



# MPS & ENG Energy Working Group (EWG)

Esther Takeuchi (MPS) & Ilesanmi Adesida (ENG)  
Advisory Committee EWG co-Chairs

Linda Sapochak (MPS) & George Maracas (ENG)  
NSF EWG - co-Chairs



# MPS / ENG EWG

MPS Co-Chair: Linda Sapochak (DMR) ENG Co-Chair: George Maracas (ECCS)

MPS AdCom: Esther Takeuchi

ENG AdCom: Ilesanmi Adesida

Members:

Members:

MPS - Morris Aizenman

CHE - Colby Foss

CHE - Suk-Wah Tam-Chang

CHE – Matt Platz (DD)

DMR - Mary Galvin-Donoghue

DMS - Hank Warchall

DMS - Jay Alexander

PHY - Tom Carruthers

ENG - Darren Dutterer

CMMI - Bruce Kramer

CBET - Bruce Hamilton

CBET - Greg Rorrer

ECCS - Larry Goldberg

EFRI - George Antos (CBET)

IIP - Grace Wang

EER - Barbara Kenny



## MPS/ENG EWG

Formed in November 2010

### Charge

Respond to Office of Management and Budget call requests

Prepare a 5-Yr Strategic plan for the Energy part of SEES

Maintain updates of MPS & ENG energy-related awards and activities

Maintain updated information on specific internal and external energy-related areas relevant to NSF for use by MPS & ENG Directorates

### 6-Month Activities

Energy Topics List created

MPS/ENG Energy Awards Portfolio and mapping in progress

Held a Clean, Sustainable Energy Retreat at NSF





# Clean, Sustainable Energy (CSE) Retreat

## March 15, 2011

### Purpose

Effectively frame MPS/ENG Clean, Sustainable Energy activities into the SEES mission.

### Structure

*Distill* Community and NSF ideas (external and internal survey data) into

Science & Engineering, Innovation, Socioeconomic and Education Challenges

*Identify* existing strengths and synergies (NSF and external)

*Develop* new strategies to address the Challenges

### Output

A prioritized list of Challenges and strategies relevant to NSF toward accelerating a Clean-Sustainable Energy Future



# Addressing Major Challenges

Existing activities and strengths coordinated to address  
Clean-Sustainable Energy major challenges in the areas of:

**Science & Engineering**

**Innovation**

**Socioeconomics**

**Education**



# Breakout Groups

<b>Question 1 Science &amp; Engineering</b>	<b>Question 2 Innovation</b>	<b>Question 3 Socioeconomics</b>	<b>Question 4 Education</b>
Esther Takeuchi (MPS) - Lead	Barb Kenny (ENG) - Lead	Mary Galvin- Donoghue (MPS) - Lead	Ilesanmi Adesida (ENG) - Lead
Bruce Kramer (ENG)	Grace Wang (ENG)	Colby Foss (MPS)	Hank Warchall (MPS) Haiyan Cai (MPS)
George Maracas (ENG)	Morris Aizenman (MPS)	George Antos (ENG)	Darren Dutterer Bruce Hamilton (ENG)
Charles Ying (MPS)	Greg Rorrer (ENG)	Wendell Hill (MPS)	Linda Sapochak (MPS)
Suk-Wah Tam-Chang (MPS)	Kathy Covert (MPS)		Samir El-Ghazaly (ENG) Maura Borrego (OIA)



# Underlying Principles and Enablers for Science & Engineering Challenges

## Underlying principles

Use earth-abundant, environmentally-benign, sustainable resources in an economically viable way. Ensure security and safety across the entire life-cycle.

## Required enablers

Interdisciplinary expertise

Public Opinion

Multi-scale Design and Understanding enabled by advanced computational and experimental methods

Manufacturing/Scale-up

Improved Communications



# Science & Engineering Challenges

Energy Generation

Systems Design & Integration of Alternate Energy Sources

Energy Storage

Energy Transmission and Distribution

Energy Use & Conservation







# Innovation Challenges

Integration of market-pull into research-push

Common frame of sustainability metrics

System-level thinking

Fostering strategic partnerships

Innovation in government policies





## Socioeconomic Challenges

Create a sustainability research community that includes physical science, engineering, economics, biological and social/behavioral sciences participants.

Promote systems-level awareness in developing research and education programs to address sustainable energy issues.

Effective education and promotion to the public of the acute need for sustainable energy solutions.



## Education Challenges

Integrate into the mindset of science & engineering students the socio-behavioral- economic realities. And vice-versa.

Train Science & Engineering students to communicate better to the public.

Balance depth with breadth in Clean-Sustainable Energy training programs at the undergraduate and graduate level.

Incorporate clean-sustainable energy topics into the education curriculum of K-12 and undergrad students.

Understand the needs of industry, government, non-profit, etc. when designing new clean sustainable energy curricula .



# General Needs emerged crosscutting all Challenges

Foster Systems-level thinking

Engage SBE as a *stronger* partner in Science, Engineering, Innovation and Education Program planning.

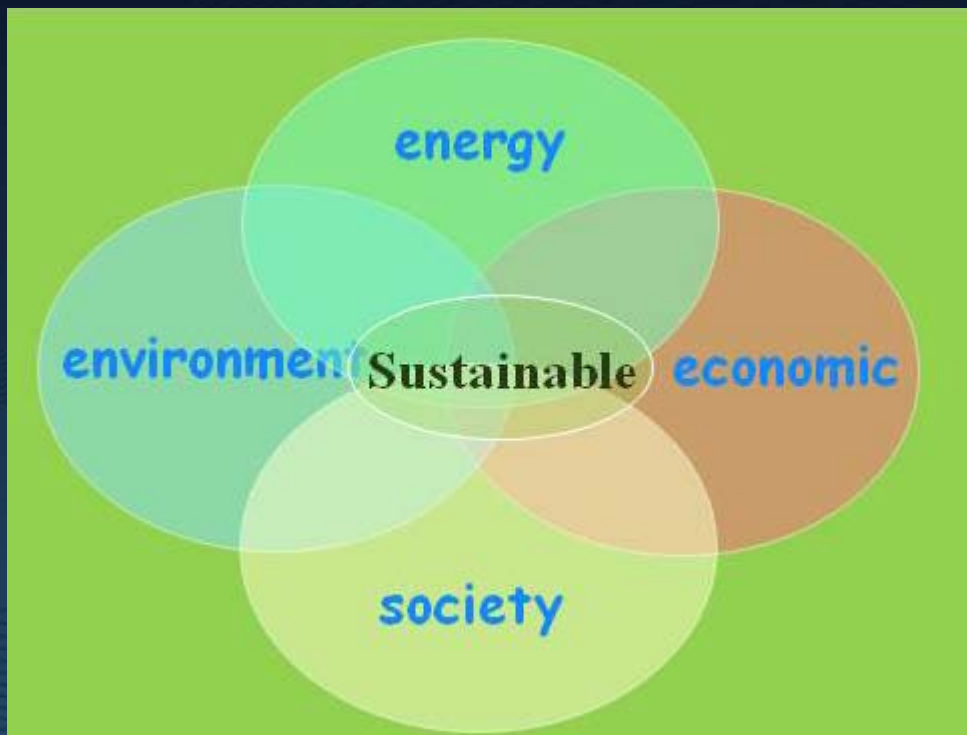
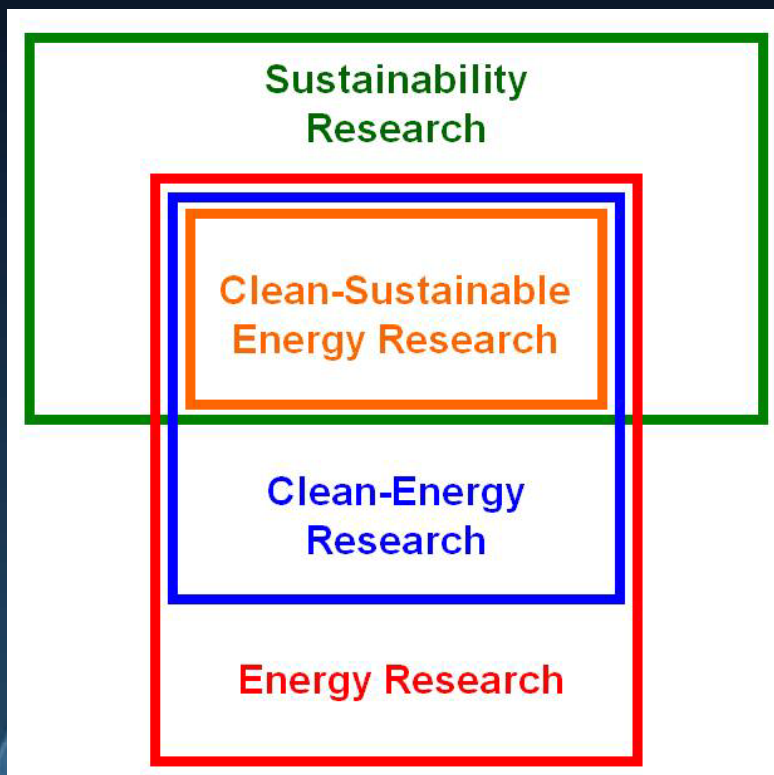
Build a Sustainability Community

Develop better mechanisms for information flow among Communities addressing Sustainable Energy Systems Challenges.

Train scientists and engineers to function in diverse, interdisciplinary settings and effectively communicate with the Public and Policymakers.



# Clean, Sustainable Energy (CSE) White Paper





## Next Steps

**Create a strategy for how ENG/MPS can frame Clean, Sustainable Energy under SEES**

**Quantify Strengths, weaknesses and opportunities in our investment portfolio**

**Articulate these in a 5-Year Plan**





# Backup Slides





# Identify & Strengthen Synergies

## MPS

SOLAR

CEMRI & CCI

IMR & CRIF

MWN & ICC

STC  
GOALI  
MRI

NSF - wide

EAGER  
RUI  
CAREER

## ENG

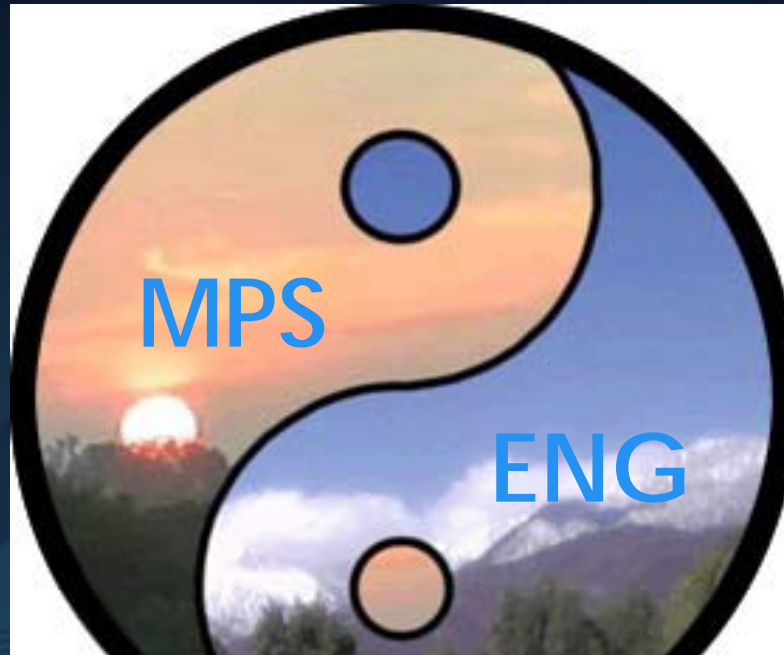
EFRI

TRAC(AIR)

ERC

I/UCRC

SBIR/STTR



**Energy projects are found in all**





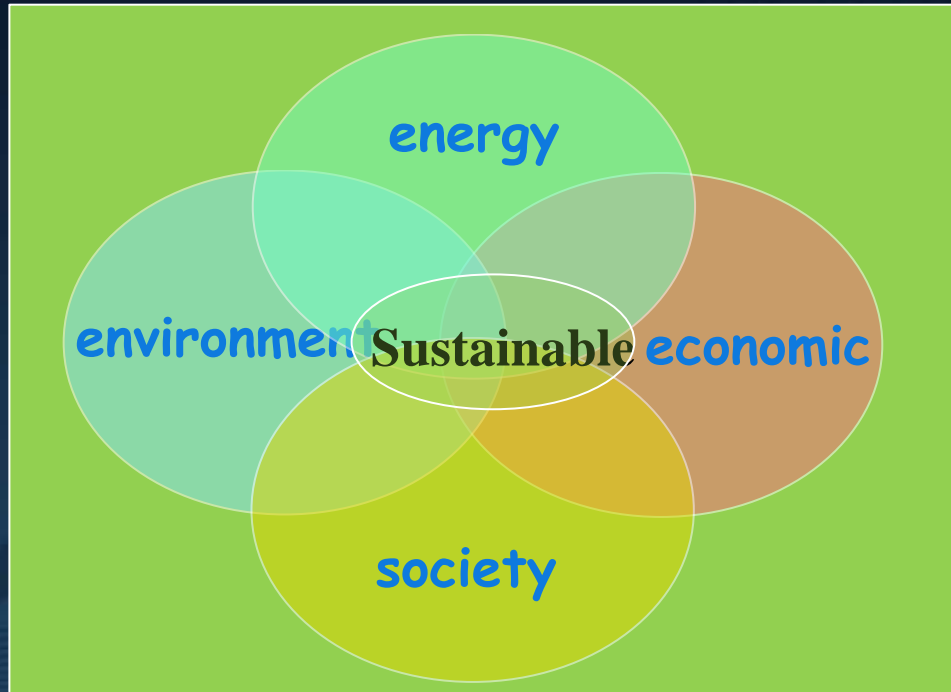
# Breakout Group - Questions

## Scientific Community & MPS/ENG Divisions

- 1) What are the top few scientific/engineering challenges and opportunities toward achieving sustainable energy within the next decade? (short term)? Within the next 50 years (long term)?
- 2) What are the major areas of innovation needed toward implementing a Clean Energy Future?
- 3) How should the science and engineering research community consider and engage the socio-economic issues?
- 4) How should the next generation of scientists and engineers be prepared so they can address these issues?

## MPS/ENG Divisions

- a) What can MPS and ENG do to achieve the Goals and what linkages between ENG & MPS are necessary to achieve them most effectively?
- b) What linkages between other Directorates (GEO, BIO, SBE, etc) and Offices (Polar Programs, Integrative Activities, etc) are necessary to achieve them most effectively?
- c) What differentiates NSF from other agencies with respect to the proposed activities in part a) and b)? Are there activities proposed that compliment what other agencies are doing in Clean Sustainable Energy?





# External MPS & ENG Community Leaders Respond to CSE Retreat Survey

<b>John Abelson</b>	Cornell University, Chemical & Biomolecular Engineering
<b>Robert Brown</b>	Iowa State Univ, Bioeconomy Institute
<b>Emily Carter</b>	Princeton Univ, Director, Andlinger Center for Energy & the Environment
<b>F. Hadley Cocks,</b>	Duke Univ, Mechanical Engineering
<b>Frank DiSalvo</b>	Cornell , Director, Atkinson Center for a Sustainable Future
<b>Declie Durham</b>	Univ of Southern Florida, Mechanical Engineering
<b>Dan Kammen</b>	UC Berkeley, Engineering
<b>Trung Nguyen</b>	Univ of Kansas, Chemical & Petroleum Engineering
<b>Daniel Scherson</b>	Case Western Univ, Director, Center for Electrochemical Sciences,
<b>Cliff Singer</b>	Univ of Illinois –UC, Nuclear, Plasma, and Radiological Engineering
<b>Chris Somerville</b>	UC Berkeley, Director, Energy Biosciences Institute
<b>John Sutherland</b>	Purdue Univ, Environmental & Ecological Engineering
<b>Jeff Tester</b>	Cornell, Assoc. Director, David R. Atkinson Center for a Sustainable Future
<b>Eric Wachsman</b>	Univ of Maryland, Director, Energy Research Center
<b>Jay Whitacre</b>	Carnegie Mellon, Engineering and Public Policy