SCIENCE, ENGINEERING, AND EDUCATION FOR SUSTAINABILITY (SEES)

National Science Foundation
Washington State University
Outreach
April 2013

Outline

Overview – Jessica Robin (GEO)

Dimensions of Biodiversity – Simon Malcomber (BIO)

Sustainable Energy Pathways - George Maracas (ENG)

Sustainable Research Networks - Sarah Ruth (GEO)

Hazards SEES – David Fountain (GEO)

Rapid, multifaceted global change is challenging human well-being

Ships take to Arctic Ocean as Sea Ice Melts. Journey time between Europe and China can be reduced by half. MSNBC.com

Meeting Sustainability Challenges…

…requires multifaceted approaches and research at the nexus of societal needs and behavior, environmental impact, and economic demands.

NSF's Science, Engineering and Education for Sustainability (SEES) Portfolio

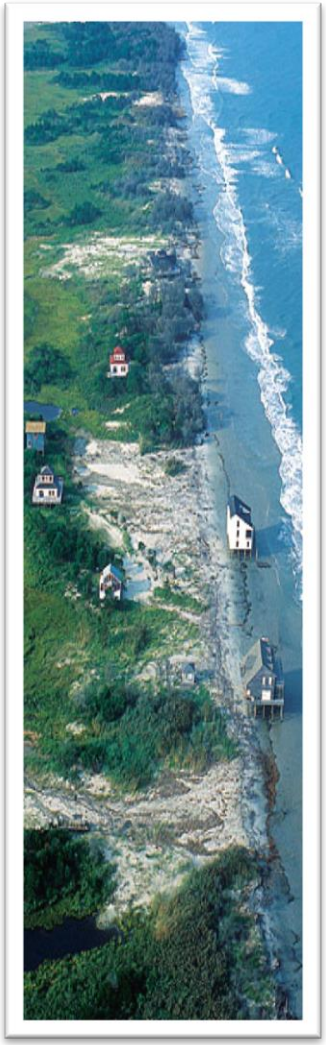
SEES Overview

Mission: *to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being*

- Established in Fiscal Year 2010
- Portfolio of existing and new programs
- All NSF Directorates and offices involved
- Partnerships

SEES Goals

1. **Interdisciplinary research and education…towards** global sustainability
2. Link projects and **partners** and add **new participants** to sustainability endeavors
3. Develop the **workforce**…to address…sustainability



SEES Characteristics

System Thinking

- Holistic approaches that link human, built and natural systems, and reach across disciplines

Partnerships & Networks

- Connect intellectually and spatially disparate communities, institutions and organizations

Workforce & Education

- Development and education of new researchers and students on critical aspects and issues of sustainability

SEES Themes

- Natural Systems
- Human Systems
- Built Systems
- Energy and materials
- Adaptation and Resilience

SEES Programs – FY2010/2011

- Ocean Acidification (NSF 12-600)
- **Dimensions of Biodiversity (NSF 13-536)**
- Decadal and Regional Climate Prediction using Earth System Models (NSF 12-522)
- Water Sustainability & Climate (NSF 13-535)
- Climate Change Education (NSF 12-523)
- Research Coordination Networks – SEES track (NSF 131-520)
- Dynamics of Coupled Natural and Human Systems – SEES track (NSF 10-612)

SEES Programs – FY2012

- SEES Fellows (NSF 12-601)
- **Sustainability Research Networks (SRN) (NSF 11-574)**
- **Sustainable Energy Pathways (SEP) (NSF 11-590)**
- SEES focus in Partnerships for International Research and Education (PIRE) solicitation (NSF 11-564)
- RCN – SEES track continues (NSF 11-531)
- CNH – SEES track continues (NSF 10-612)
- Climate-related (CRI) competitions continue

SEES Programs – FY2013

- Arctic SEES(NSF 12-553)
- Coastal SEES(NSF 12-594)
- **Hazards SEES(NSF 12-610)**
- Cyber SEES (NSF 13-500)
- SuSChEM (NSF13-501)
- STTR SEES (NSF 13-501)
- RCN – SEES track (NSF 11-531)
- CNH – SEES track (NSF 10-612)
- Climate-related (CRI) competitions continue

Dimensions of Biodiversity

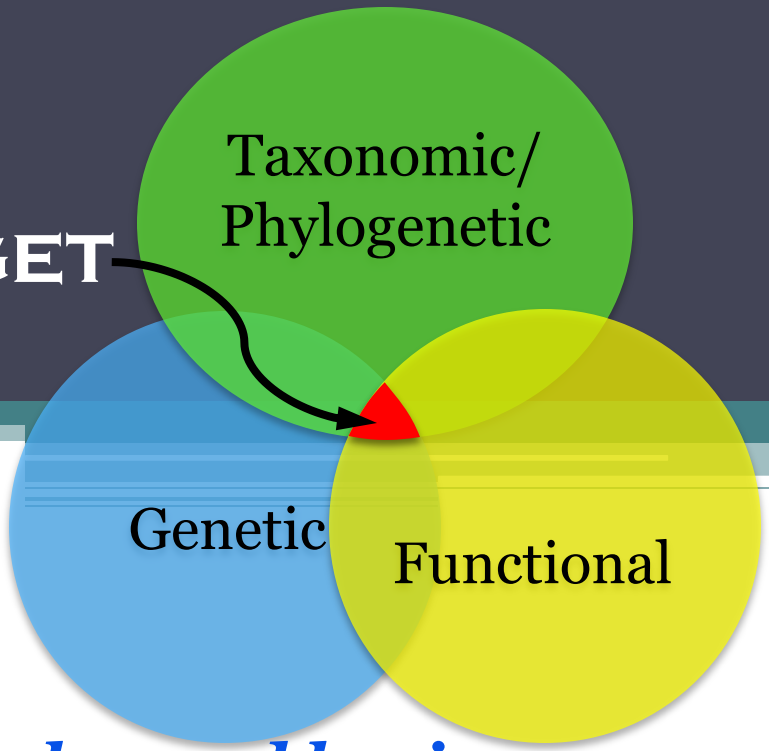
Dimensions of Biodiversity

A 10-year campaign to characterize the dimensions of biodiversity on Earth

Initial focus on areas where three dimensions overlap

- Integrative approaches
- Innovative concepts
- Rapid advances

TARGET



"This has pushed the community beyond business as usual."

"[Dimensions] will accomplish in 10-15 years what would ordinarily take 50 years"

Dimensions of Biodiversity

FY2010

- 290 letters of intent; 195 proposals reviewed in 2 panels
- 13 research awards, one joint U.S.-China IRCN
- $26.3 M Total: BIO $18.9 M; other NSF $6.8 M; NSFC $600 K

FY2011

- 117 proposals reviewed in 1 panel
- 11 research awards and one joint U.S.-China IRCN
- $28.6 M Total: BIO $17.5 M; other NSF $10.5 M; NSFC $600 K

FY2012

- 122 proposals reviewed in 1 panel
- 14 research awards – two US-China, one US-Brazil
- $31.5 M Total: BIO $21M; other NSF $5.4 M; NSFC $2.4 M; Brazil $2 M; NASA $731 K

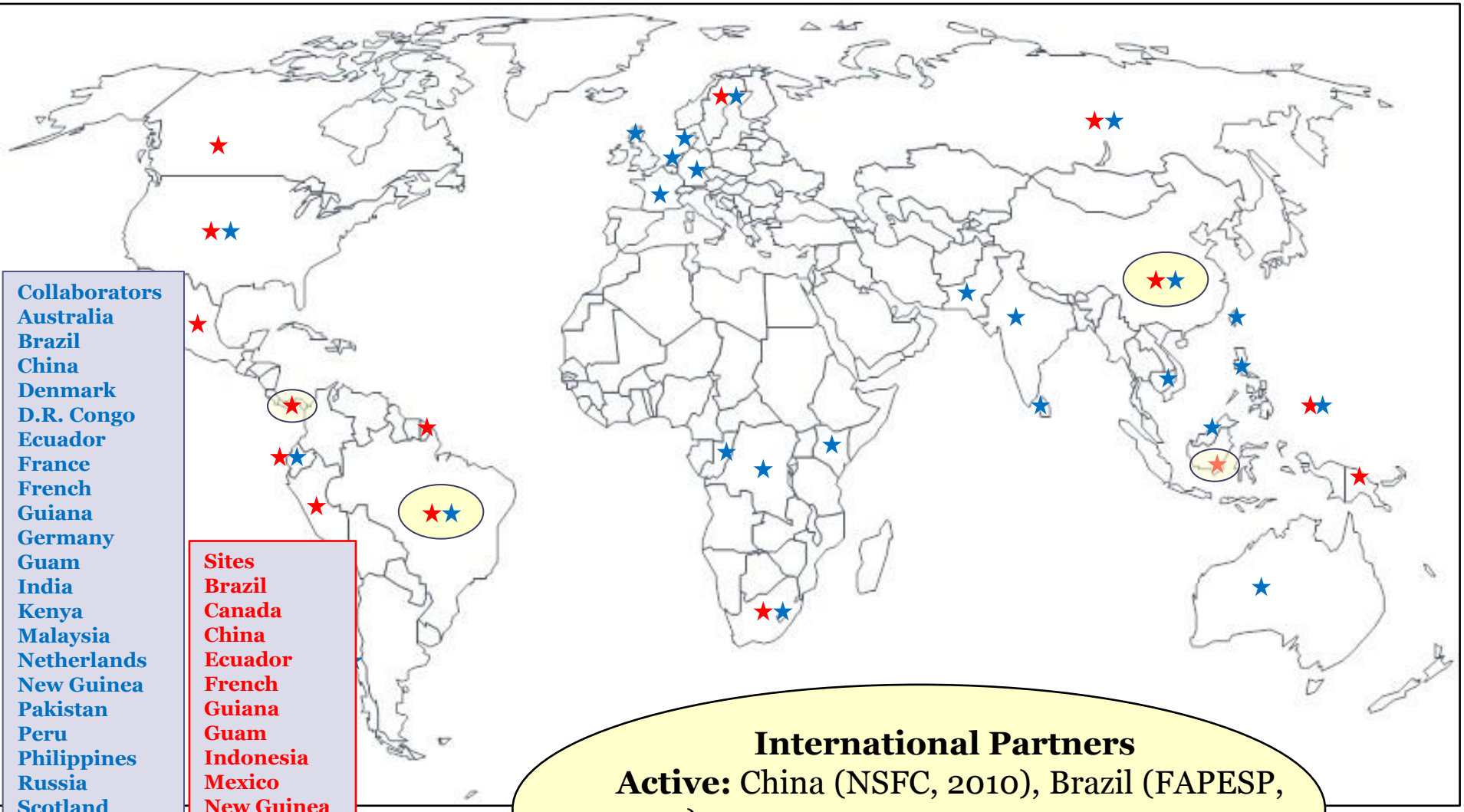
Dimensions of Biodiversity

Streams of activity	2020 Goals
Research	An integrated understanding of the key but unknown dimensions of biodiversity on earth
Cyberinfrastructure	Informatics and infrastructure that support accessible, interoperable information capability for dimensions of biodiversity
Collections	Digitization of collections and enhanced physical infrastructure to link to cyberinfrastructure and leverage the enormous investments of the past
Workforce	A diverse, interdisciplinary, globally-engaged, scientific workforce capable of transforming and communicating our understanding of biodiversity on Earth
Synthesis	Scientific analyses and syntheses that generate and disseminate useful information for scientists, educators and decision makers

Approach:

Planning & Partnering • Base lining & synchronizing • Assessing progress • Aligning investments with emerging priorities

An international campaign



Collaborators
Australia
Brazil
China
Denmark
D.R. Congo
Ecuador
France
French
Guiana
Germany
Guam
India
Kenya
Malaysia
Netherlands
New Guinea
Pakistan
Peru
Philippines
Russia
Scotland
South Africa
Sri Lanka
Sweden
Taiwan
Thailand

Sites
Brazil
Canada
China
Ecuador
French
Guiana
Guam
Indonesia
Mexico
New Guinea
Panama
Peru
Russia
South Africa
Sweden

International Partners

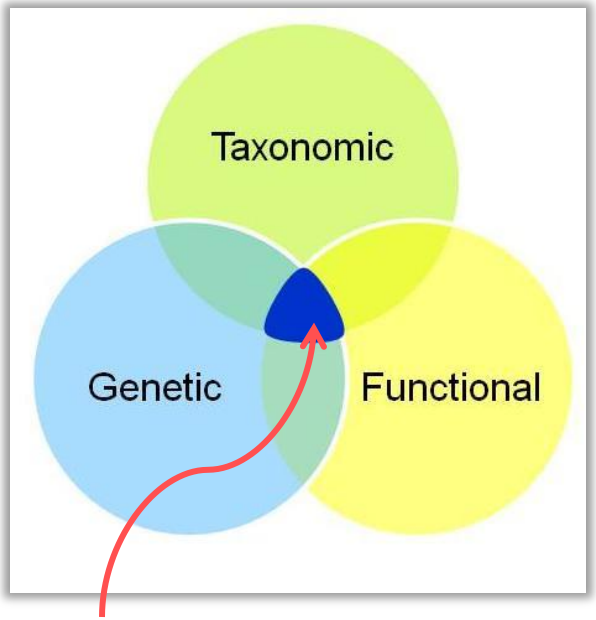
Active: China (NSFC, 2010), Brazil (FAPESP, 2012)

Planning: Panama, Indonesia

Dimensions of Biodiversity (NSF 13-536)

Goal: A 10-year campaign to characterize the dimensions of biodiversity on Earth

Purpose: to support research that characterizes biodiversity on Earth through the use of integrative and innovative approaches to develop an understanding of key dimensions of biodiversity



Solicitation targeted areas where three dimensions of biodiversity overlap

- NSF Directorates: BIO, GEO, OPP
- Additional partners: NASA, China (NSFC), Brazil (FAPESP)
- Next Competition: FY13 (deadline May 6, 2013)

Sustainable Energy Pathways (SEP)

SEP Management Team - 2012

Zeev Rosenzweig	George Maracas	Co-Chairs
Linda S. Sapochak	Tong Ren	MPS
Ram Gupta	Richard Fragaszy	ENG
Stephen S. Harlan	Anjuli S. Bamzai	GEO
Krishna Kant	Thyaga Nandagopal	CISE
Antoinette WinklerPrins	Michael Reksulak	SBE
Graham Harrison		OD
Alphonse DeSena		EHR
Anne Doyle	Margaret Anne Wampamba	MPS BFA

Sustainable Energy Pathways 2012

To develop efficient pathways towards sustainable energy, from starting points to ending points, via a systems approach in the priority areas of

MPS, ENG CISE, GEO, SBE
BIO, EPSCoR, MPS/OMA

$37M for 20 awards

Topic Areas

- Sustainable Energy Harvesting, Conversion, and Storage
  - Energy harvesting and conversion
  - Energy storage solutions
  - Critical elements and materials
  - Nature inspired processes
  - Reducing carbon intensity
- Energy Transmission, Distribution, Efficiency, and Use
  - Transmission and distribution
  - Energy efficiency and management

Fundamental Considerations

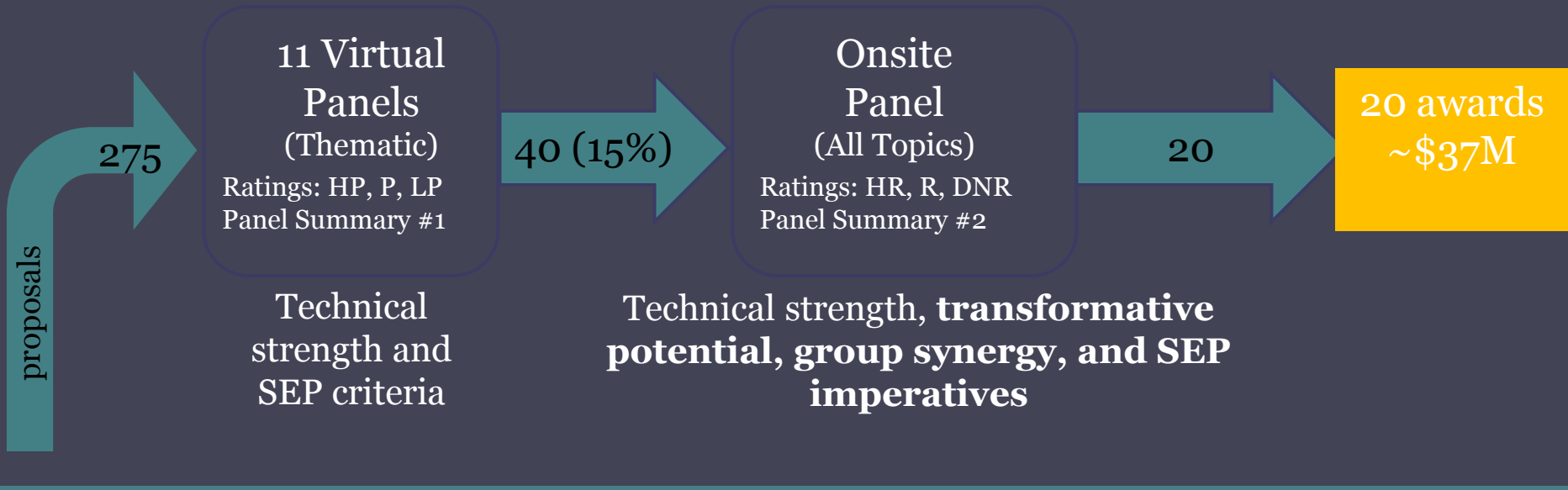
•*Scientific knowledge & technological innovation*

•*Environmental, societal and economic imperatives*,

* *Education and workforce development*,

Role of SBE – present in all awards

SEP 2012 Proposal Review Process

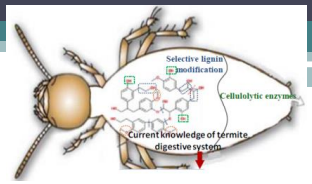


MPS	12,500,000	SBE	4,000,000
ENG	10,000,000	EPSCoR	489,957
CISE	5,000,000	MPS/OMA	300,000
GEO	4,000,000	BIO	500,000

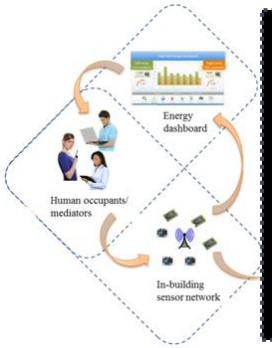
Allocated funds $36,789,957

SEP 2012 Awardees (selected)

Tidal turbines in Puget Sound (B. Polagye)

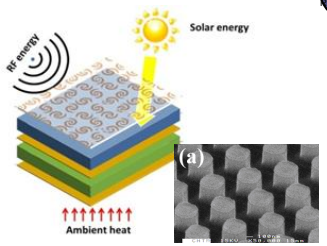


Lignocellulosic biomass fuels using termite enzymes. (S. Chen)

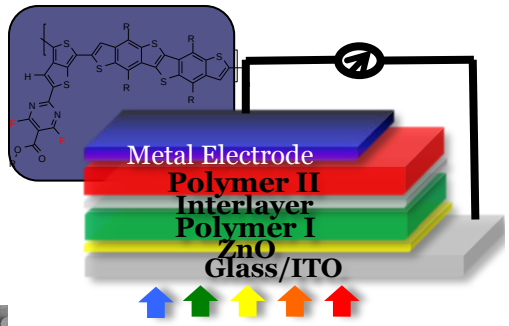


Building Energy, Environment, Lighting, Water Control Systems

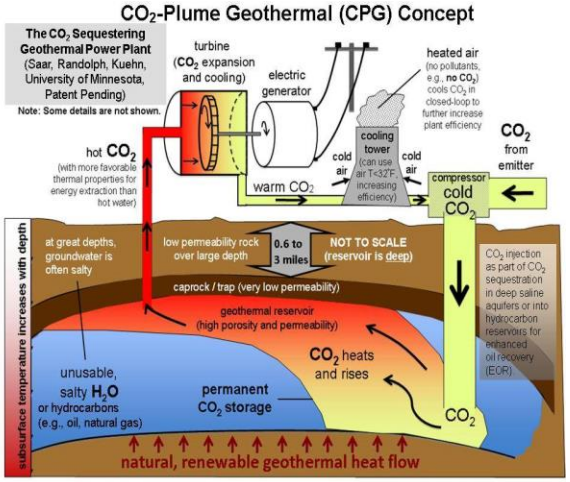
Human-mediated energy systems in multi-occupancy buildings (B. Becerik-Gerber)



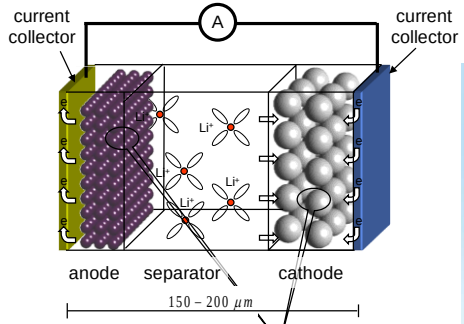
Solar, heat, RF & microwave energy harvesting (O. Lavrova)

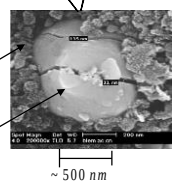


New organic PV materials (L. Yu)



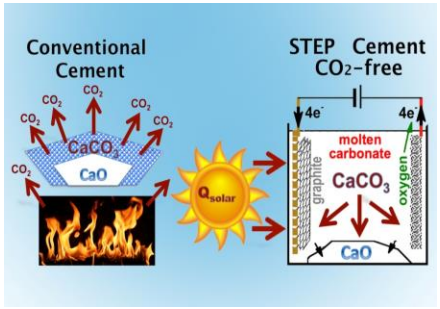
CO2-Plume Geothermal (O.Saar)



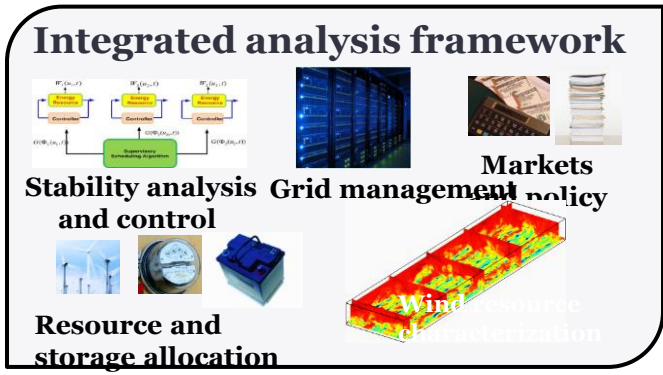


Wang 2004

Solid state Li pyrite (SS-LP) battery. FeS_2 is environmentally benign, inexpensive, and energy dense. (S-H Lee)



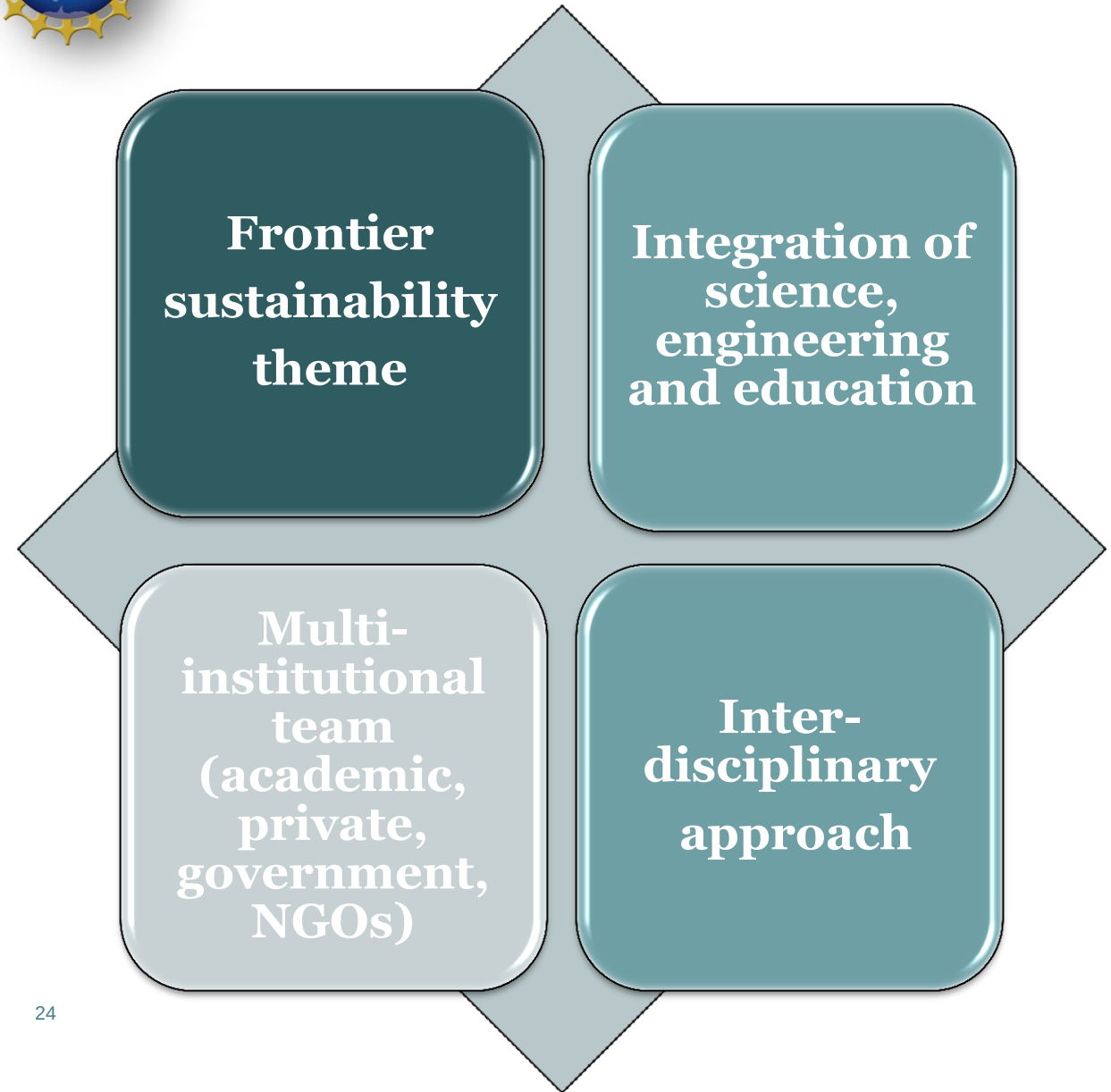
Calcium oxide production without CO_2 emission (S. Licht)



High renewables penetration electric power systems (D. Gayme)

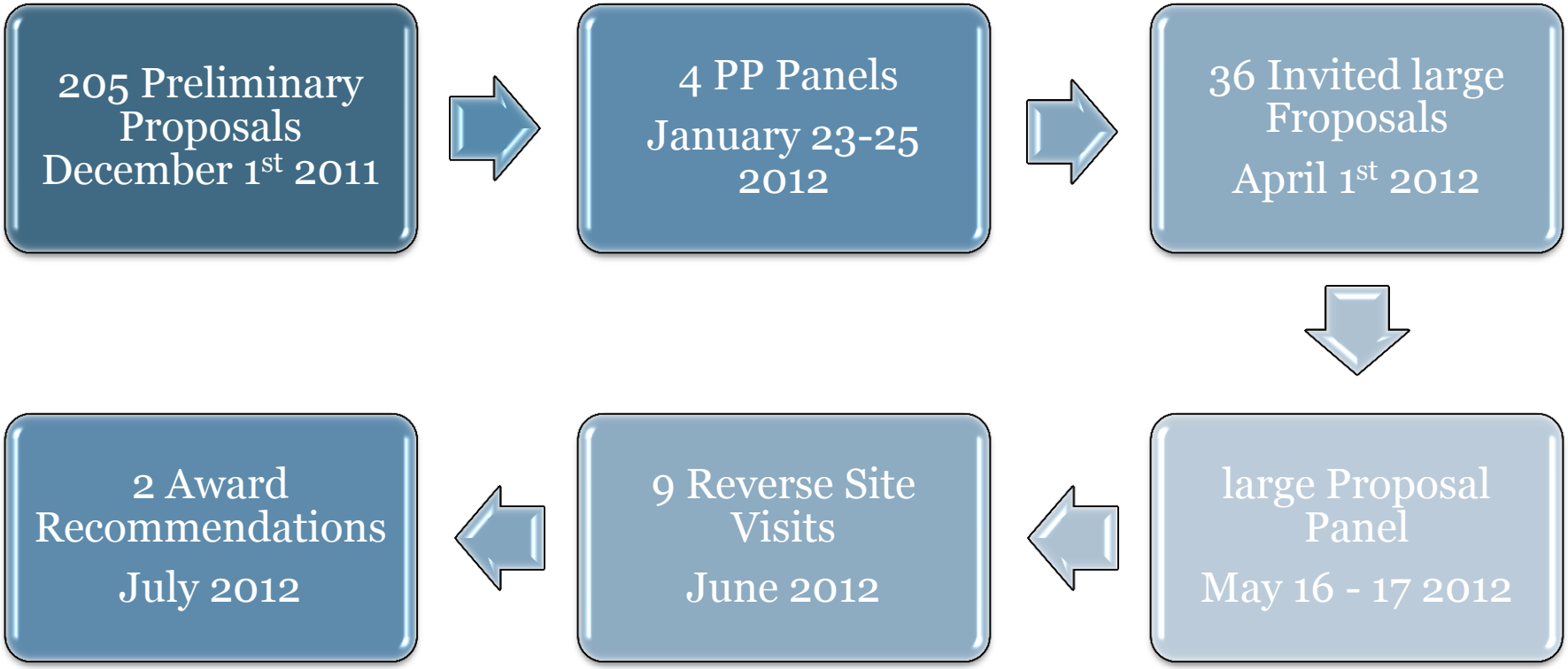
Sustainability Research Networks (SRN)

SRN Solicitation



- 3 - 4 awards
- 4 - 5 years
- up to $12 million each
- Awarded as cooperative agreements, with additional NSF oversight.

SRN 2012 Timeline



2012 SRN Awards

Joseph Ryan (PI) – University of Colorado Boulder

Routes to Sustainability for Natural Gas Development and Water and Air Resources in the Rocky Mountain Region.

Requested amount: $11.1 million

Klaus Keller (PI) - Pennsylvania State University

What are Sustainable Climate-Risk Management Strategies?

Requested amount: $11.9 million

Interdisciplinary Research in Hazards and Disasters (Hazards SEES) (NSF 12-610)

- **Goals**
  - Advance understanding of fundamental processes associated with specific natural hazards and technological hazards linked to natural phenomena, and their interactions
  - Better understand causes, interdependences, impacts and cumulative effects of hazards on individuals, natural and built environment, and society as a whole
  - Improve capabilities for forecasting or predicting hazards, mitigating effects, and enhancing capacity to respond to and recover from resultant disasters

- **Awards**
  - Type 1: forge new or emerging interdisciplinary teams (up to $300K, 2 yrs)
  - Type 2: major new integrated hazards research (up to $3M, 4 yrs)
- **NSF Directorates/Offices**: CISE, ENG, GEO, MPS, OCI, SBE
- **Deadline**: February 4, 2013

Eos, Vol. 93, No. 1, 3 January 2012

A Focus on Science, Engineering, and Education for Sustainability

Science, Engineering and Education for Sustainability (SEES)

National Science Foundation

Mission: *to advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being*

A sustainable world is one in which human needs are met equitably without harm to the environment, and without sacrificing the ability of future generations to meet their needs. Meeting this formidable challenge requires a substantial increase in our understanding of the integrated system of society, the natural world, and the alterations humans are making to Earth. NSF's Science, Engineering and Education for Sustainability (SEES) investment aims to address this need through interdisciplinary research and education.

Under SEES, NSF employs a systems approach to understanding, predicting and reacting to change in the linked natural and built environment. SEES encompasses the entire range of scientific and engineering disciplines and aim to:

1) **Build the knowledge base** for interdisciplinary research and education

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Crosscutting/NSF-wide

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Science, Engineering and Education for Sustainability NSF-Wide Investment (SEES)

SEES Mission Statement

To advance science, engineering, and education to inform the societal actions needed for environmental and economic sustainability and sustainable human well-being.

CONTACTS

For general inquiries about SEES related activities: nsf-sees-info@nsf.gov.

For program or discipline-specific questions, please see the full list of contacts at: http://www.nsf.gov/geo/sees/sees_contacts.jsp

SYNOPSIS

Science, Engineering, and Education for Sustainability (SEES) is a portfolio of activities that highlights NSF's unique role in helping society address the challenge(s) of achieving sustainability.

A sustainable world is one in which human needs are met equitably without harm to the environment, and without sacrificing the ability of future generations to meet their needs. Meeting this formidable challenge requires a substantial increase in our understanding of the integrated system of society,

http://www.nsf.gov/sees