ENERGY CAT – Driving Industry Collaboration
CAT Program Mission

CFES is a New York Science, Technology and Innovation (NYSTAR) funded Center for Advanced Technology (CAT):

• Collaborate with S/M/L energy companies on innovative research to create economic development within New York State:
• Connect value added faculty expertise and world class research facilities
• Assist partners on potential funding pathways – NYSERDA, SBIR, STTR, NEXUS NY, 76 WEST, GTAC, Cleantech Open
• Utilize cost share funds to spur technology-based applied research in energy
• Protect intellectual property of clients
• Promote technology transfer and licensing opportunities
• Partners provide economic impact to CAT - NYS jobs, product revenues, investment…
New York State Centers for Advanced Technology (CAT)

Technology Foci which hold significant potential to expand the NYS economy:

Microelectronics

Sensors

Photonics

Nanotechnology

Energy

Materials

Life Sciences

IT

Manufacturing

Leverage State funds to increase competitiveness of NYS companies
Working with CFES Energy CAT: Technology Foci

**Advanced Energy Systems**
- Energy Storage Materials
- Full Spectrum Solar Cells
- Vibration Energy Harvesting
- Thermoelectric Generators
- Fuel Cell Membranes
- Active Flow Control Technology

**Energy Efficiency**
- Advanced Building Systems
- BIW, BIPV
- Solid State Lighting
- Air and Water Quality
- Power Electronics
- Variable Speed Drives

**Distribution System Platform**
- DER Grid Integration
- Microgrid EMS
- Autonomous Control
- Power Quality
- Wide Area Network
- High Voltage DC, FACTS
CFES Partnering Across NY State
2005-2017 CFES Highlights

- CAT Re-designated August 2015, 10 more years ($9.2M)
- Sponsored Research $33 Million ($9M Industry)
- Over 84 Industry Partnerships formed – 100+ Projects
- $110+ Million in NYS Economic Impacts, 240 jobs
- Engaged 40+ RPI Faculty
- Education Experience for 140 Graduate Students, 25 Post Docs, 53 URP’s, 12 Energy Scholars (RPI)
- Two World Class CFES Labs
  - Energy Materials & Device Lab (EMDL)
  - Distributive Energy Resources Simulation Integration Lab (DERSIL)
- RPI Facilities Collaboration:
  - Wind Tunnel; Hydrogen and Fuel Cell Lab, Lighting Research Center
  - Two NSF Engineering Research Center’s: CURENT, LESA
  - High Performance Computing; CASE Building Test-beds
Benefits of Working with CFES: Faculty and Staff Expertise

Key Research Thrusts:
- Nanostructured Silicon Anodes for Li Ion Batteries
- Scale-able Graphene Manufacturing for Li Electrodes
- Novel Membrane Polymers for Fuel Cell Application
- Development of High ZT Thermoelectric Crystals
- Novel Glass Ceramic Composites
- Advanced Electrochemical Storage Materials
- Electrostatic Energy Vibration Harvesting Devices
- Design of Up/Down Conversion PV Devices
- Development of Luminescent Solar Concentrator
- Biaxial Semiconductor Films for Thin Film PV
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Key Research Thrusts:
- Distributed Energy Resource Grid Integration
- Autonomous Energy Management & Control
- Wide Area PMU Monitoring & Control
- High Voltage DC Power Transmission
- New HiV Power Electronic Devices: SiC, GaN
- Oil and Gas Process Refinement
- Advanced Lighting Systems and Applications
- Advanced Building Systems: HVAC, BIPV, SSL
- Wind Turbine Active Flow Control Demo
- Energy Materials and Device Lab
Benefits of Working with CFES: University Assets

Energy Materials & Device Lab
- Optical Spectrometers
- Battery and Ultracapacitor Fabrication and Testing
- PV Cell Characterization

Advanced CFD
- Surface Analysis Systems
- Rapid Wet-Chemical Processing

DER System Integration Lab
- Photovoltaic Systems
- Battery and Ultracapacitor Storage
- Fuel Cell Systems

Lighting Research Labs
- LED Testing

Wind Tunnels
- Wind Turbine Testing

High Performance Computing
- Supercomputing Center

Fuel Cell Lab
- Fuel Cell Testing

Manufacturing Design Lab
Benefits of Working with CFES: Technology Cluster

- Participate in key symposia, workshops and conferences
- Access to technology commercialization and tech transfer
- Assistance to find research funding, access to funding partners:

Recent CFES NYSERDA Grant Highlights

Company Sponsored Research Awards:
- PON 2474 Utility Systems Technologies – Smart Transformer
- PON 2414 Troy Boiler Works – Wood Chip Dryer Design & Prototype
- PON 2569 XCA Composites – Demonstrate Synthetic Jets in Turbine Blades
- PON 2458 Besstech – Graphene Based Anodes for Li Ion Batteries
- PON 2606 Thermal Solution Resources – SSL LED Luminaire Development
- PON 2606 United Semiconductor – Slow Decay Phosphors for AC LED’s
- PON 2927 ThermoAura – Novel TE Materials via Spark Plasma Sintering
- PON 2781 Acatsys – Active Aerodynamic Flow to >> Vehicle Fuel Efficiency
- PON 2458 EnerMat Technologies – All Carbon Electrodes for Li Ion Batteries
- PON 3404 Pterra – Hardware in the Loop Study of Islanding
- PON 3404 PVMC/Borrego – Multi-inverter GFOV Protection
- PON 3397 JEM Engineering – Reclose Blocking Impact Simulation

Faculty Sponsored Research Awards:
- PON 2458 Simmons - Novel Cathode Materials for Li-S Batteries
- PON 2606 D. Borca-Tasciuc - Luminescent Solar Concentrators
- PON 2606 D. Borca-Tasciuc - Electrostatic Vibration Energy Harvesting
- PON 2715 M. Wang - State Estimation using PMU’s
- PON 2606 Amitay/Dyson – Optimization of Building Wind Flow Patterns
- PON 2942 F. Gandhi – Continuously Conformable Wind Turbine
- PON 3397 J. Chow – Performance Monitoring Using Synchrophasor
High Energy Density
High Power Density Hybrid Battery Technology

Max Bloomfield
Computer Scientist

VectorWall Technology
Manufacture ceramic based custom checkerwalls for high temperature reaction furnaces in oil and gas

Keith DeCarlo
R&D Manager

CFES
NYSTAR
High Energy Density
High Power Density Hybrid Battery Technology

Develop Simulation Methodology to Optimize High Temperature Process Streams

- CFES facilitated initial funds matching grant awarded to Professor Plawsky
- RPI and Blasch have collaborated on 2D/3D turbulent flow simulations
- BPC is able to leverage results to expand sales and increased plant capacity
- Investigate VectorWall technology for chemical and petrochemical markets
Virtual Aero-Shaping Active Flow Control
It is a technique used in aerospace engineering to modify the aerodynamic performance of airplanes without changing their actual shape.
High Energy Density High Power Density Hybrid Battery Technology

Active Flow Control System for Higher Fuel Efficiency in Transportation

- Use of Actasys modules can increase fuel efficiency by 6% with potential up to 18%
- Savings (per year, per truck) between $4,600 to $11,000 in US market
- Actasys awarded $500,000 from NYSERDA (PON 2781) for prototype development
- Currently partnered with Price Chopper for product development

Virtual Aero-Shaping Active Flow Control
It is a technique used in aerospace engineering to modify the aerodynamic performance of airplanes without changing their actual shape.

Transportation Fuel Efficiency
Every truck consumes per-year almost $61,000 in diesel fuel. More than 50% of the fuel is used to overcome aerodynamic drag.

Actasys Technology
Actasys product uses active flow control to enhance the aerodynamic performance of trucks without changing their shape. The system can be used to retrofit any truck model and future trucks.
Develop POWERPATCH™ Technology Platform based Products to Deliver Peak Power Pulses

- Electrochemical characterization and charge-discharge device lifetime testing
- First product is an ultrathin ultracapacitor that increases battery life by 20-40% and reduces components in mobile computing and portable electronic products
- Unique materials processing, patented architecture, to get industry-leading power density in the thinnest ultracapacitor

**Flexible Electrochemical Energy Storage**
Ultrathin ultracapacitors that can wrap around batteries and components to assist and improve performance by 20-40%

**Cellulose-Ionic Liquid Processing**
Provided expertise in carbohydrate processing to develop early laboratory devices from cellulose, ionic liquids, and carbon nanotubes

**EMD Lab & Biotech Center**
Materials synthesis and evaluation, device assembly, electrochemical stability characterization, and device testing

**Paper Battery Company**
Shreefal Mehta, CEO

**Robert J. Linhardt**
Constellation Professor
RPI

**Trevor J. Simmons**
Research Scientist
CFES

**Paper Battery Technology**
High Energy Density
High Power Density Hybrid Battery Technology

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RPI

**Trevor J. Simmons**
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CFES

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**Paper Battery Company**
Shreefal Mehta, CEO
High-energy density, high power density hybrid battery technology

- Early technology stage NSF Research grants (CFES) to develop materials
- CFES Facilities Use Agreement, Energy Materials Lab access
- Company wins NSF SBIR Phase I & II grants to develop scalable manufacturing
- NYSERDA supported manufacturing grants, FUZEHUB support

Thermoelectric
High efficiency, affordable solid state cooling and power generation

- Synthesis of Chalcogenides: High throughput microwave technology pathway to commercialization
- Characterization: Characterization of high ZT chalcogenide materials and iterative optimization

G. Ramanath
Distinguished Professor
RPI

Rutvik Mehta
CEO

Theodorian Borca-Tasciuc
Professor

Rutvik Mehta
CEO

Theodorian Borca-Tasciuc
Professor

Synthesis of Chalcogenides
High throughput microwave technology pathway to commercialization

Characterization
Characterization of high ZT chalcogenide materials and iterative optimization

High-throughput production technology for nanostructured thermoelectric materials
Visible Light Disinfection and Antimicrobial LED Research

- Company Need: third party to conduct fundamental applied research in infection control
- NYSERDA advanced building technology award for LED visible lighting investigation
- RPI CFES assistance in Faculty selection and CBIS Lab facilities identification
CFES Management Team

• Dr. Jian Sun, CFES Director
  jsun@rpi.edu 518-276-8297

• Martin Byrne, MBA 82 Director Business Development
  byrnem2@rpi.edu 518-276-6953

• Lisa Valenti, Administrative Specialist
  valenl@rpi.edu 518-276-6754

• Dr. Collin Hitchcock, Research Scientist, EMDL Supervisor
  hitchc@rpi.edu 518-276-3849

• Dr. Huan Guo, Research Scientist, DERSIL Supervisor
  huang@rpi.edu 518-276-8132

• Mike Austin, Business Administrator
  austim2@rpi.edu 518-276-6950
THANK YOU