

Renewable Energy: Integrated Energy Harvesting and Storage:

NSF EPSCoR Track I Proposal
Stillwater, Oklahoma
November 17, 2011

Energy Generation

- Electric Energy Generation Capacity = 20 terawatt hours*
 - Coal 42%
 - Natural gas 21%
 - Oil 5%
 - Nuclear 14%
 - Hydro 15%
 - Renewable Energy Technologies only 3%

*World Energy Outlook 2010; International Energy Agency: Paris, 2010.

Energy: The Mainstay of Oklahoma Since Statehood

- Oil Industry
- Recently BioEnergy

Future Energy Research in Oklahoma

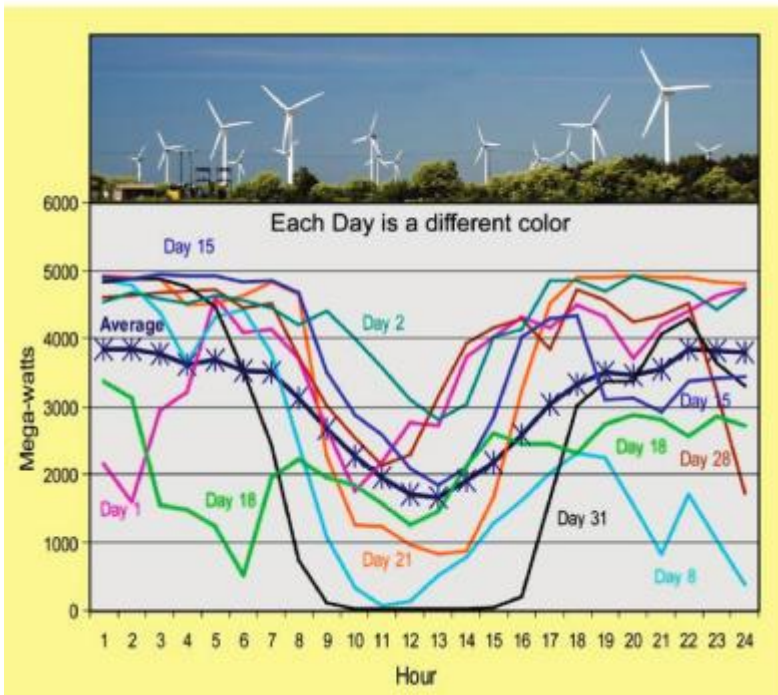
- Energy Harvesting and Storage

Renewable Energy

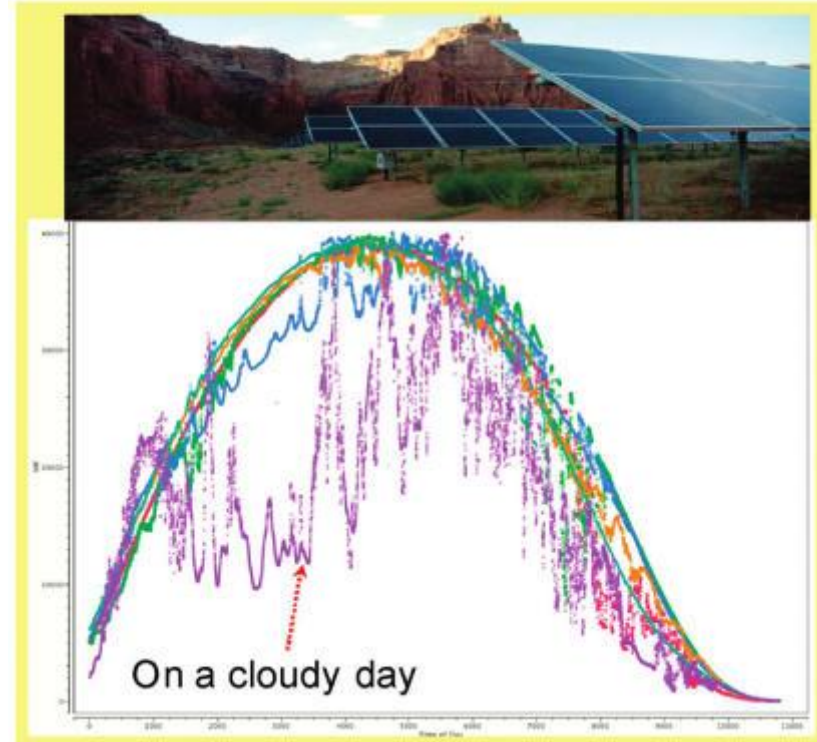
- Solar
- Wind

Energy Harvesting and Storage Must be Coupled

(a)

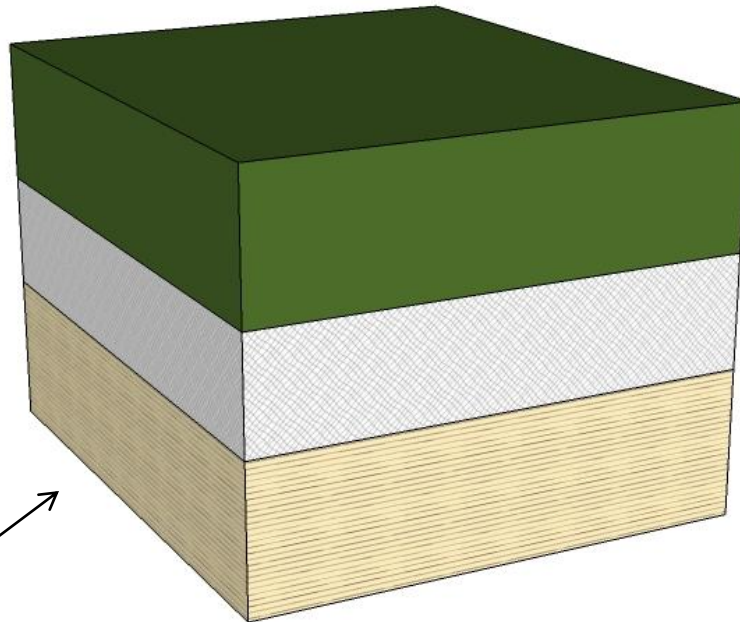
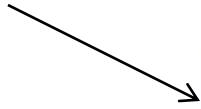


(b)



Couple the Harvesting of Energy and Its Storage with a Smart Interface

Energy Harvesting



Energy Storage



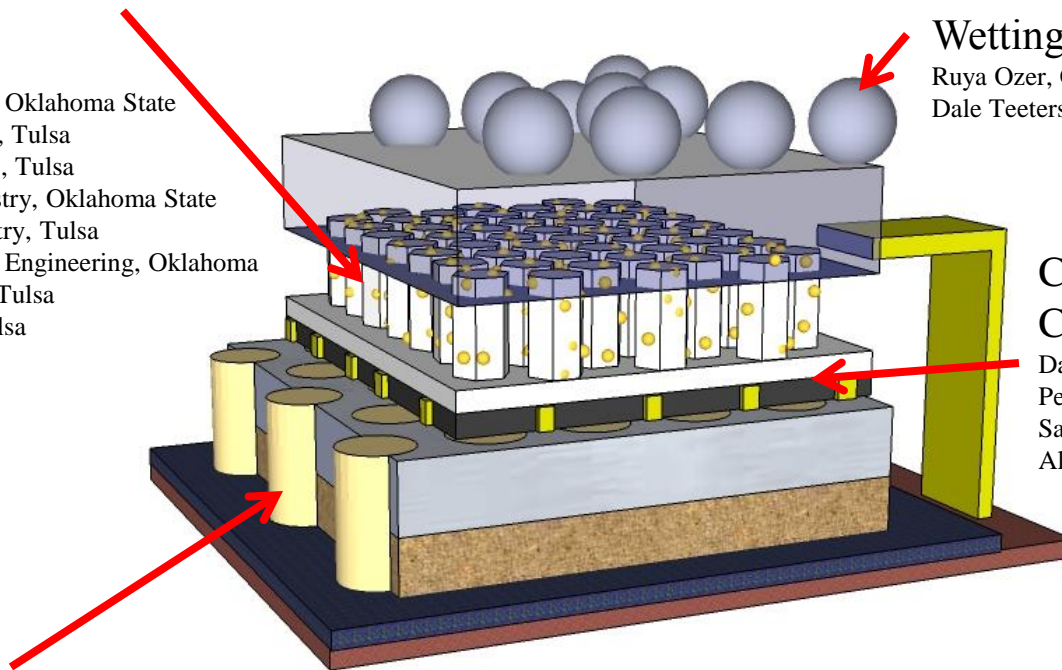
Integration of
Energy Collection
and Storage



Example: Integrated Light Harvesting with Battery Storage

Photovoltaic: Nanorods Decorated with Quantum Dots:

Allen Apblett, Chemistry, Oklahoma State
Alexei Grigoriev, Physics, Tulsa
Paramewsar Hari, Physics, Tulsa
Nicholas Materer, Chemistry, Oklahoma State
Kenneth Roberts, Chemistry, Tulsa
Alberto Striolo, Chemical Engineering, Oklahoma
Dale Teeters, Chemistry, Tulsa
Sanwu Yang, Physics, Tulsa



Self-cleaning Surface for Photovoltaic: Wetting “tuned” Nanoparticles:

Ruya Ozer, Chemistry, Tulsa
Dale Teeters, Chemistry, Tulsa

Control Using Carbon Electronics

Daniel Resasco, Chemical Engineering, Oklahoma
Peter Hawrylak, Electrical Engineering, Tulsa
Sanwu Wang, Physics, Tulsa
Alberto Striolo, Chemical Engineering, Oklahoma

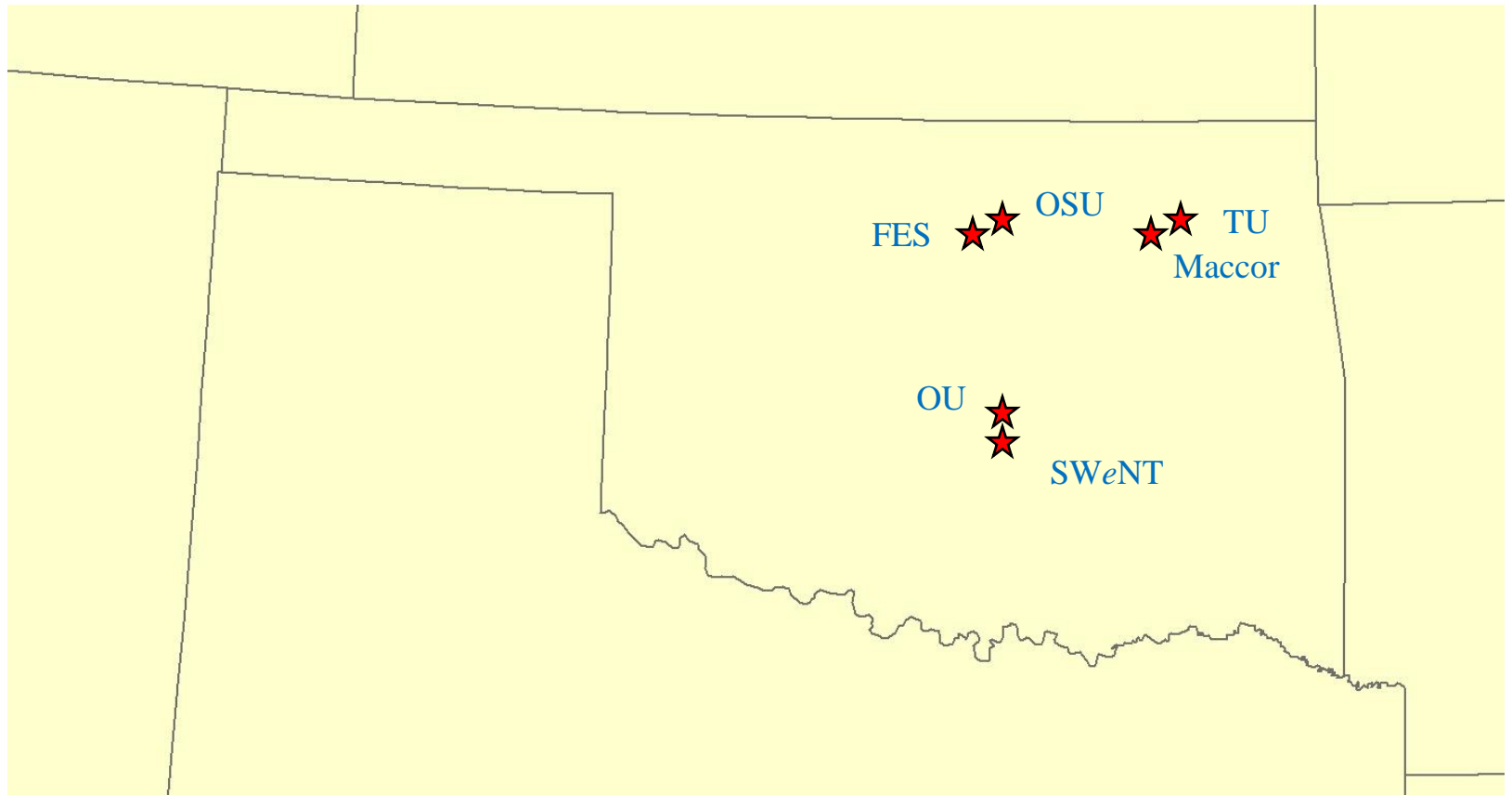
Enhanced and Distributive Power Storage by Using Nanobattery Configuration:

Dale Teeters, Chemistry, Tulsa
Daniel Resasco, Chemical Engineering, Oklahoma
Sanwu Yang, Physics, Tulsa
Alberto Striolo, Chemical Engineering, Oklahoma

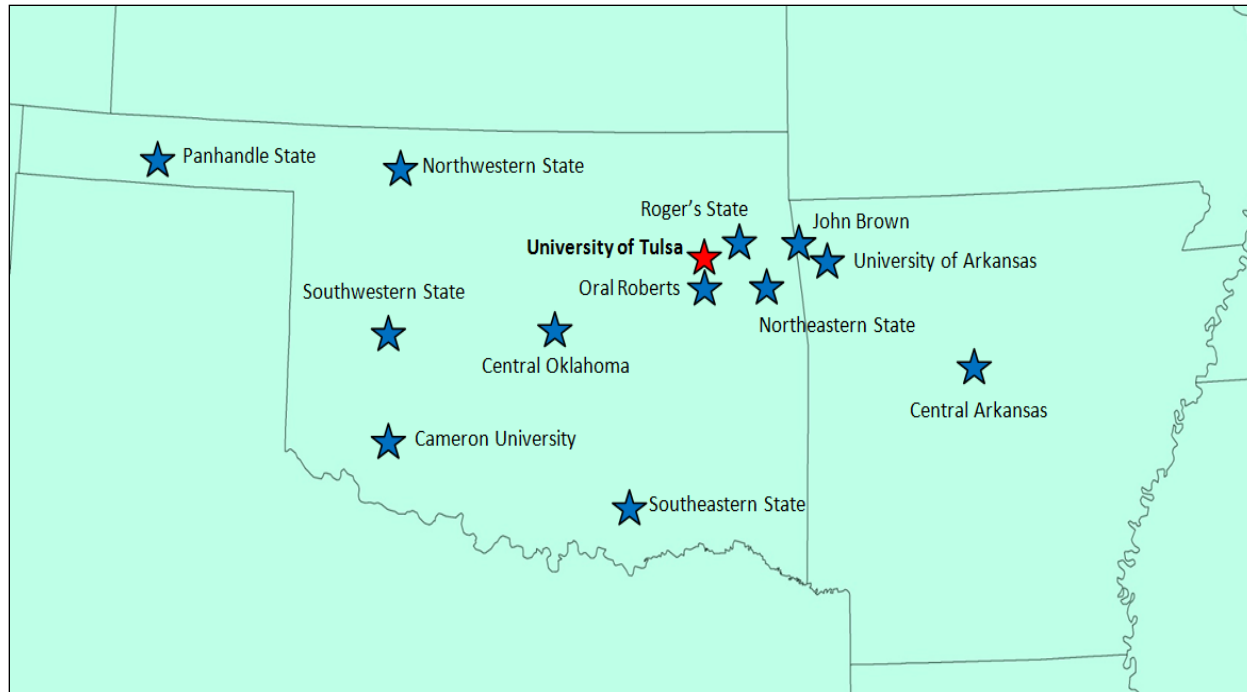
Physical and Mechanical Properties:

Alexei Grigoriev, Physics, Tulsa
Michael Keller, Mechanical Engineering, Tulsa
Nicholas Materer, Chemistry, Oklahoma State
Dale Teeters, Chemistry, Tulsa

University and Industrial Partners



Greater Impacts, Outreach



Research Funding and Collaborations

- NSF
- DOE
- NASA
- DoD
- Local Industry

Team Members (so far)

- Allen Apblett, Chemistry, Oklahoma State
- Alexei Grigoriev, Physics, Tulsa
- Peter Hawrylak, Electrical Engineering, Tulsa
- Paramewsar Hari, Physics, Tulsa
- Friederike Jentoft, Chemical Engineering, Oklahoma
- Michael Keller, Mechanical Engineering, Tulsa
- Nicholas Materer, Chemistry, Oklahoma State
- Ruya Ozer, Chemistry, Tulsa
- Daniel E. Resasco, Chemical Engineering, Oklahoma
- Kenneth Roberts, Chemistry, Tulsa
- Alberto Striolo, Chemical Engineering, Oklahoma
- Dale Teeters, Chemistry, Tulsa
- Sanwu Wang, Physics, Tulsa