GCEP – Revolutionizing Energy Research at Universities

Richard Sassoon,
GCEP Managing Director

Session on GCEP Innovations – Past, Present, and Future

GCEP 12th Annual Research Symposium

November 2, 2016
Goal

- Examine the impact that GCEP has had on the energy research field during its existence

Session 1: Wed Nov 2, 10:45 – 12:00

- GCEP - Revolutionizing Energy Research at Universities
  *Richard Sassoon, GCEP Managing Director, Stanford*

- Renewable Fuels
  *Tom Jaramillo, Chemical Engineering, Stanford*

- Solar PV
  *Mike McGehee, Materials Science and Engineering, Stanford*

Session 2: Thu Nov 3, 2:15 – 3:15

- Energy Storage
  *Yi Cui, Materials Sciences and Engineering, Stanford*

- Biomass Conversion
  *Clint Chapple, Biochemistry, Purdue*
The Global Climate and Energy Project

Mission

▪ Research on low-GHG emission energy supply
▪ Focus on fundamental and pre-commercial research
▪ Applications in the 10-50 year timeframe

Strategy

▪ Research projects with potential for significant impact on GHG emissions
▪ Seek potential breakthroughs for new conversion options
▪ High risk / high reward
▪ Unleash the creativity of energy researchers at universities worldwide

Established 2002 Over $200M Commitment
GCEP Impact
- Some Statistics

- Committed over $200M to Project
- Issued 24 solicitations and received 309 proposals over 12 years
- Funded 100 major research activities
- Resulted in 855 publications in peer-reviewed journals and 1247 papers presented
- Developed over 60 technologies and 15 patents already issued
- Trained over 800 graduate students and post docs

GCEP Publications
2010 - 2015

<table>
<thead>
<tr>
<th>Publications</th>
<th>Citations</th>
<th>Authors</th>
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<tr>
<td>272</td>
<td>13,647</td>
<td>818</td>
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Field-Weighted Citation Impact: 5.23
Citations per Publication: 50.2

Publications in top 10% most cited worldwide: GCEP 2003-15: 59.6%

Cited over 3000 times
GCEP Impact
- Addressing the Energy Challenge

- Nature of challenge requires a big picture approach to finding game-changing solutions
- Faculty were pushed to think outside of their individual areas and take a multi-disciplinary systems view of energy
- Large scale of Project enabled search for solutions across the broad energy space

Collaboration Across GCEP Research Programs

- 20% Single PI
- 80% Multiple PIs
- 25% Multiple Institutions
- 75% Single Institution
GCEP Impact - Stanford

**Energy Community**
- Faculty Recruitment
- Energy Courses
- Student Interest

**Research Areas of Expertise**
- Tens of M$ of follow-on funding with significant advances in:
  - Solar Photovoltaics
  - Renewable Fuels
  - Low-Carbon Fossil Fuels
  - Batteries and Fuel Cells

**Energy Research Ecosystem**
- Spawned a broad set of energy-focused research centers under the Precourt Institute of Energy
GCEP Impact - Beyond Stanford

**Sponsors**
- Recruitment of GCEP graduates
- Early awareness energy trends
- Informed strategic direction

**Other Research Centers**
- Pioneer in supporting energy research at scale
- Served as model for other energy programs

**Entrepreneurial Community**
- Multiple companies begun based on or inspired by GCEP technologies
GCEP Impact
- New Technical Fields

- Investment in novel ideas across a broad energy research portfolio led to the development of several whole new technical fields devoted to new approaches to energy conversion.

Hybrid Solar Conversion

Microbial Electrochemistry

Stanford University
North American branch of the International Society of Microbial Electrochemistry and Technology
Stanford University, Stanford, CA
October 5-7, 2016
GCEP Impact
- Advancing Energy Technologies

Many scientific advances addressing questions on technology viability and energy conversion efficiency move technology areas forward towards wide-scale application.