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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)

What is "Academic Engagement?"

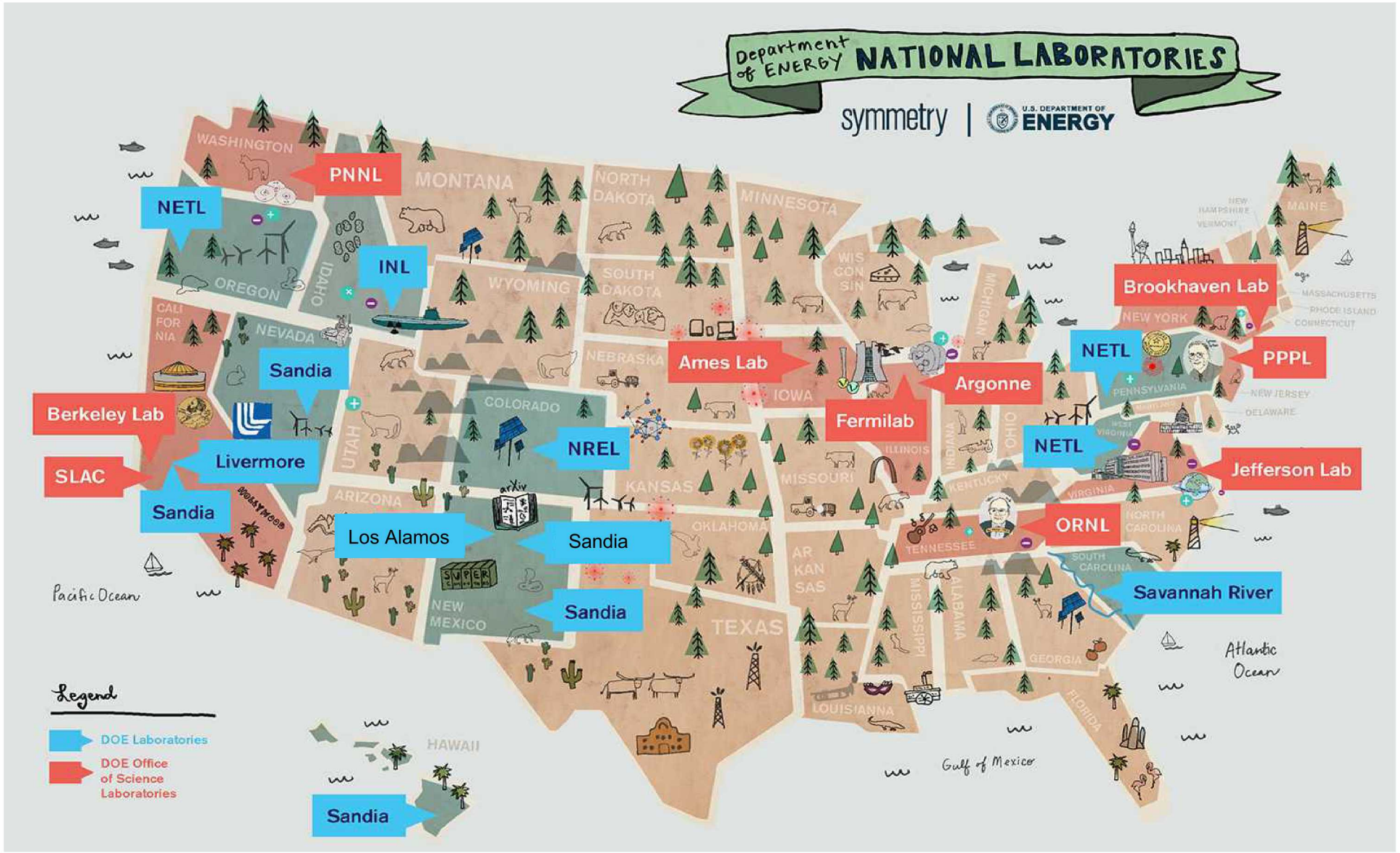
HOW do academic partnerships fit into the DOE core mission?

- 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.

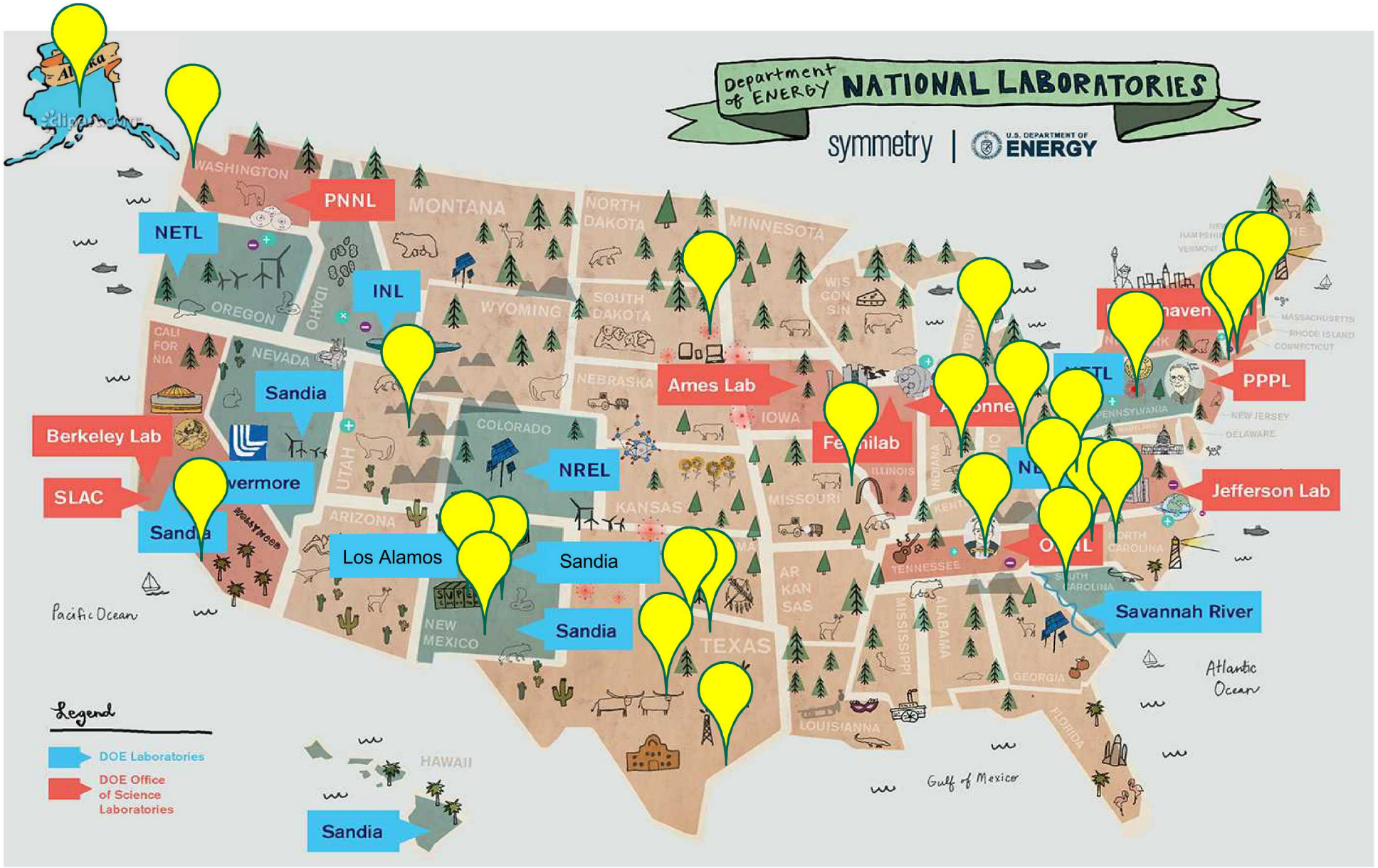
A two-way collaborative synergy:

- 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.

DOE National Laboratories



Diverse and Widespread DOE OE Academic Partners



Flow Batteries

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 Batteries

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_2$ Batteries

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

*** U.S. EPA's Green Chemistry Challenge Energy Award (June, 2019)
"Rechargeable Alkaline Zn-MnO2 Batteries for Grid Storage Applications"

Dr. Gautam Yadav (CUNY Energy Institute, Urban Electric Power – SNL)
Project: Manufacturable Low-Cost MnO2 Birnessite Cathode

Professor Josh Galloway *(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_2 Alkaline Batteries

Professor Xingbo Liu (West Virginia University - PNNL)
Project Title: Advanced Manganese Oxide-Based Cathodes for Rechargeable Aqueous Zinc-ion Batteries

Sodium-Based Batteries

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

Project: Characterizing Separators and Membranes for Low Temperature NaX Batteries and Aqueous Zn-MnO_2 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

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

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

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

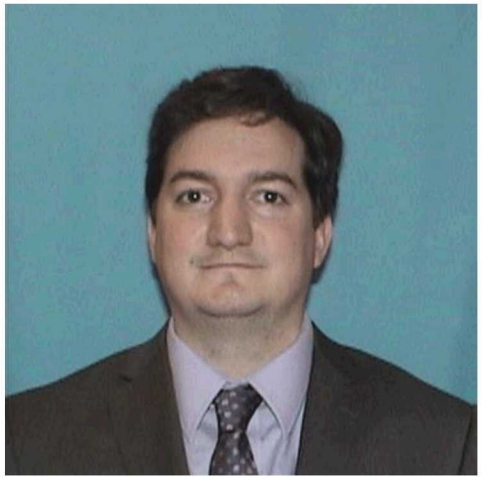
AIChE regional Chem E-Car champions!

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)

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!

These collaborations would not be possible without the support of the DOE Office of Electricity's Energy Storage Research Program, managed by Dr. Imre Gyuk.

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Pacific Northwest National Laboratory (PNNL)

Vincent Sprenkle / Wei Wang
David Reed

Sandia National Laboratories (SNL)

Babu Chalamala

Oak Ridge National Laboratory (ORNL)

Michael Starke