

# Engaging Academia: Creating Productive Networks

*PRESENTED BY*

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# What is “Academic Engagement?”




**DOE Office of Electricity  
Energy Storage Research Program**





**Pacific Northwest National Laboratory (PNNL)**



**Sandia National Laboratories (SNL)**



**Oak Ridge National Laboratory (ORNL)**



## Why Team with Academia?



HOW do academic partnerships fit into the DOE core mission?

- OE drives electric grid modernization and resiliency in the energy infrastructure.
- OE leads the Department of Energy's efforts to ensure a resilient, reliable, and flexible electricity system.
- OE accomplishes this mission through **research, partnerships**, facilitation, modeling and analytics, and emergency preparedness.

### A 2-Way Collaborative Partnership

- Universities provide access to creative ideas, expertise, and fundamental scientific research.
- National Laboratories provide leadership and direction, with multiscale energy storage expertise, and facilities that may be difficult for academic PIs to access.
- Vehicle for staffing and career development.



## *What is expected from an academic collaborator?*

These are supported collaborations, not grants, so...

- ✓ Be involved and communicate with your National Lab team in an open and timely manner.
- ✓ Have passion! Bring new ideas to a program and challenge the ideas of others.
- ✓ Support students and postdocs.
- ✓ Perform high quality, impactful, and *purposeful* work in *collaboration* with your team.
- ✓ Disseminate your results:
  - Publications
  - Presentations
  - Patents

\*\*\* *(Please properly acknowledge support from Dr. Gyuk's program in the DOE Office of Electricity!)*

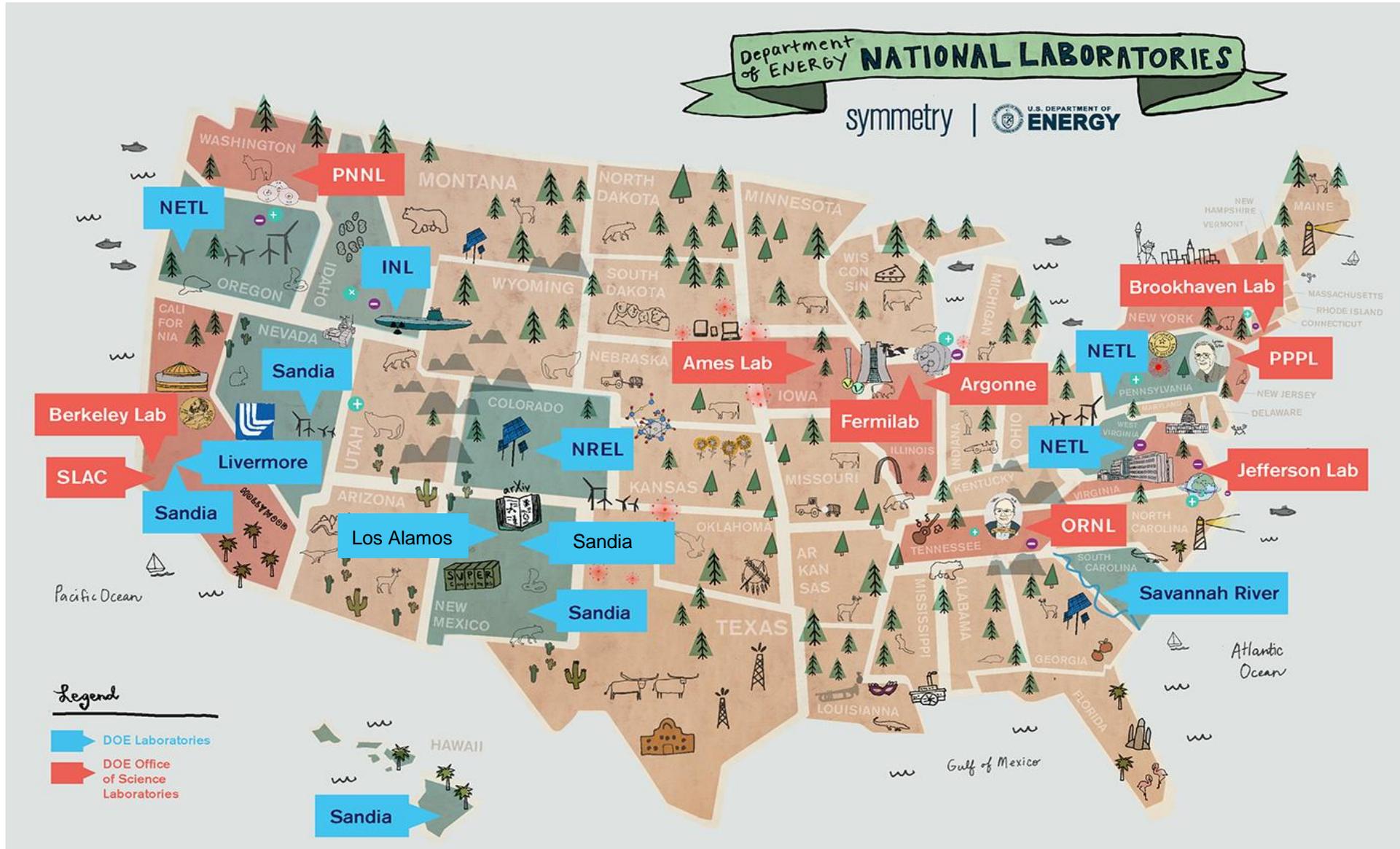
## *How does someone become an academic collaborator?*

There is no “magic formula” for joining the OE team.

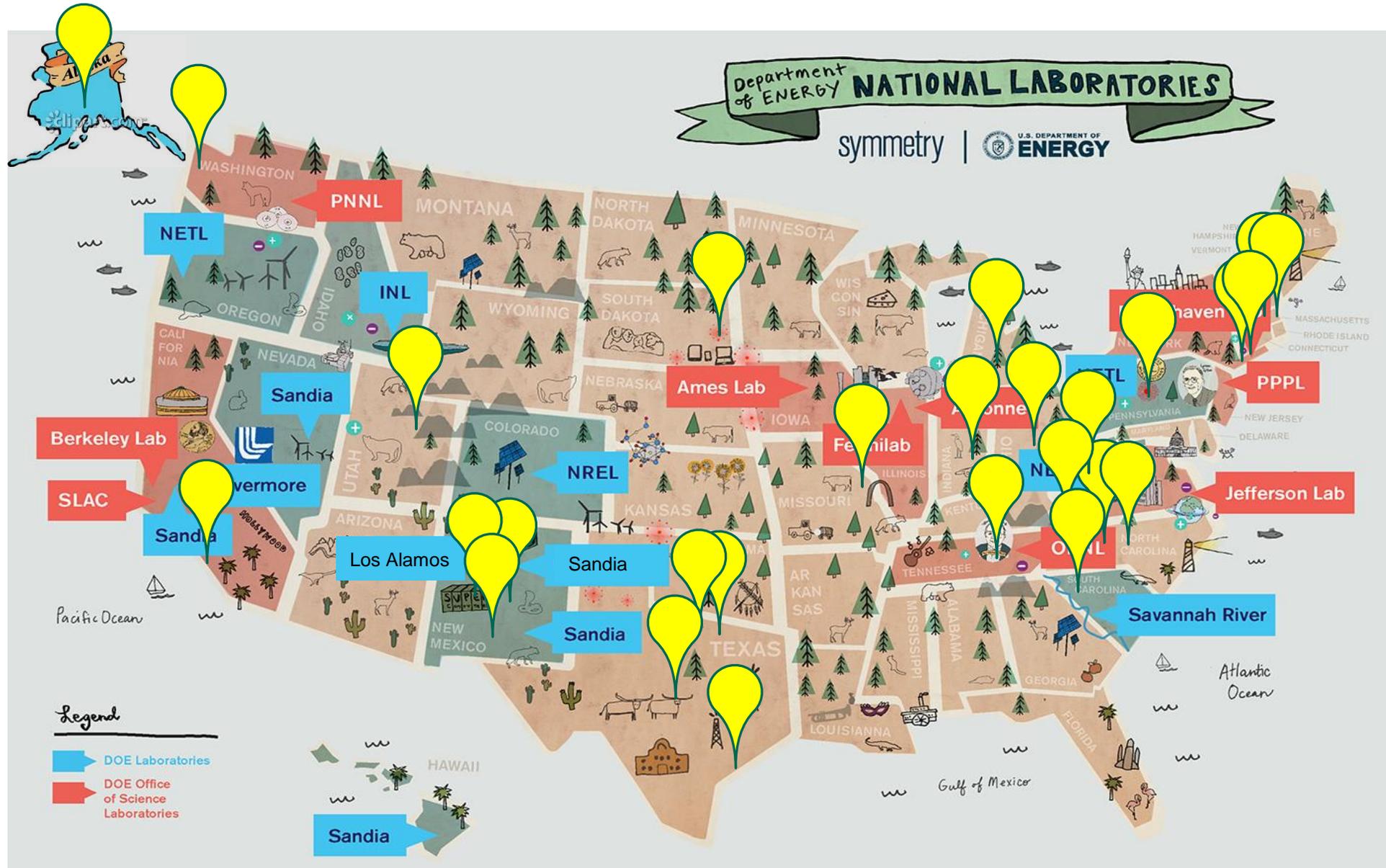
*A few good ideas:*

- Get to know the OE program.
- Talk to the Principal Investigators, Program Managers, Lab Leadership, OE Program Head (Dr. Gyuk).
- Become an integral part of a big vision!

# DOE National Laboratories



# Diverse and Widespread DOE OE Academic Partners





**Professor Michael Aziz** (Harvard University - PNNL)

Project: Aqueous Soluble Organic Molecules and Electrode Development

**Professor Tom Zawodzinski** (University of Tennessee - ORNL)

Project: Component Research for Redox Flow Batteries and Open Batteries

**Professor Mitch Anstey** (Davidson College - SNL)

Project: Synthesis of Electrolytes with Multielectron Redox Processes

**Professor Venkat Subramanian** (University of Washington/University of Texas, Austin - SNL, PNNL)

Project: Modeling and Simulation of Vanadium Redox Flow Batteries

Project: Quantifying capacity fade mechanisms, transport, and kinetic parameters for Li-ion batteries

**Professor Jesse Wainright** (Case Western Reserve University - PNNL)

Project: Electrokinetic Evaluation of Redox Organic Molecules

**Ellen Matson** (University of Rochester) - Unfunded collaboration with SNL

Project: Polynuclear Charge Carriers for Nonaqueous Electrochemical Energy Storage

**Christopher Bejger** (University of North Carolina at Charlotte) - Unfunded collaboration with SNL

Project: Radialene Radicals for Aqueous Redox Flow Batteries

## Zinc-Based Battery Collaborations



**Professor Sanjoy Banerjee** (City University of New York, CUNY Energy Institute, Urban Electric Power - SNL)

Project: Stable Zinc Anodes for High Energy Density Rechargeable Aqueous Batteries (CUNY)

Project: Advanced Manufacturing Research: Creating Roadmap to \$50/kWh for Zn-MnO<sub>2</sub> Batteries

**\*Brenden Hawkings, Snehal Kolhekar, Jinchao Huang, Valerio De Angelis**

\*\*\* U.S. EPA's Green Chemistry Challenge Energy Award (June, 2019)

“Rechargeable Alkaline Zn-MnO<sub>2</sub> Batteries for Grid Storage Applications”

**Dr. Gautam Yadav** (CUNY Energy Institute, Urban Electric Power - SNL)

Project: Manufacturable Low-Cost MnO<sub>2</sub> Birnessite Cathode



**Professor Josh Gallaway \*(Andrea Bruck)** (Northeastern University - SNL)

Project: Understanding Phase Change Processes of Energy Storage Materials

**Professor Esther Takeuchi \*(Amy C. Marschilok)** (Stony Brook University - SNL)

Project: Battery Systems Based on Naturally Abundant, Low Cost Materials

**Professor Igor Vasiliev \*Birendra Ale Magar** (New Mexico State University - SNL)

Project: Computational Modeling of Zn-MnO<sub>2</sub> Alkaline Batteries

**Professor Xingbo Liu** (West Virginia University - PNNL)

Project Title: Advanced Manganese Oxide-Based Cathodes for Rechargeable Aqueous Zinc-ion Batteries

## Sodium-Based Battery Collaborations



Professor Yang-Tse (YT) Cheng (University of Kentucky - SNL)

Project: Characterizing Separators and Membranes for Low Temperature NaX Batteries and Aqueous Zn-MnO<sub>2</sub> Batteries.

Professor Donghai Wang (Pennsylvania State University - PNNL)

Project: Development of Sulfide based Solid State Electrolytes for Na-ion Batteries.

Professor David Mitlin (University of Texas at Austin - ORNL)

Project: Development Na-ion Cathodes and their electrochemical performance testing in full cell configuration with hard carbons and alloy anodes.

## Power Electronics Collaborations



Professor (Provost) Enrique Lavernia (University of California, Irvine - SNL)

Project: High Frequency Link Converters/Advanced Magnetics

Professor Bruce Gnade (Southern Methodist University - SNL)

Project: Dielectric Breakdown of Capacitors

Professor Mariko Shiraji (University of Alaska, Fairbanks - SNL)

Project: Medium voltage DC-DC Power Converters

Professor Zhong Chen (University of Arkansas)

Project: Design and Fabrication of High-Temperature Optocoupler For High-Density Power Module

## Validated Safety and Reliability Collaborations



**Professor Raja Kaushik \*(Harish Sarma Krishnamoorthy)** (University of Houston - SNL)

Project: Predicting Reliability, Improving Safety and Reliability in Grid Energy Storage Systems

**Professor Satish Ranade** (New Mexico State University - SNL)

Project: Advanced PCS Topologies using WBG-materials

Project: Panel Integrated Storage for Firm Renewables

**Professor Alex Huang** (University of Texas at Austin - SNL)

Project: Low Voltage and High Current Bidirectional Converter for Grid-tied Flow Battery Energy Storage System

**Professor Wei-Jen Lee** (University of Texas at Arlington - SNL)

Project: Dynamic Short Circuit Model of Battery Storage System for DC Arc Flash Analysis

**Professor Anant Agrawal \*(Kristen Booth)** (The Ohio State University - SNL)

Project: Medium-voltage Power Electronics for Grid-tied Energy Storage Applications

**Professor Mike Hargather \*(Frank Austin Mier)** (New Mexico Institute of Mining and Technology - SNL)

Project: Rechargeable Battery Abuse - *in situ* and *ex situ* Studies

# Energy Storage Analytics and Controls Collaborations



Professor William Pickard (Washington University in St. Louis)

Project: Modeling & Economic Analysis of Large Storage Plants

Professor Joydeep Mitra (Michigan State University - SNL)

Project: Holistic Optimization Framework for Grid Integrated Energy Storage

Professor Marsood Parvania (University of Utah)

Project: Optimal Dispatch of Energy Storage

Professor Reinaldo Tonkoski (South Dakota State University )

Project: Integrating Virtual Inertia in Energy Storage Systems and Energy Markets

Professor Pierluigi Pisu (Clemson University)

Project: Distributed Control Algorithms Wide-Area Power Grids using Energy Storage

# DOE OE Collaborations Enable Early Career Development



Ryan Hill



AIChE regional Chem E-Car champions!

Undergraduate  
at University of  
New Mexico

Student Intern at  
Sandia National  
Laboratories

Graduate Student with  
Professor YT Cheng at  
University of Kentucky

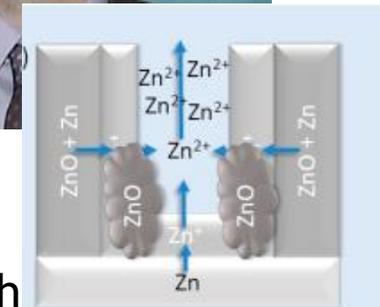
Dr. Reed  
Wittman



Graduate Student at  
University of Tennessee  
with Tom Zawodzinski

OE-supported  
collaborations with  
ORNL and SNL

OE-funded postdoc  
at SNL (started late  
summer, 2019)



Wittman, et al. (2019) *J Power Sources* **438**, 227034.

# A Summary of Academic Engagement



A diverse academic portfolio

- 30 Partnering Universities (more than \$2M in funding)

Universities are actively engaged across the DOE OE Energy Storage program:

- 28 presentations at peer review!
  - Battery materials
  - Power electronics
  - Safety and Reliability
  - Analytics and Controls

Universities and National Labs form collaborative relationships!

- Joint expertise and new ideas
- Avenues to industrial engagement
- Career Development

These partnerships are a key part of the DOE efforts to ensure a resilient, reliable, and flexible electricity system

# Thanks and Acknowledgements



THANK YOU!



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Pacific Northwest National  
Laboratory (PNNL)



Sandia National  
Laboratories (SNL)



Oak Ridge National  
Laboratory (ORNL)

Vincent Sprenkle / Wei Wang  
David Reed

Babu Chalamala

Michael Starke