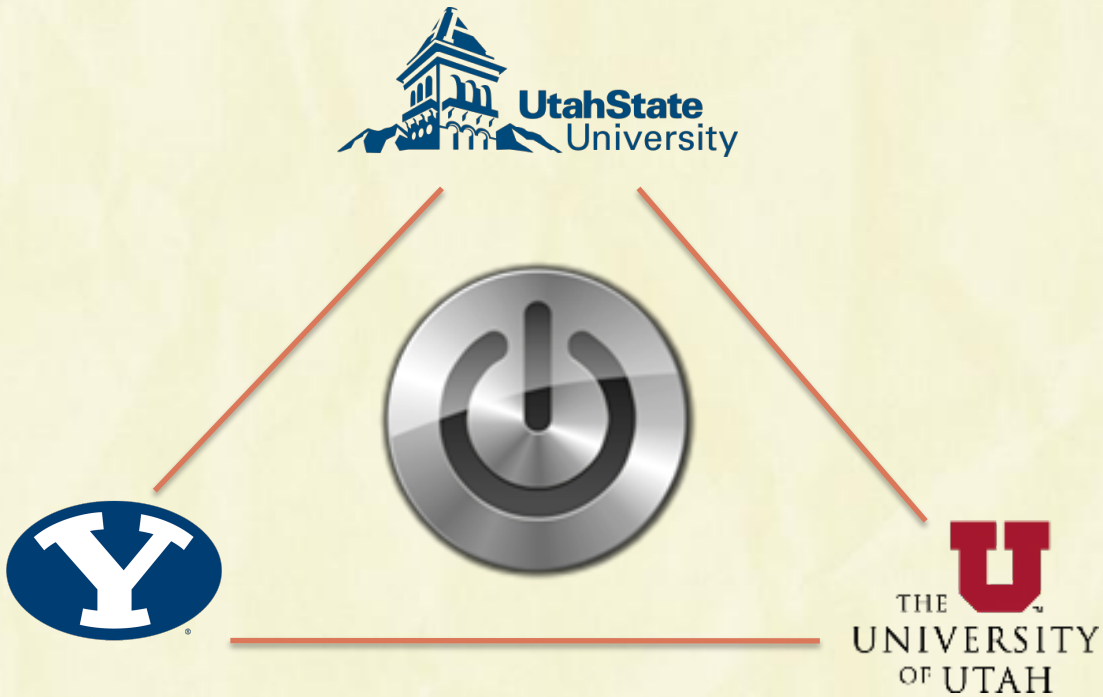
Powering the Energy Research Triangle

A competitive and collaborative proposal designed to tackle Utah's biggest energy challenges



Alan Walker

Director, USTAR Technology Outreach and Innovation Program

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Powering the Energy Research Triangle

- Introduction
- Why is Utah launching an Energy Research Triangle
  - 10 Year Energy Plan: Principles, Goal, Cross-cutting strategies
  - Governor Gary Herbert – Cody Stewart – Al Walker
- What are the innovation assets we are capitalizing on
  - U of U: Energy & Geoscience Institute (EGI), Institute for Clean & Secure Energy (ICSE), Energy Commercialization Center (ECC)
  - Utah State University (USU) world-class research in water management, air quality, sensor technology
  - Brigham Young University (BYU) world-class research in combustion, carbon capture
  - Industry – vertically integrated from development and production to transmission and distribution to utilization
  - Resource Base – R&D in conventional, unconventional, renewable, efficiency
- The Energy Research Triangle Plan
  - Vision, Mission, Strategic Objectives, Metrics , Strategic Initiatives, Organization Structure, Budget
- Discussion and Q and A

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Introducing Utah Energy Research Triangle Management: Al Walker

Al Walker: Executive Director of Utah's Energy Research Triangle and Senior Advisor, EGI (Energy & Geosciences Institute, University of Utah)

- 25+ years of energy industry experience with General Electric, Amoco, and Questar in production engineering, storage, transmission, distribution, and regulatory affairs.
- 5 years as Director of USTAR's Technology Outreach Program for Eastern Utah
- Retired US Army Special Operations Officer

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2012: 10 Year Strategic Energy Plan

Governor Gary R. Herbert
Energy Initiatives & Imperatives
Utah's 10-Year Strategic Energy Plan

- Call to Action: Ensure access to affordable, reliable and sustainable energy by producing 25% more electrical energy than we consume by 2020.
- Objective 1: Advocate responsible energy resource development.
- Objective 2: Promote policies and practices for improved air quality.
- Objective 3: Aggressively pursue <u>technology innovations in energy efficiency and development.</u>

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The Governor's 10-year Energy Plan: 2012

The Energy Plan's 8 Strategic Initiatives

1. Establish an Energy Office (HB475)
2. Develop Plans to Keep Public Lands Open
3. Enhance Technology Advancement
4. Review Role of Tax Incentives
5. Increase Regulatory/ Licensing Transparency
6. Reduce Energy Consumption State-Wide
7. Diversify Transportation Fuels
8. Lay Foundation for Base Load Growth

The Energy Research Triangle is directly focused on the accomplishment of Initiative 3 and "Innovation" in general can play a role in Initiatives 6,7 and 8

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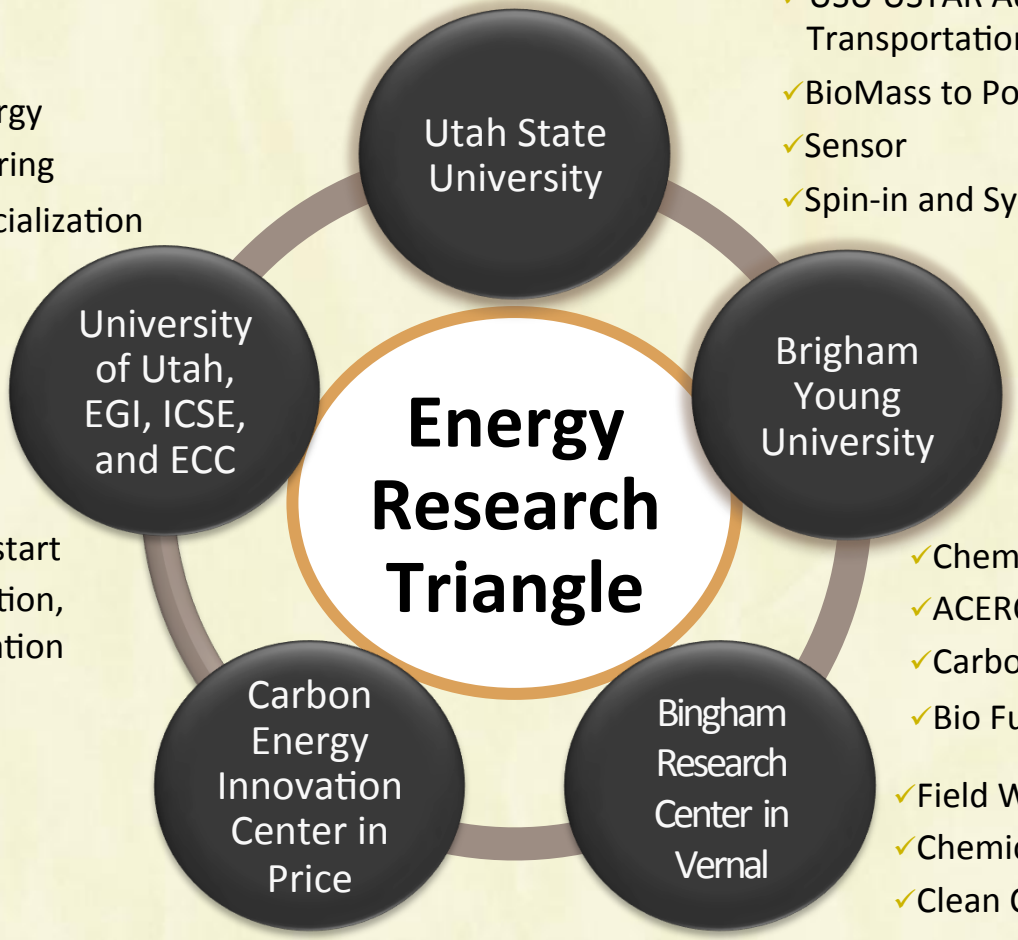
Resources: Infrastructure

- ✓Fossil Energy
- ✓Geothermal Energy
- ✓ Carbon Engineering
- ✓Energy Commercialization Center (ECC)

Utah Industry

- ✓EGI Associates
- ✓Renewable Tech Ventures and Kickstart
- ✓R&D, E&P, Generation, Transmission, Utilization



- ✓ USU USTAR Advanced Transportation Institute
- ✓BioMass to Power
- ✓Sensor
- ✓Spin-in and Systems Integration

- ✓Chemical Engineering
- ✓ACERC (Combustion)
- ✓Carbon Capture
- ✓Bio Fuels

- ✓Field Work/prototyping
- ✓Chemical Analysis
- ✓Clean Coke

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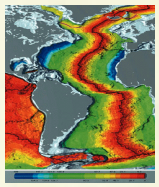
EGI Infrastructure

EGI

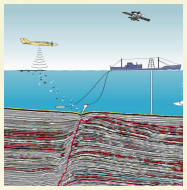
Energy & Geoscience Institute
College of Engineering at the University of Utah

EGI…*the science to find energy* Calgary - Houston - London - Salt Lake - Bratislava - Sydney - Tripoli

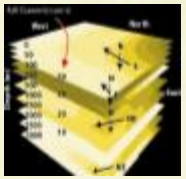
Core Strengths



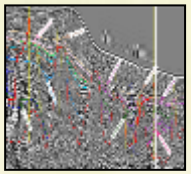
Structure



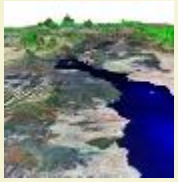
Geochemistry



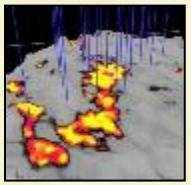
Metocean



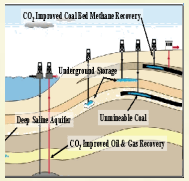
Chronostratigraphy



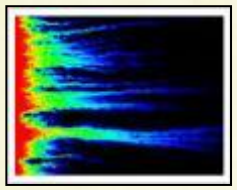
Satellite & GIS Analysis



Visualization



Carbon Engineering



Reservoir Geomechanics & Tracers

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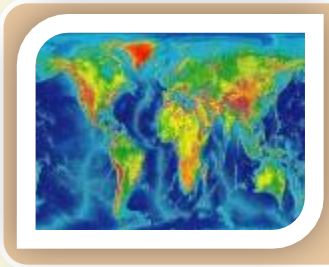
EGI Core Research Programs



Fossil Energy

- Industry Membership - Governments
- Exploration & Production – 62 countries

Geothermal Energy

- US DOE & Industry
- Hydrothermal and Enhanced Systems

Carbon Engineering

- Climate Mitigation
- CO2 Storage & Sequestration

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U of U's ICSE Infrastructure

Computational and Pilot Scale Facilities

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Institute for Clean and Secure Energy:
Cradle to grave R and D for Coal

Near-term solutions

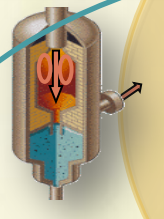
Above Ground

Pulverized Coal Boilers

- USC corrosion
- Hg control
- models for sorbent injection

Simulation

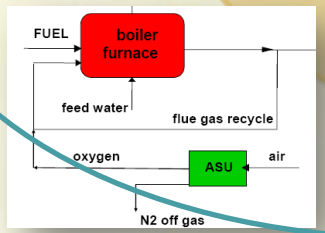
Gasifiers



- C/CO_2 & C/H_2O kinetics
- ash deposition
- refractory wear
- one-dimensional-turbulence model of 2-phase flow

Medium -term solutions

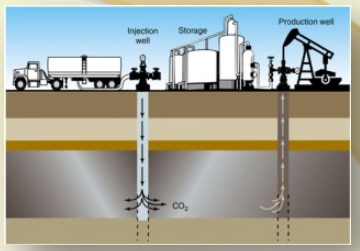
Oxy-Fuel Combustion



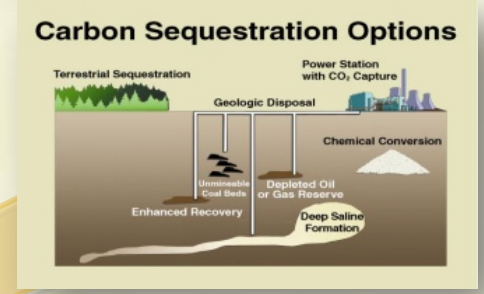
- coal injector studies
- Ash partitioning
- Oxy CFB

Below Ground

CO_2 Sequestration



- contaminants
- model mixing CO_2 and brine



Long-term solutions

Chemical Looping Combustion
Oxygen Transport Membranes
Underground Thermal Treatment

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Program Rationale and Impact

Alignment with the Governor's Top priorities

- **Education** – Increasing revenues to raise new funding for education
- **Sustainable Energy Development**– Promote Utah as a National thought leader in energy innovation
- **Jobs** – Energy jobs have a large benefit to rural economies
- **Self-determination** – Shows Utah's resolve, independent of support from Federal government; Provides a leadership agenda for the Western Governor's Association

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Overview of Program

- Governor's 10-Year Energy Strategic Plan has proposed the Energy Research Triangle to unlock the potential of Utah's energy resources

- "Powering the Research Triangle" is designed to:
  - Fund energy research relevant to Utah
  - Promote the next level of collaboration between Utah's research universities
  - Increase revenue for Utah education

- Takes into account the interest of all stakeholders: Using a "multi-tiered project" approach, the program would support research and translational development at multiple levels to tackle Utah's leading energy challenges while addressing sustainable energy development concerns: (Air Quality, Water Management, Land Use, Energy to Market)

- Industry Driven and Competitively Selected: Research projects would be selected through competition by panel of state energy experts

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It's time to power up Utah

- Input: Contact Alan Walker – Executive Director, Utah's Energy Research Triangle
- alanjwalker@utah.gov or

  alanjwalker@egi.utah.edu

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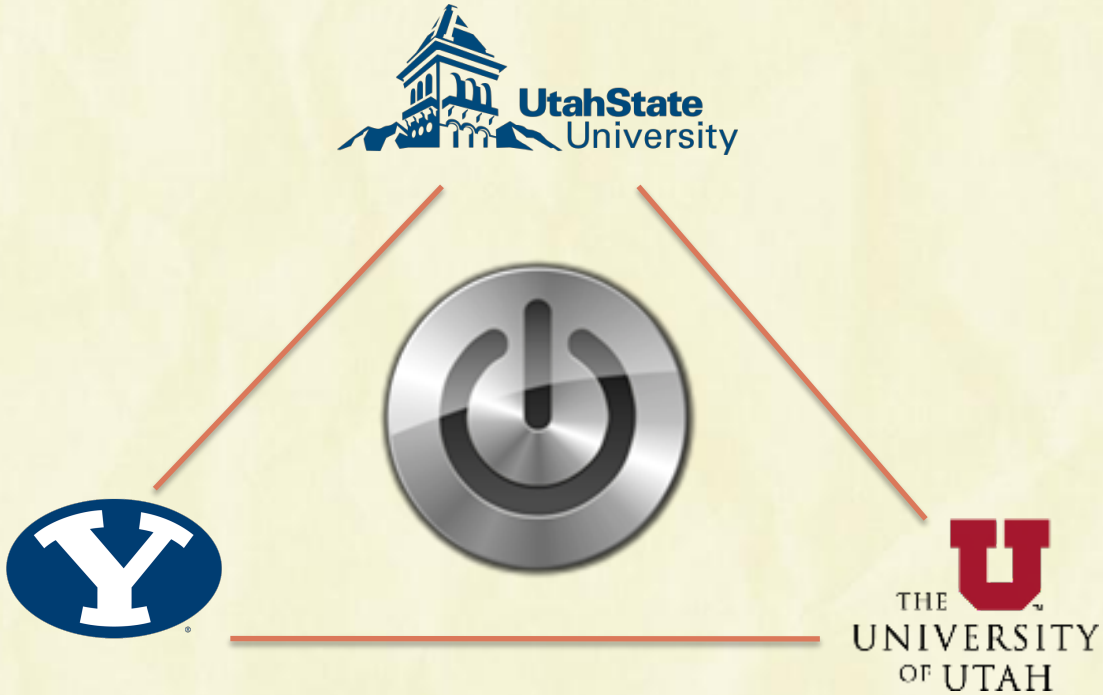

Appendix Materials

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USTAR Energy Vision in 2006

- Existing fields & new fields (advanced reservoir characterization)
- Unconventional production (Coal-bed, tight reservoirs, shale gas)
- Alternatives (Biofuels, Intuitive Buildings, LIDAR)
- CO2 Sequestration and CO2 Enhanced Oil Recovery
- Alternatives (Advanced Fusion, Electric Transportation)
- Gas-to-Liquids (GTL) and Coal Gasification
- Oil Sands and Oil Shale (Next 10 - 30+ years)

0 5 10 15 20 25 30 years

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Energy Innovation Area

USTAR Energy Team

Alternative Energy Batteries: Anil Virkar's

Alternative Energy Solar: Kelly Minteer, Ph.D.

Biofuels: Jeff Muhs, Kevin Shurtleff, Ph.D. and Foster Agblivar (Jan11)

Carbon Engineering: BJ McPherson, Ph.D.

Energy Dynamics Lab at Utah State University: Alan Marchant, Ph.D.

Hybrid Energy Geothermal: John McClennan, Ph.D.

Hybrid Energy Other: Manoram Misra, Ph.D. (Jan11)

Intuitive and Solar Buildings: Aravind Dasu, Ph.D.

TOIP Team: Al Walker, Scott Hill, Rob Simmons, Perry Thomson

Components of each Innovation Focus Areas

Applied R & D Center

-Quick Response
-Flexible
-Applied research
-Near-term
-Collaborative with industry
-Non-academic appointments

Core Facility

-Shared labs
-Shared technical & administrative staff
-Research Professors
-Academic appointments

USTAR Professor

-Independent
-Long-term discovery-based research
-Tenured
-Reports to DH
-Direct control of funding

...

USTAR Professor

-Independent
-Long-term discovery-based research
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Applied R & D

Academic Research

Energy

University of Utah

Fossil Energy & Carbon Engineering

John McLennan

Brian McPherson

Mano Misra

Alternative Energy

Shelley Minteer

Utah State University

Synthetic Bio-Manufacturing Institute

Randy Lewis

Foster Agblevor

USTAR Advanced Transportation Institute

Hunter Wu

Reagan Zane

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Energy: Biomass/Algae Biofuels

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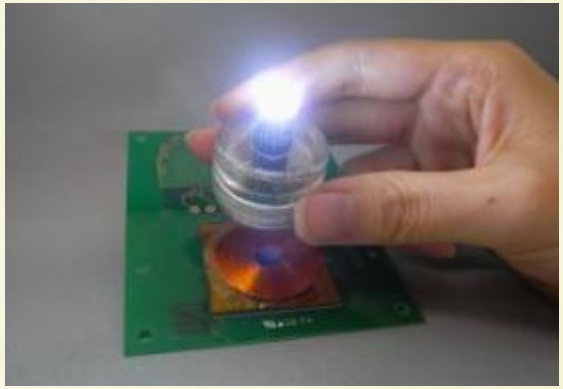
Sodium Batteries (Anil Virkar, U of U)

- High-capacity arrays that don't require scarce materials

Energy: Efficiency and Transportation



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LIDAR cleantech (Alan Marchant, USU)

USU laser technology helping wind farms to generate more power

and oil producers to reduce air pollution

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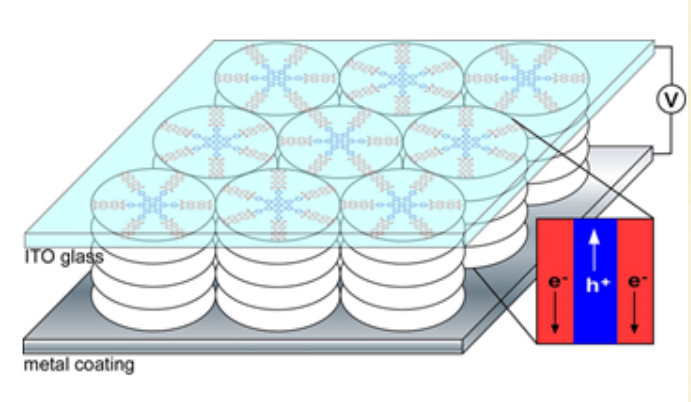
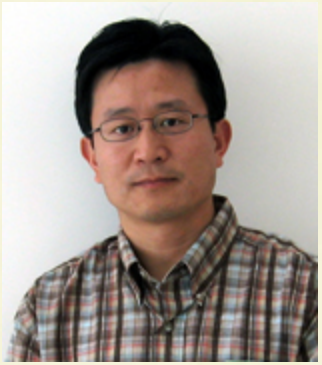
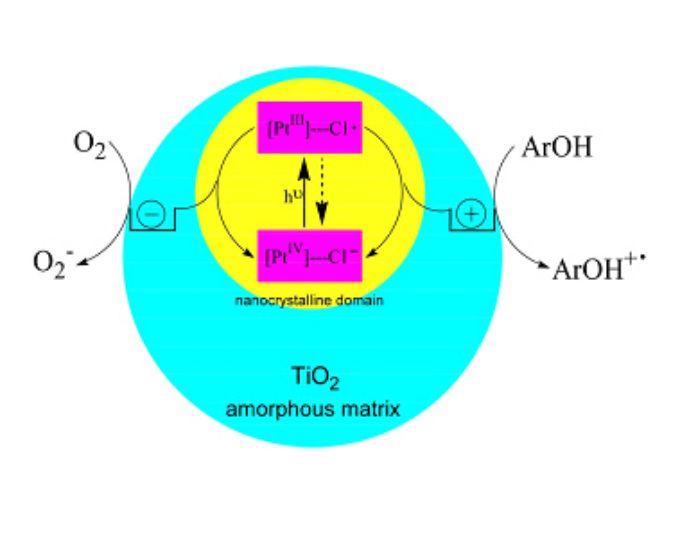
Next-gen solar (Ling Zang, U of U)

- New architecture for highly efficient solar cells



- Highly porous photo-catalysts





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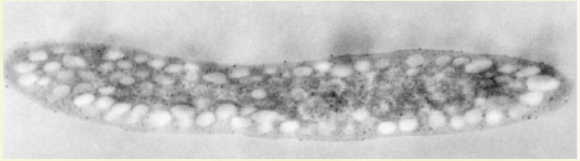
Synthetic Bio-manufacturing (USU)

- "Teaching" single-cell organisms to excrete bioplastics, biofuels



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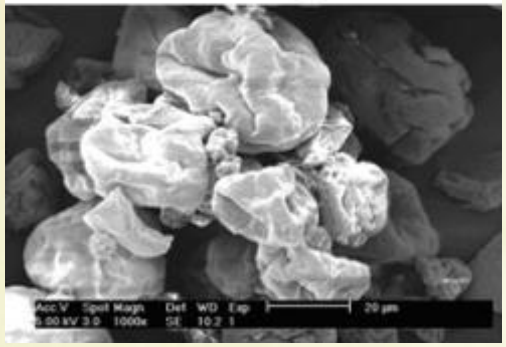
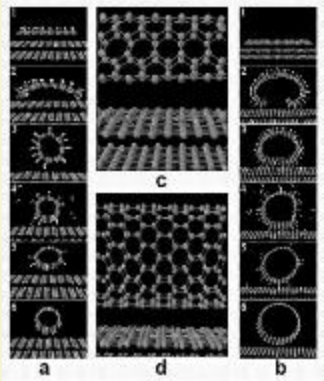
USTAR TCG examples

- Dry-process algae jet fuel
- Conditioned biogas from anaerobic digesters
- Low-cost graphene film for solar arrays
- Passive solar water heaters without roof installation

Electron microscope view of dried algae





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Tier 1 – "Principle" Project

- "Principle" Project Objectives: Address the leading challenges Utah faces in its path to energy independence and sustainable energy development
- Project(s) to have the highest possible impact for Utah
- Example – Geothermal power – over 9% of US Enhanced Geothermal reserves can be found in Utah alone. Breakthrough technology would benefit both local and national economy

U of U	$12,500	$25,000	$25,000	$12,500	$75,000
Ute Tribe (at BYU, USU or U of U)	$12,500	$25,000	$25,000	$12,500	$75,000
Yearly Totals	$125,000	$250,000	$250,000	$125,000	$750,000

Powering the Energy Triangle - Program Deliverables

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Tier 2 – "Core" Projects

- "Core" Project Objectives: Projects will propose new solutions to energy challenges
- Technology may take longer to shape the marketplace, but they are just as important for establishing Utah as a forward-thinking thought leader in the energy space (Example: Methyl Viologen)

	Tier 2 - Core Energy Issues					
PI University	***Sub PI***	**2014**	**2015**	**2016**	**2017**	**Project Total**
USU		$60,000	$37,500	$37,500	$0	$135,000
Water Resource Management	BYU	$20,000	$12,500	$12,500	$0	$45,000
	U of U	$20,000	$12,500	$12,500	$0	$45,000
					Total cost	$225,000
PI University	***Sub PI***	**2014**	**2015**	**2016**	**2017**	**Project Total**
BYU		$60,000	$37,500	$37,500	$0	$135,000
Air Quality	USU	$20,000	$12,500	$12,500	$0	$45,000
	U of U	$20,000	$12,500	$12,500	$0	$45,000
					Total cost	$225,000

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Tier 3 – "Advancing Energy Leadership" Projects

- "Energy Innovation Leadership" Project Objectives: Focused on grooming homegrown Utah talent to be the next generation of Utah's scientific and engineering innovation leadership
  - for the promising PhD candidate or appropriate MS, approved by University faculty to be completed in two years or less
  - 3 Grants for USU Students, 3 for BYU Students, 3 for UofU students and 1 for Ute Indian Tribe student (attending any of the 3 universities)

Tier 3 Details – Grant Breakdown

- Each of these research grants would be for 1 year, eligible for a 2nd year of funding if approved by the selection panel.

Tier 3 - Advancing Energy Innovation and Leadership					
Graduate Scholarship	**2014**	**2015**	**2016**	**2017**	**Project Total**
BYU	$12,500	$25,000	$25,000	$12,500	$75,000
BYU	$12,500	$25,000	$25,000	$12,500	$75,000
BYU	$12,500	$25,000	$25,000	$12,500	$75,000
USU	$12,500	$25,000	$25,000	$12,500	$75,000
USU	$12,500	$25,000	$25,000	$12,500	$75,000
USU	$12,500	$25,000	$25,000	$12,500	$75,000
U of U	$12,500	$25,000	$25,000	$12,500	$75,000
U of U	$12,500	$25,000	$25,000	$12,500	$75,000
U of U	$12,500	$25,000	$25,000	$12,500	$75,000
Ute Tribe (at BYU, USU or U of U)	$12,500	$25,000	$25,000	$12,500	$75,000
Yearly Totals	$125,000	$250,000	$250,000	$125,000	$750,000

Tier 3	**2014**	**2015**	**2016**	**2017**	
Annual Cost	$125,000	$250,000	$250,000	$125,000	
Percentage of funds dispersed, annually	16.67%	33.33%	33.33%	16.67%	
Research projects initiated	10	10	10		
Completed projects		10	10	10	
				Total tier funding	$750,000

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Tier 3 Details

USTAR interns and employees are already Utah's next generation of energy and technology leadership (5-year partial list)

- Startup Companies:

  Ben Rollins, CEO of Vaporsens
  James May, VP of WAVE
  Ameya Chaudhari, Principal at Navillum (won $100,000 and internship at TerraTek-Schlumberger)

- Growth Companies:

  Tareq al Najjar, Mgr of Business Development at Purestream
  Ben France, Engineering Manager at Enefit American Oil

- Established Companies:

  Joseph Hulse, Business Development at Questar Pipeline
  Terence Hess, Management Trainee at International Castings
  Yi Li, Goldman Sachs; Tyler Gwillam at Kennecott

- Government:

  Rob Simmons, Manager of Office of Energy Development - Unconventional Energy
  Gibson Peters – Manager, OED - Conventional Energy
  Vatsala Kaul, Manager of Business Analysis at GOED

- Education:

  Varun Gowda – Principal Investigator, DOE Energy Commercialization Center
  Mike Vrtis- PhD candidate Civil & Environmental Engineering

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Tier 3 Details – Effectiveness of Grants

- USTAR has proven that "**Seed Grants" work –**
  - $3.4m in grants – over $1m to local entrepreneurs, provided they collaborate with Universities
  - TCG has $20.3 Million in new private capital generating a 6x ROI
  - Pipeline of projects includes 98+ prototypes, 30+ new companies, 176+ new employees

Energy Research Triangle Program Summary

- Multifaceted, interdisciplinary approach
- Collaboration requirements
  - Tier 1 and Tier 2 grants will stipulate as part of the funding **that a portion of the grant money be spent at each of the three universities.**
  - The winning PI for each grant will be responsible for "subcontracting" out 20% of the research to each of the other universities.
  - Research objective becomes to attack the problem from as many innovative angles as possible

	2014	2015	2016	2017	2014-2017
Total Cost	$525,000	$500,000	$500,000	$125,000	$1,650,000
Research Projects initiated	13	10	10		33
Research Projects completed		10	13	10	33

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