Witches-Bernal and Joe Chow, RPI

c2. *Comparison of Offshore Wind Farm Electrical System Architectures with HVDC Transmission*, Shahil Shah and Jian Sun, RPI
c3. Analysis and Mitigation of Subsynchronous Resonance Involving Type-III Wind Turbines, Ignacio Vieto and Jian Sun, RPI

c4. Identification of Continuous “Unobservable” Data Attacks in Power Systems via Matrix Decomposition, Pengzhi Gao (RPI), Meng Wang (RPI), Joe Chow (RPI), Scott G. Ghiocel (RPI), Bruce Fardanesh (NYPa), George Stefopoulos (NYPa), and Michael P. Razanousky (NYSERDA)

Luncheon with Keynote Speaker (11:50am – 1:30pm) – 1st Floor, Ferris Ballroom

11. Welcome and Introduction, Jian Sun, Director of CFES
12. Keynote Speaker, Richard Kauffman, Chairman of Energy & Finance, Office of Governor Andrew M. Cuomo

Parallel Oral Sessions – Part 2 (1:45pm – 3:00pm)

A2: Energy Storage and Fuel Cells
Room: Ferris Ballroom A
Session Chair: Andrew Naukam, Eastman Business Park

a5. Anion Exchange Membranes with Improved Chemical Stability, Angela Mohanty and Chulsung Bae, RPI

a6. Anion Exchange Dynamics and Membrane Swelling of a Prospective Alkaline Anion Exchange Membrane Material for Fuel Cells, Johary Rivera-Meléndez and Hector Abrúña, Cornell

a7. Optimizing the Design of Utility-Scale Grid Storage, Chris Thompson, Eaton Corp.

B2: Power Electronics, Photovoltaics and Energy Efficiency
Room: Sage II Conference Room
Session Chair: Adam Todorski, DEMANSYS

b5. Furnace Optimization Using VectorwallTM Static Mixers, Arun Khuttan and Joel Plawsky, RPI

b6. Kick-Starting Oxetane Electron-Beam and Photopolymerizations, Jim Crivello, RPI

b7. On-Site Net Zero Buildings, Nick Novelli and Anna Dyson, RPI

C2: Renewable Energy Systems and Grid Resiliency
Room: Osborn Amphitheatre
Session Chair: Hugo Raul Bashualdo, Siemens PTI

c5. DC Links as a Bridge to the Future of Self-Healing, Smart Grids, Damian Sciano, Con Edison of New York, Inc.

c6. Advancements in the Real-Time Simulation of Large Distribution System with Power Electronic Subsystem, Amine Yamane and Jean Belanger, Opal-RT Technologies

c7. A Non-Intrusive Measurement Based Approach for CVR Factor Estimation, Chaitanya A. Baone and Santosh Veda, GE Global Research Center
Poster Session & Reception (3:00pm – 6:30pm) 1st Floor, Foyer & Ferris Ballroom

Hors d’oeuvres, beer and wine will be served during the reception.

**Student Poster Awards:** Four posters will be selected for the Best Student Poster Awards. Each award will consist of a certificate and a cash prize of $250. To qualify for this award, a poster must be prepared and presented by a student (excluding post-doc) who is identified as the lead author. Selection of the awards will be conducted by the attendees of the conference during the poster session. The results will be announced at 6:00 pm. The lead student author is underlined for each qualified poster listed below.

**Batteries and Materials for Energy Storage**

1. *Photo-Thermally Reduced Graphene Anodes for High-Performance Lithium-Ion Batteries*, Rahul Mukherjee and Nikhil Koratkar, RPI
2. *Graphene-based sulfur cathodes for next-generation high-energy lithium-sulfur batteries*, Lu Li and Nikhil Koratkar, RPI
4. *Stabilizing Electrodeposition of Metals in Batteries*, Lynden Archer, Cornell
5. *Salt-reinforced Nanoporous Ceramic/polymer Electrolyte for Lithium Metal Batteries*, Zhengyuan Tu, Yingying Lu, Deniz Gunceler, Tomás Arias and Lynden A. Archer, Cornell
7. *Nucleation and Growth of Lithium Peroxide in the Li-O2 Cell*, Sampson Lau and Lynden Archer, Cornell
p14. **Operando X-Ray Scattering and Spectroscopic Analysis of Germanium Nanowire Anodes in Lithium-Ion Batteries**, Katharine Silberstein, Michael A. Lowe, Benjamin Richards, Jie Gao, Tobias Hanrath and Hector Abrúña, Cornell


p16. **Scalable Fabrication of Si Nanowire Anodes**, Ben Richards and Tobias Hanrath, Cornell

p17. **Conducting Polymers as Cathode Materials for Electrical Energy Storage Applications**, Luxi Shen, Masato Mizutani, Gabriel G. Rodríguez-Calero, Héctor D. Abrúña and Geoffrey Coates, Cornell

p18. **Lignocellulosic Composites and Fibers for Advanced Applications**, Trevor Simmons and Robert Linhardt, RPI

p19. **High-speed High-sensitivity Carbon Nanotube-based Composite Bolometers**, Trevor Simmons (RPI) and Javier Gonzalez (CIACyT-UASLP)

p20. **CFES Energy Materials and Device Laboratory**, Trevor Simmons and Jian Sun, RPI

**Fuel Cells**

p21. **Synthesis and Characterization of Novel Fluorescence-Based Polymers for Anion Exchange Membranes**, Woo-Hyung Lee, Angela D. Mohanty & Chulsung Bae, RPI

p22. **Poly(arylene ether sulfone) with Pendant Perfluorosulfonic Acid for Proton Exchange Membrane Fuel Cell Application**, Dong Won Shin, Ying Chang (RPI), Giuseppe F. Brunello (Georgia Tech), Jeffrey Fuller (Georgia Tech), Melanie L. Disabb-Miller (Pennsylvania State), Marilyn E. Hawley (Los Alamos National Laboratory), Yu Seung Kim (Los Alamos National Laboratory), Michael A. Hickner (Pennsylvania State), Seung Soon Jang (Tech), and Chulsung Bae (RPI)

p23. **Anion Exchange Membranes with Improved Chemical Stability**, Angela Mohanty and Chulsung Bae, RPI


**Power Electronics and Photovoltaics**

p28. **Characteristics of MOS Capacitors with NO and POCl₃ Annealed Gate Oxides on (0001), (11-20) and (000-1) 4H-SiC**, Sauvik Chowdhury (RPI), K. Yamamoto (Denso Corporation), C. Hitchcock (RPI) and Paul Chow (RPI)
p29. 4H-SiC P-i-N Diodes on Lightly Doped Free-Standing Substrates, Sauvik Chowdhury, C. Hitchcock, R. Dahal, Ishwara Bhat and Paul Chow, RPI

p30. Performance Evaluation on Channel Length Downscaling of Various High Voltage AlGaN/GaN Power HEMTs, Zhibo Guo and Paul Chow, RPI

p31. Electrochemical Rectification of Molecular Multilayered Films Towards Redox Mediators for Dye-sensitized Solar Cells, Marissa Civic and Peter Dinolfo, RPI


p33. The Role of Ferroelectric Polarization on Charge Separation and Recombination in Perovskite Solar Cells, Yiping Wang and Jian Shi, RPI

p34. Artificial Photosynthesis for Alternative Energy Production and CO2 Sequestration, Adam Bross, Mark Durniak, David Elsaesser, Stuart Smith, K. V. Lakshmi and Christian Wetzel, RPI

p35. The Structure and Function of Porphyrins in Energy Transduction: Electrochemical, Optical and Quantum Mechanical Studies of the Electronic Structure of Magnesium Porphyrins, Greg Theophall, Yi-Yang Sun and K. V. Lakshmi, RPI

p36. High-Resolution Electronic Structure of the Primary Electron Acceptor A0 of Photosystem I, Stuart Smith (RPI), Sergey Milikisiyants (RPI), Sijie Hao (Pennsylvania State), John H. Golbeck (Pennsylvania State) and K.V. Lakshmi (RPI)

p37. Mechanism of Proton-Coupled Electron Transfer at the Redox-Active Tyrosine Residues of Photosystem II from an Electronic Structure Perspective, Yi-Yang Sun (RPI), Zhaoyang Zheng (Dalian University), K. V. Lakshmi (RPI) and Shengbai Zhang (RPI)

p38. Phase Transformation Toughening of Glass Using Cristobalite Silica, Siddhardth Sundararaman and Liping Huang, RPI

Renewable Energy Systems and Grid Resiliency


p40. Fault Behavior and Protection of a Series-DC Collection System for Offshore Wind Farms, Shalil Shah, Huan Guo and Jian Sun, RPI

p41. Impedance Modeling of Type-III Wind Turbines, Ignacio Vieto and Jian Sun, RPI

p42. Analysis and Mitigation of Subsynchronous Resonance in Doubly Fed Induction Generators, Ignacio Vieto and Jian Sun, RPI

p43. Modeling and Control of Modular Multilevel Converters, Hanchao Liu and Jian Sun, RPI

p44. System Control of Series-DC Collection Systems for Offshore Wind Farms, Rohail Hassan and Jian Sun, RPI

p45. DC-DC Converters for Offshore Wind Farms with DC Collection, Huan Guo, Shalil Shah and Jian Sun, RPI

p46. CFES Real-Time and Hardware-in-the-Loop Simulation Platforms and Applications, Huan Guo and Jian Sun, RPI
p47. Identification of Continuous “Unobservable” Data Attacks in Power Systems via Matrix Decomposition, Pengzhi Gao (RPI), Meng Wang (RPI), Joe Chow (RPI), Scott G. Ghiocel (RPI), Bruce Fardanesh (NYP), George Stefopoulos (NYP), and Michael P. Razanousky (NYSERDA)


p49. A Fundamental Study of Applying Wind Turbines for Power System Frequency Control, Felipe Wilches-Bernal and Joe Chow, RPI

p50. The Engineering, Economic, and Environmental Electricity Simulation Tool, Biao Mao (RPI), Daniel L. Shawan (Resources of the Future), Di Shi (Arizona State), Ray D. Zimmerman (Cornell), Juno Yan (Cornell), John T. Taber (Cornell), Charles M. Marquet (Cornell), Yujia Zhu (Arizona State), Richard E. Schuler (Cornell), William D. Schulze (Cornell) and Daniel Tylavsky (Arizona State)

p51. Systems Equations for Wind Turbine Design, Dave Runkel (GE) and Mark J. Embrechts (RPI)

Energy Efficiency

p52. High Efficiency Light Emitting Sources Using Narrow Line-width Green Phosphor, Anqing Liu, A. Khanna, Partha Dutta and Michael Shur, RPI

p53. Modeling and Design of Phosphor Based Luminescent Solar Concentrators, Michael D. Hughes, Diana-Andra Borca-Tasciuc and Deborah A. Kaminski, RPI

p54. A Study of Iron Porphyrin (FeP) Molecular Conductance with STM Molecular Break Junctions, Qi Zhou and Kim Lewis, RPI

p55. LED Campus Lighting, Jennifer Brons, RPI

p56. Vibration Energy Harvesting on HVAC Ducts for Smart Building Applications, John Oxaal, Mona Hella and Diana Borca-Tascuic, RPI

p57. On-Site Net Zero Buildings, Nick Novelli and Anna Dyson, RPI

p58. Performance Assessment of the Integrated Concentrating Solar Façade System as Deployed in the General Hospital Lobby of the Sheikh Khalifa Medical City, Abu Dhabi, UAE, Nick Novelli, Brandon Andow, Jason Vollen, Anna Dyson, RPI

p59. Furnace Optimization Using Vectowall™ Static Mixers, Arun Khuttan and Joel Plawsky, RPI

Energy Scholars

p60. Overview of CFES Energy Scholars Program, CFES Staff, RPI

p61. Mini-scale Cleanup of Natural Gas for Liquification, Nancy Zhong (RPI), Joel Plawsky (RPI) and John Corey (Chart Industries)

p62. Glass/Ceramic Materials for Energy Storage Applications, Eric Dominguez (RPI), Chulsung Bae (RPI) and Patrick Tepesch (Corning)

p63. Selective Catalytic Reduction(SCR) System Improvement, Jinyuan Yu (RPI), Wayne Bequette (RPI) and Parag Kulkarni (GE Power & Water)

p64. Effects of Optimized Microgrids on Generation Sources, Samuel Brown (RPI), Jian Sun (RPI) and Clayton Burns (National Grid)
Industry Exhibition (3:00pm – 6:30pm) 1st Floor, Foyer & Ferris Ballroom

The following companies and organizations will exhibit their technologies and collaboration with CFES at the annual conference. The exhibition tables will be mixed with posters in the 1st floor foyer and ballroom according to the technology areas of the companies and products.

- 7AC
- ActaSys, Inc.
- Bettergy Corp.
- Blasch Precision Ceramics
- Conamix, Inc.
- CSS Nanotech, Inc.
- DemanSys Energy LLC
- DNV-GL
- Eaton Industries Co.
- EnerMat Technologies Inc.
- GE Global Research
- Lionano, Inc.
- Intertek
- MicroOrganic Technologies, Inc.
- National Grid
- New York Independent System Operator (NYISO)
- Opal-RT Technologies, Inc.
- Paper Battery Co.
- Siemens PTI
- ThermoAura, Inc.
- Troy Boiler Works, Inc.
- Vital Vio, Inc.
- Widetronix
- RPI Emerging Ventures EcoSystem (EVE)
- RPI Office of Technology Commercialization
- NYSERDA/Center for Economic Growth
- NY Battery and Energy Storage Technology (NY-BEST) Consortium
Richard L. Kauffman  
Chairman of Energy & Finance  
Office of Governor Andrew M. Cuomo

Richard Kauffman joined the administration of Governor Andrew M. Cuomo as New York State’s first “energy czar” in February of 2013. In this capacity, Mr. Kauffman is responsible for developing and advancing the Governor’s ambitious plan to create a cleaner, more resilient and affordable energy system.

Mr. Kauffman oversees and manages New York State’s entire energy portfolio, including the New York State Department of Public Service, the New York Power Authority, the Long Island Power Authority, and the New York State Energy Research and Development Authority (NYSERDA). He was appointed chair of NYSERDA’s board in June 2013. Mr. Kauffman leads New York State’s comprehensive Reforming the Energy Vision (REV) initiative. REV includes groundbreaking regulatory reform to fundamentally restructure the energy and utility industry, an unprecedented ten-year commitment to support local renewable energy and efficiency markets through the creation of the Clean Energy Fund, and other bold initiatives such as NY Green Bank and the pioneering $1 billion NY-Sun solar program.

Prior to joining the administration, Mr. Kauffman worked in energy and finance at some of the nation’s highest levels, most recently serving as Senior Advisor to Secretary Steven Chu at the U.S. Department of Energy. In his private sector career, he was Chief Executive Officer of Good Energies, Inc., a leading investor in clean energy technologies, a partner of Goldman Sachs where he chaired the Global Financing Group, and vice chairman of Morgan Stanley’s Institutional Securities Business and co-head of its Banking Department.

Mr. Kauffman has served as Chairman of the Board of Levi Strauss & Co., as well as on the boards of several organizations, including the Brookings Institution and the Wildlife Conservation Society. He is a member of the Council on Foreign Relations.

Mr. Kauffman earned a bachelor’s degree from Stanford University, a master’s degree in international relations from Yale University, and a master’s in public and private management from the Yale School of Management.
Biographies of Session Chairs

Session A: Energy Storage and Fuel Cells – Andrew Naukam

Andrew Naukam is recently retired from industry with 32 years of experience primarily in two fields of interest: manufacturing engineering, batteries and energy systems. In the battery field, he initially focused on the research and development of non-rechargeable lithium manganese dioxide cell chemistry, configuration and production for military, automotive and medical applications. He oversaw the scale up and optimization of production of cells and batteries in factories in the UK, China and India and managed supply chain, quality assurance, testing and certification of batteries and charging systems.

Andy transitioned into applications for larger energy storage modules with lithium ion chemistries, and integration with solar generation, inverters and system control architecture and most recently worked in business development.

Session B: Power Electronics, Photovoltaics and Energy Efficiency – Adam Todorski

Adam Todorski is the Chief Technology Officer and a co-founder of Demansys Energy, a smart grid technology company which operates energy storage assets and real time industrial demand response for the provision of reserves and regulation in eastern United States and Texas. Adam has worked in distributed generation and had an early demand response technology company. He has also managed business software development teams and one of the largest supercomputers in the world.

Adam has a BS in Computer Science from RPI.

Session C: Renewable Energy Systems and Grid Resiliency – Hugo Raul Bashualdo

Mr. Bashualdo brings to the Siemens PTI team over 20 years of specialized engineering and managerial experience within the distribution system. His technical expertise includes distribution planning, distributed generation interconnection impact studies, power loss reduction strategies, reliability improvement, and the design, construction and maintenance of distribution systems.

He has led various areas within a distribution utility business, including: Technical Analysis; Design and Construction; Power Loss Control; Distribution Studies; and Planning, Tariff, Control, and IT. He improved the technical and economic performance of each area he managed. Mr. Bashualdo joined Siemens PTI in February 2012, and leads the consulting group in Distribution Planning and Microgrids.