

# **Sustainable Energy:**

## **Institute for Critical Technology and Applied Science (ICTAS)**

Shashank Priya

Director, Energy and Materials Initiative and  
ICTAS Sustainable Energy Thrust Leader

Dennis Grove

Program Manager, Sustainable Energy and Sustainable  
Water Thrusts

# ICTAS

**Vision:** To become among the top-rated institutes, globally, focused on transformative, interdisciplinary research (IDR) towards a sustainable future.

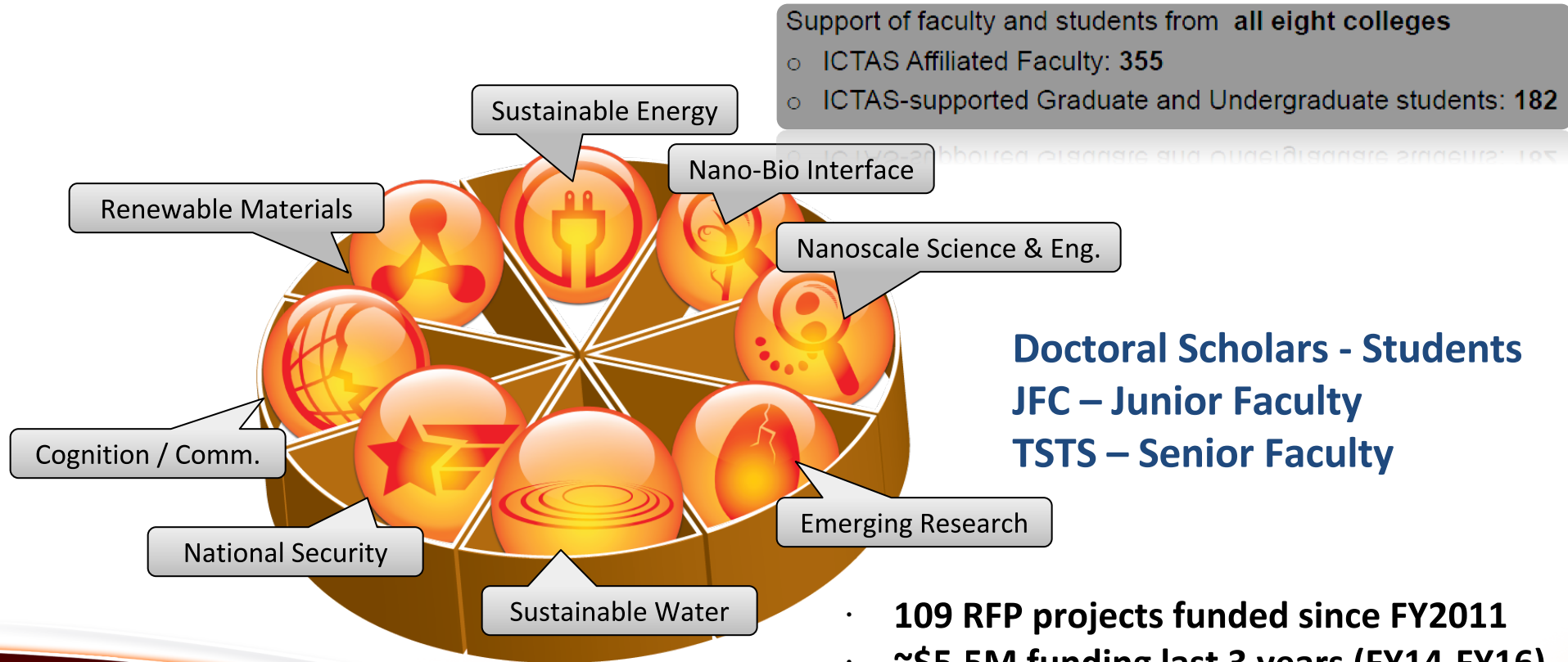
Major investments in high-impact, interdisciplinary/transdisciplinary research at the intersection of engineering, the sciences - physical, social and life - and the humanities

An investment institute – we support IDR efforts through:

- Seed research projects and centers
- Instrumentation
- Facilities
- Administrative and management support



# Research Thrusts

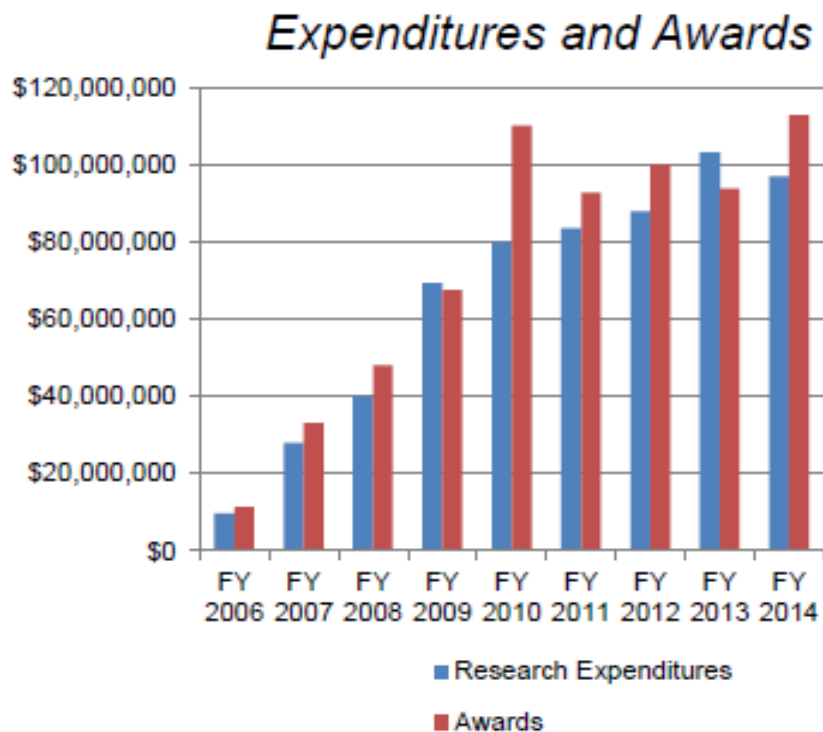


**Doctoral Scholars - Students**  
**JFC – Junior Faculty**  
**TSTS – Senior Faculty**

- **109 RFP projects funded since FY2011**
- **~\$5.5M funding last 3 years (FY14-FY16)**
- **59 Doctoral Scholars since 2007**

# ***Proposal activity/research awards***

- Proposals submitted by ICTAS and ICTAS- affiliated faculty: **\$588,063,358**
- Awards to ICTAS and ICTAS- affiliated faculty: **\$112,962,858**
- Research expenditures for ICTAS and ICTAS affiliated faculty: **\$97,070,468**





# ICTAS support of Wind and Water Energy Projects

- Understanding the Distortion of Atmospheric Turbulence Approaching a Wind Turbine, Devenport PI
- Bio-Inspired Technique for the Reduction of Wind Turbine Trailing Edge Noise, Devenport PI
- Turbulence in re... impact on large scale wind energy, Lo...
- Bio-inspired solu... better wildlife preservation, Ma PI
- Geotechnical Survey Strategies for Cost-efficient Ocean Renewable Energy Early Site Characterization, Stark PI
- Morphodynamic and Ecological Impacts of Marine Hydrokinetic Energy Extraction: A Multiscale, Interdisciplinary Approach, Xiao PI

**\$480,000**



ICTAS HQ



ICTAS CRC

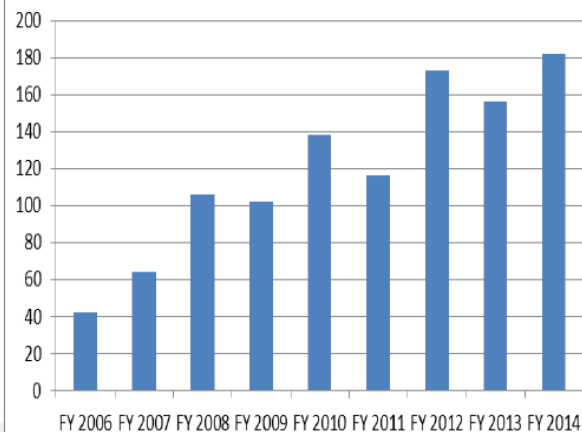


ICTAS LSC



ICTAS NCR

## Students Supported



## Global Outreach



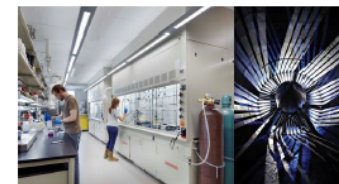
**Amrita Research Park  
Swaranabhoomi**

**VT, India ICTAS Innovation Center  
6,000 SF, with potential growth up to  
45,000 SF**

## ■ VT, India ICTAS Innovation Center

### Three Areas of Research:

- Materials & Sustainable energy
- Nanotechnology
- Cognitive Radio Communications



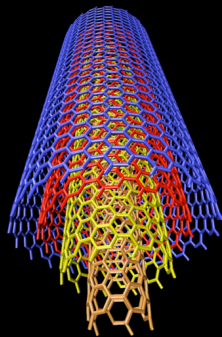
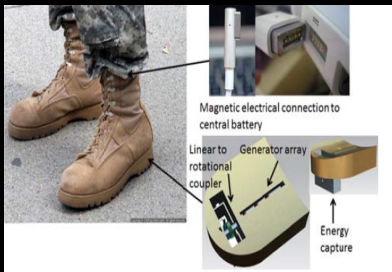
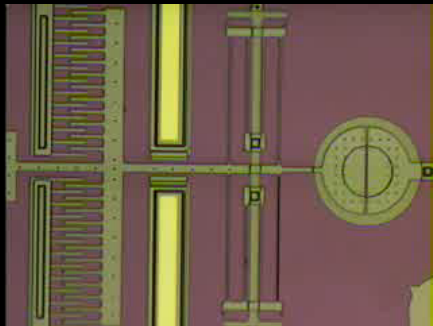
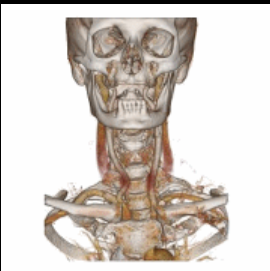
**UK**

**Chile**

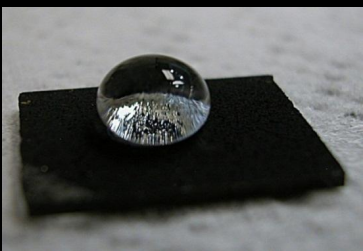
**Ghana**

**Australia**

**Inauguration on May 24, 2014.**



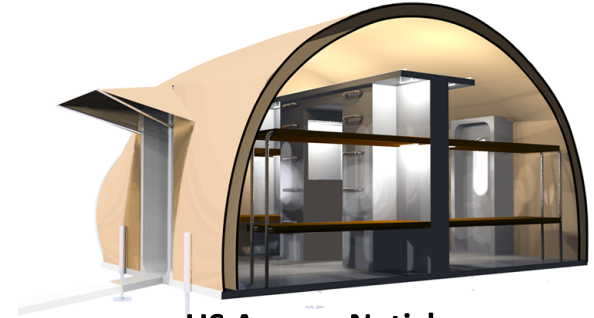
# ICTAS RESEARCH



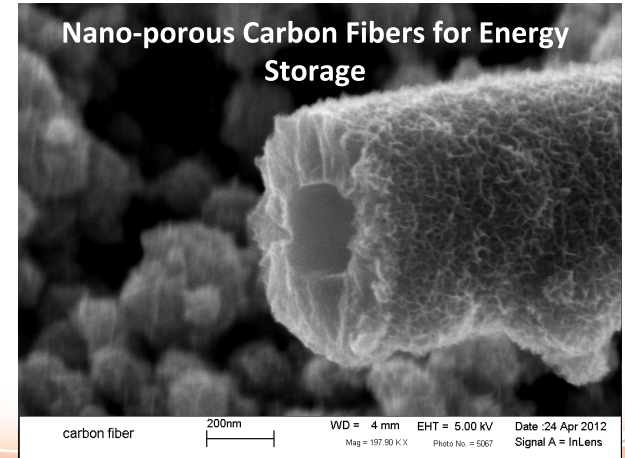
# ICTAS Sustainable Energy Thrust

Dedicated to discovering alternative energy resources based on renewable fuels or the efficient harvesting of energy from the natural world.

- Wind and Water Power
- Center for Power Electronic Systems
- NSF I/UCRC Center for Energy Harvesting Materials and Systems
- Photovoltaic Technology
- Electrochemical Energy Conversion and Storage



US Army – Natick  
Self-sustaining Living Module



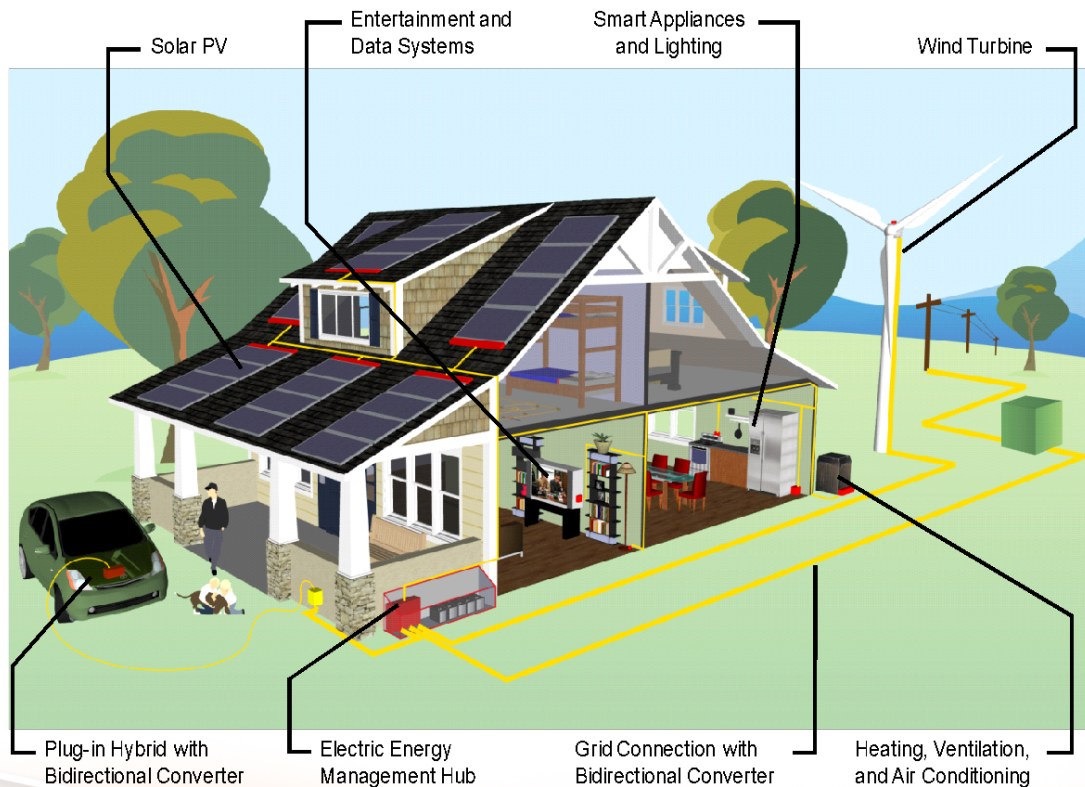


# CPES Renewable Energy and Nanogrids

## Mini-Consortium

### Work Scope:

- PV Systems
- Wind Power
- Battery Storage
- Nanogrid Architectures
- Hybrid Electric Vehicles
- Energy Management
- Solid State Lighting





# Center for Energy Harvesting Materials and Systems



## NSF Industry/University Cooperative Research Center

### Technical Thrusts

#### Thermal

Thermoelectrics  
Phase change materials  
Concentrated solar power



Ray Baughman (UTD)  
Scott Huxtable (VT)

#### Mechanical

Turbines (Wind, water, ...)  
Vortex induced vibrations  
Tensegrity structures  
Piezoelectric, electromagnetic,  
Electrostatic, electret, elastomers



Walter Voit (UTD)  
Muhammad Hajj (VT)

#### Chemical

Batteries, Supercapacitors  
Photovoltaics, Scattering  
Fuel cells and Bio-processes, Piezoelectrics  
Materials characterization (TGA-MS-FTIR)



D. Smith (UTD)  
Mike Ellis (VT)

#### Power Electronics and Communications

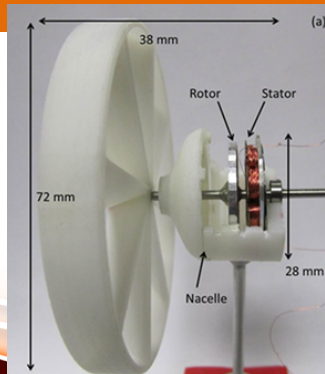
Low power energy harvesting circuits  
Wireless radios  
Wireless power transfer  
RF energy

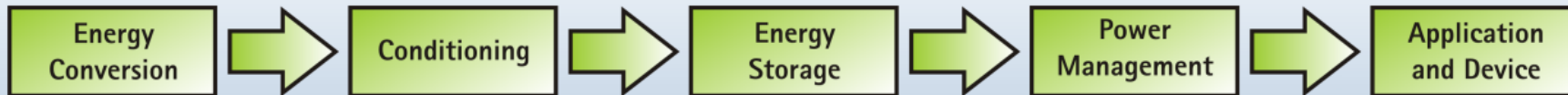


Duncan MacFarlane (UTD)  
D. Ha (VT)

### Research Highlights

- Demonstrated world's best power density for micro-wind turbine
- Demonstrated world's highest piezoelectric sensitivity for vibration energy harvesting
- Filed patent on inductive energy harvesting technology

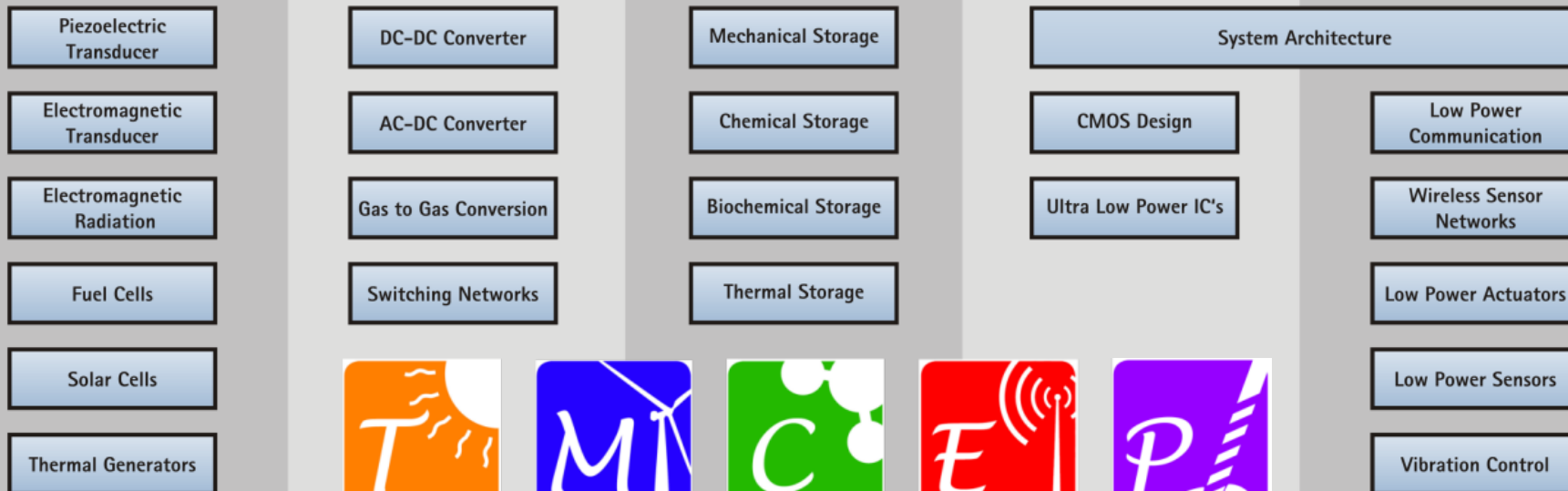




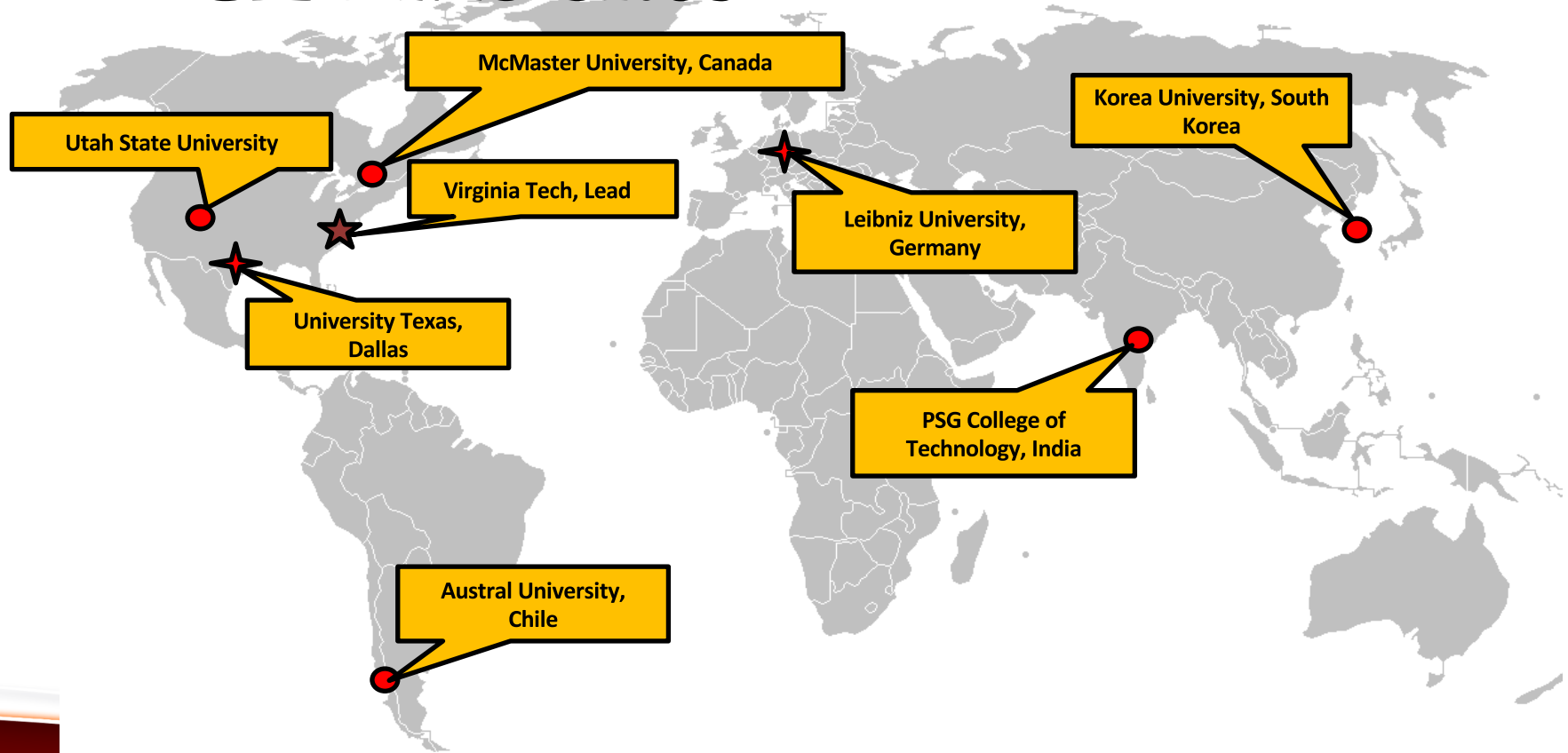
System Modeling and Characterisation of Energy Harvesting Devices

Production Technologies for Energy Harvesting Systems

Multi Criteria Analysis and System Optimization



# CEHMS Sites







## Center for Renewable Energy and Aerodynamic Testing

Researchers devoted to enabling wind and  
water power at utility scale

Nationally recognized expertise

World-leading Facility



K. Todd Lowe



William Devenport



Aurélien Borgoltz



Ricardo Burdisso



Eric Paterson



Lin Ma



Seongim Choi

Dennis Grove, ICTAS

Nathan Alexander, AOE

George Hagerman, VT ARI

Nanya Intaratap, AOE

Sara Karpanty, FWC

Leigh McCue, AOE

Matt Kuester, AOE

Wing Ng, ME

Michael Philen, AOE

Nina Stark, CEE

Heng Xiao, AOE

# Summary

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Sustainable Water Thrusts  
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<b>Nanoscale Science and Engineering</b>	Environmental Nanoscience and Technology   Nanomaterials including carbonaceous materials   Nanosensors
<b>Nano-Bio Interface</b>	Targeted Delivery of Nano-medicine   Cellular Engineering Microsystems   Non-invasive Sensing and Diagnosis   Inflammation   Bio-Imaging
<b>Sustainable Energy</b>	Fuel Cells   Organic Photovoltaics   Biologically Derived Fuels   Energy Harvesting   Clean Coal Energy
<b>Renewable Materials</b>	Bio-based Materials: Design and Processing
<b>Sustainable Water</b>	Water Infrastructure Management   Waste Water Treatment   Water Shed Management   Water & Health
<b>Cognition and Communication</b>	Cognitive Radio Networks   Autonomous Secure Communications   Human Computer Interface
<b>Homeland Security</b>	Naval Surface Warfare Center Dahlgren Division (NSWCDD)   DARPA, NASA
<b>Emerging Research</b>	Complex Network Systems   Accelerating Scientific Discovery through Data Mining   Personal Health Informatics   Humanoid Hospital