Opportunities for CISE Researchers in Sustainability

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Directorate of Computer and Information Sciences

National Science Foundation

Oct 14, 2011, 13:00 – 14:45

Welcome by

Dr. Farnam Jahanian

Assistant director

CISE Directorate

Dr. Keith Marzullo

Division Director

Computer & Network Systems (CNS) division

Agenda

13:00 Welcome by CISE Management

13:10 Overview of SEES – Jessica Robin, Krishna Kant

13:25 SEES solicitations

- Sustainable Energy Pathways – Krishna Kant
- SRN and RCN-SEES – Krishna Kant
- SEES Fellows – Petros Drineas
- PIRE-SEES, CNH, WSC – Petros Drineas

14:15 Questions

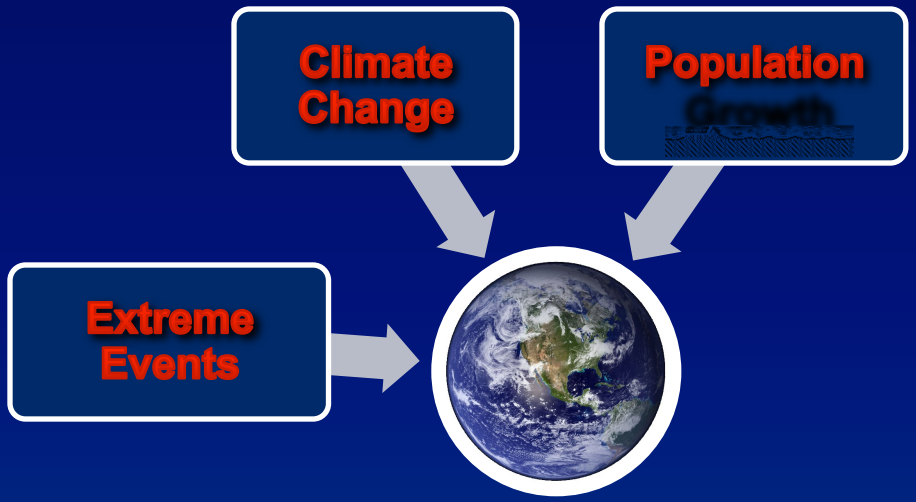
The Sustainability Challenge

Dr. Jessica Robin
Office of International Science and Engineering

A World Under Pressure

There are increasing natural and anthropogenic pressures on our natural and social systems

- 3 major earthquakes in 2010-2011 – Haiti, Chile and Japan
  Japan also experiencing tsunami & nuclear crisis simultaneously.
- Unsustainable population growth & its impact
- Diminishing resources such as fresh-water, forest cover, and others



Sustainability Issues Remain at the Forefront

- Sustainability issues remain at the forefront both in academic journals and popular media.

- Sustainability science is emerging as a new academic discipline

Neither "basic" nor "applied" research but as a field defined by the problems it addresses rather than by the disciplines it employs.

-- William Clark in Proc. of National Academy of Sciences

The Challenge of Sustainability

What is Sustainability?

The interactions between natural and social systems, and how those interactions affect the challenge of… meeting the needs of the present and future generations while substantially reducing poverty and conserving the planet's life support systems

It is more than just climate change or energy, or disaster response, or …

It is research at the nexus of societal needs and behavior, environmental impact, and economic demands

Meeting the Challenge

Requires multifaceted approaches

- Understanding change and projections of impact
- Adaptation methods and technologies
- Mitigation actions and technologies
- Human well-being on a crowded planet

Role of Science and Technology

Inform decision making to drive policy

Create new products and capabilities with deep societal impact

Prepare the workforce to address global change

Science, Engineering, and Education for Sustainability (SEES)

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

Support interdisciplinary research and education that can facilitate the move towards global sustainability	**Build linkages among existing projects and partners and add new participants in the sustainability research enterprise**	**Develop a workforce trained in the interdisciplinary scholarship needed to understand and address the complex issues of sustainability**

GOALS

Prior NSF SEES Activities

NSF sponsors 5 climate focused solicitations in FY10

- Earth Systems Modeling (EaSM)
  - $50-$35M total awards including DoE & USDA
- Ocean Acidification (OA)
- Dimensions of Biodiversity (DB)
- Water, Sustainability, and Climate (WSC)
- Climate Change Education (CCEP)

NSF issues Dear Colleague Letter

- Issued on January 2011 (NSF 11-022)
- Informs community on the planned future of SEES activities

Fiscal Year 2012 Priorities

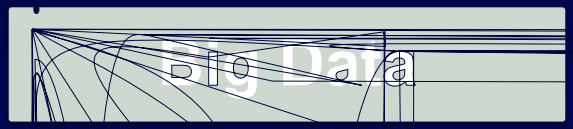
- Advance a clean energy future
- Nurture the emerging SEES workforce
- Expand research, education, and knowledge dissemination
- Develop interdisciplinary research networks
- Engage with global partners

Tremendous opportunity to build on NSF strengths and efforts

Role of CISE in SEES

Monitoring

- **Scalable sensing & data collection for sustainability apps**
  - Ocean ice dynamics
  - Biodiversity tracking,
  - Water quality & availability
  - Disaster monitoring
  - Human well being (e.g., healthcare for masses)
- **Sensing in difficult environments (e.g., arctic, wild-fires, animals)**
- **Working with citizen science data**



Workshops Exploring Sustainability

- US-China workshop on CS & Sustainability Challenge
  - DIMACS, Rutgers University, Sept 2011
  - http://dimacs.rutgers.edu/Workshops/China4/program.html
- Workshop on info. & comm. technologies for sustainability
  - SECON, Salt-lake City, June 2011
  - http://www.cs.ucdavis.edu/~liu/WICS/SustainabilityReport.pdf
- Role of Info., Sci. & Eng. In Sustainability
  - CCC workshop, Washington DC, Feb 2011
  - http://cra.org/ccc/seesit_report.php
- Science of sustainability workshop
  - Warrenton, VA, Nov 2009
  - www.nsf.gov/mps/dms/documents/SustainabilityWorkshopReport.pdf

CISE Centric Sustainability Programs

Core

- Energy efficient IT design and energy management
- Sensor networks and embedded computing for sustainability applications
- Increasing interest in broader sustainability aspects of computing

Cross Cutting

- Programs include Cyber Physical Systems (CPS) and Smart Health and Wellbeing (SHW)
- Includes projects in smart homes/buildings, smart grid, vehicles, healthcare, and more

Large Scale

- CISE Expedition awards funds up to $2M a year for up to 5 years
- Awards include projects on Computational Sustainability (Cornell) and Data Driven Climate Modeling (University of Minnesota)

Current SEES Portfolio

CISE Sponsored 2012

SEP
Sustainable Energy Pathways

SRN SEES
Sustainability Research Networks

RCN SEES
Research Coordination Networks

PIRE SEES
Partnerships for Int. Rsrch & Edu

SEES Fellows
Preparing New Researchers

Others 2012

WSC
Water Sustainability and Climate

CNH
Coupled Natural Human Systems

OA
Ocean Acidification

Past – not available

EASM
Modeling Earth Systems

DBD
Dimensions of Biodiversity

CCE
Climate Change Education

Common SEES Solicitation Requirements

Must be interdisciplinary by design

- Proposals fundable by core program of directorates not suitable.
- Integration of multi-disciplinary parts is important

Must promote interdisciplinary education & training

- Integrating multi-disciplinary education into core curriculum
- Enhancing cross disciplinary interaction
- Creation of infrastructure for multidisciplinary research
- Enhancing public's understanding of sustainable energy future

Must go beyond just creating technologies – need to consider social, economic, and environmental aspects

- Proposals requires only consideration, not in-depth treatment.
- Depth of treatment depends on proposal scope

FY12 Solicitations

1. SEP
2. RCN-SEES
3. SRN
4. Fellows
5. PIRE
6. WSC/CNH

Sustainable Energy Pathways

NSF 11-590

Amount

$34M for 15 -20 awards

Awards

Up to $500K/year
Up to 4 years

Requirements

At least 3 PIs (one lead, 2 co-PIs)
Represents 2 or more disciplines

Restrictions

Max 3 proposals per organization
Max 1 proposal per PI

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

- 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

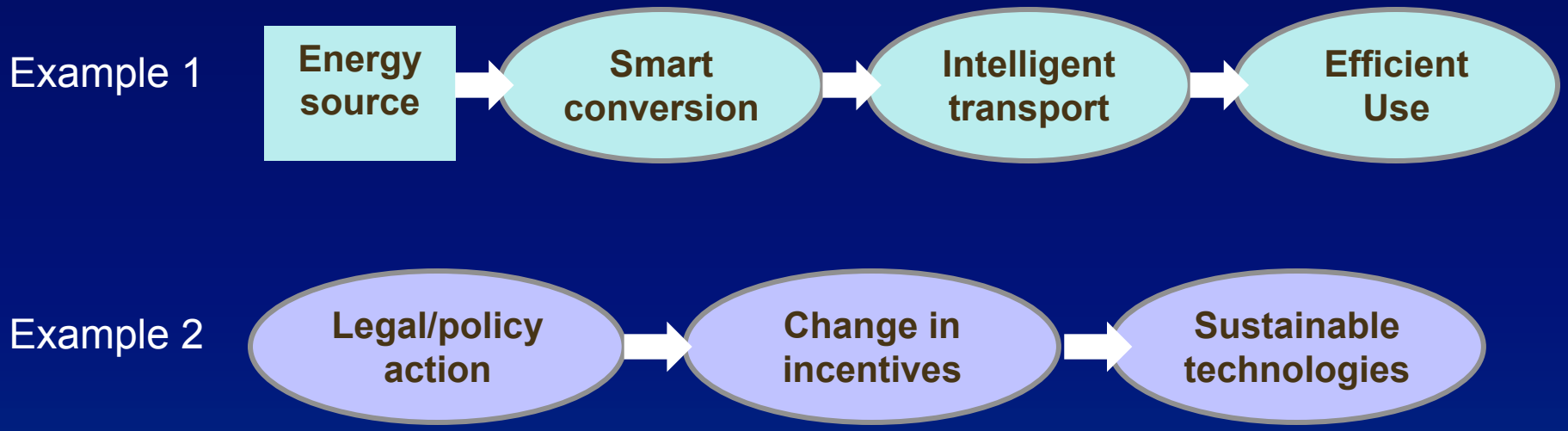
Due Date, Feb 01, 2012

SEP Requirements and Review Criteria

The extent to which the proposal articulates SEP vision	Synergistic engagement of multiple disciplines	Integration of education & workforce development in research
• Embraces the overarching theme of sustainability, • Develops and integrates scientific knowledge & technological innovation, with environmental, societal, & economic aspects.	• As reflected in the research plan, expertise/roles of PIs, and the project management plan	• As reflected in the potential effectiveness and impact in educating students and promoting public understanding of sustainable energy

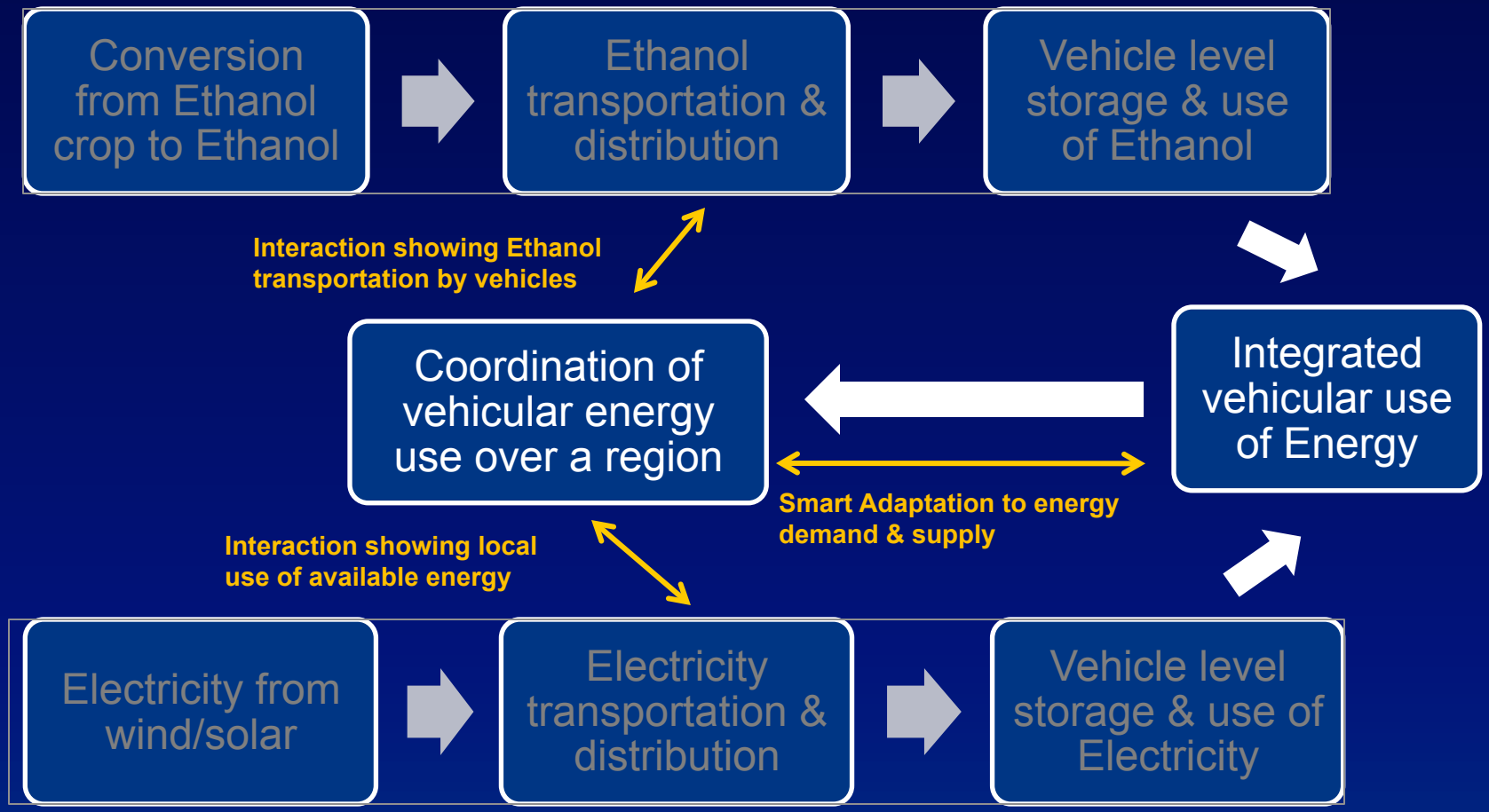
What is a Sustainable Energy Pathway?

A set of coordinated and well orchestrated steps to advance the goal of a sustainable energy future

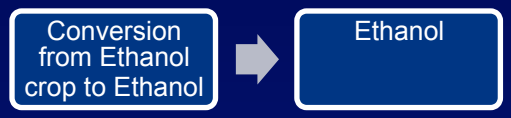


Energy Sub-Pathway for Transportation

Building the Entire Pathway



Some CISE Research Opportunities



Research Coordination Networks

NSF 11-531

Amount

$7.5M to $17.5M (pending availability) for 15-25 awards

Awards

Up to $750K total

Over 4 - 5 years

Requirements

No collaborative proposals; only subawards by lead institution

Restrictions

No participation limits

- Existing program with SEES track added for FY12
  - CISE supporting only the SEES track
- Supports collaboration between existing research efforts
  - Does not support research activities, only networking activities
  - Intended for creating new networks, not sustaining old ones
- Expected to include diverse organizations
  - International participation highly encouraged & expected to be of mutual benefit
  - Just involving multiple CS/CE participants is inadequate

Due Date: Feb 03, 2012

2011 RCN Awards

11 awards given in 2011, two of them co-sponsored by CISE

Sustainable Energy Systems

Arizona State U
Award: $750,000
Sponsors: CISE, OISE+

A collaborative network of University Centers, industrial partners, and regulatory agencies.

Seeks to exploit multidisciplinary advances in nanotechnology related to energy generation (e.g., photovoltaics), storage (e.g., batteries), and transmission (e.g., integration of renewables in the electric grid).

Sustainable Cities: People and the Energy-Climate-Water Nexus

Univ of Colorado at Denver
Award: $749,930
Sponsors: CISE,GEO,MPS+

A national network of researchers from 20+ US Universities and 2 National Labs. Collaborates with international sustainability research networks (in Australia, EU, Asia).

Research has an emphasis on reducing energy use and carbon emissions and mitigating climate-risks to water supply and public health in cities.

Two Past RCNs (2007)

GLEON

Global Lake Ecological Observatory Network

A network of limnologists, ecologists, IT experts, and engineers to build a scalable network of lake ecology observatories

FluxNet

A Global Network of Flux Tower Networks

An infrastructure to collect and distribute data using a global array of towers that measure CO2 exchanges, water vapor, and energy between biosphere and atmosphere.

Sustainability Research Networks

NSF 11-574

Amount

$36M for 3 - 4 awards

Awards

Up to $2.4M/year for up to 5 years

Amount requested to be consistent with project scope

Restrictions

Max 3 proposals per organization

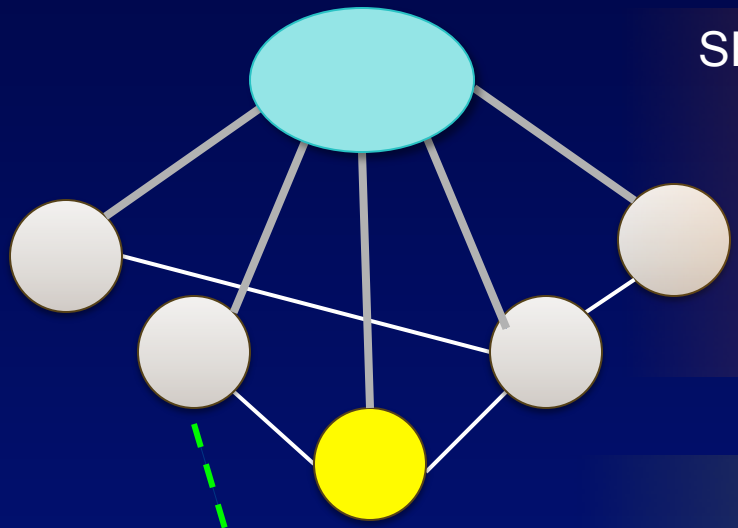
Max 1 proposal per PI

No collaborative proposals; only subawards by lead institution

- Goes beyond RCN-SEES
  - Intended for much larger, nationally important sustainability themes
  - Can fund gaps or new essential research for a comprehensive thematic coverage.
  - Can enhance existing research networks
- Encouraged to develop linkages with other networks, government entities, and the private sector, both nationally and internationally
- Multidisciplinary education and training are crucial components

Preliminary Due	December 1, 2011
Full Due	April 1, 2012
Site Visit	Summer 2012

CISE Opportunities in SRNs



PARTICIPATE

SRNs involving coordination of complex IT-infused ecosystems, e.g.,
large scale e-health or smart transportation systems,
Interactions between consumer segments of a resource

by contributing on CISE aspects of sustainability themes such as understanding, mitigation, and adaptation to global change, or responding to extreme events

CONNECT

in the future, and tap into a funded SRN via a RCN, PIRE, another SRN, or other project

SRN Review Criteria

Preliminary proposals

- Is the vision sufficiently compelling to justify the investment?
- Is there a framework to address social, economic, and environmental components?
- Is the goal of overcoming barriers to sustainable well-being addressed?
- Are the approaches proposed innovative and flexible?
- What are the contributions of partners and the management structure?
- Does the SRN leverage existing research/education nodes?
- Is there a plan to develop workforce for the tackling complex issues of sustainability?

Additional considerations for full proposals

- Quality of management plan and team
- Quality of educational activities and efforts to broaden participation
- Level of community participation and external engagement

Potential SRN Theme: Urban Sustainability

Situation

80% of US population lives in cities

Huge ongoing migration to cities in developing world

Complication

Megacities consume resources at prodigious rate

How do we develop sustainable urban systems?

Resolution

There are many opportunities for the CISE community to join in the search for solutions

(e.g., energy, food, water, health, transportation)

Potential SRN Theme: Energy Dynamics

Coordination of energy conversion, distribution, and consumption across multiple segments, e.g.,

- Distributed electricity generation from multiple sources and its two way flow
- Electricity consumption in homes, offices, factories, data centers, vehicles, etc.
- Fuel distribution & use in transportation systems, heating systems, etc.

NSF SEES Fellows

NSF 11-575

Amount

$6 - 8M for 12 - 20 awards

Awards

2 - 3 years of fellowship costs

$88K/year in salary, $20K/year in research expenses, $10K/year in international research costs

Requirements

Applicants must be US citizens, nationals, or permanent residents

Applicants must have received PhD within 4 years of deadline

Restrictions

One proposal/PI

To create the necessary workforce to enable discoveries leading to environmental, energy, and societal sustainability

- The Fellow's proposed research should:
  - Cross traditional disciplinary boundaries
  - Go beyond his/her current core disciplinary expertise
  - Address issues of sustainability through a systems approach
  - Build bridges between academic inquiry, economic growth, and societal needs
- Fellows must develop a research partnership in order to broaden the impact/scope of the proposed research
- Fellows are expected to devote time to a professional development activity

Due	December 5, 2011
Due Thereafter	First Monday in December

SEES Fellows review criteria

Full proposal (the prospective fellow is the PI)

- **Intellectual merit & broader impact criteria**
- **Additional criteria: will the proposed project**
  - **<u>SEES-related</u>**
    - Integrate across NSF-supported disciplines by creating new interdisciplinary networks/collaborations?
    - Advance the foundations of sustainability?
  - **<u>Research Host and Research Partner</u>**
    - Help the applicant expand beyond his or her current core disciplinary expertise?
    - Via the research partnership, broaden the impact and/or scope of the proposed research?
    - Via international partnerships, bring mutual benefit of expertise, facilities and/or resources?
  - **<u>Professional development</u>**
    - Enhance the applicant's professional growth while complementing the proposed research?

Partnerships for International Research and Education (PIRE)

NSF 11-564

Amount

$10 - 15M (annually) for 10 - 15 awards

Awards

$4M expected average award

Over 5 years

Requirements

Preliminary proposals required

Restrictions

1 proposal per institution (as lead)

Goals:

To facilitate development of a diverse, globally engaged US science and engineering workforce.

To promote opportunities where international collaboration can enable advances that could not occur otherwise.

To engage and share resources and infrastructure within and across institutions to build international partnerships.

- FY2012 solicitations focuses solely on SEES topics
- Encourages research on global sustainability including climate change, clean energy, food security, biodiversity, and communication networks.
- Proposals should address linkages across natural social and/or built environments

Preliminary Due	October 19, 2011
Full Due	May 15, 2012

Additional Opportunities for CISE

Coupled Natural Human Systems

- Quantitative, interdisciplinary analyses of human and natural system processes and complex interactions at diverse scales
- Support for exploratory awards & RCN

NSF 11-612

Amount

$17 for 5 - 17 awards

Awards

$150K to $1.5M, depends on award type

Due November 15, 2011

Water Sustainability and Climate

- Modeling to predict impact of climate variability and change, land use, and human activity on water systems.
- Developing adaptive water resource management
- Designing water systems to be more resilient and sustainable to meet diverse and conflicting needs

NSF 11-551

Amount

$31M for 12 - 26 awards

Awards

$150K to $1.5M, depends on award type

Due October 19, 2011

An Opportunity for CISE Community

The Time is Now

Sustainability problems are not going away

Support for sustainability research continues to expand

Please Participate!

Additional Resources

- SEES web links
  - Master site: www.nsf.gov/sees
    - Will have a link to this presentation
  - FAQs: http://www.nsf.gov/pubs/2011/nsf11039/nsf11039.jsp?org=NSF
  - DCL: http://www.nsf.gov/pubs/2011/nsf11022/nsf11022.jsp?org=NSF
- Questions
  - General queries on solicitations:
    - sep@nsf.gov, srn@nsf.gov, seesfellows@nsf.gov, PIRE-info@nsf.gov
  - SEES queries:
    - General: nsf-sees-info@nsf.gov
    - Discipline Specific: http://www.nsf.gov/geo/sees/sees_contacts.jsp

WHERE DISCOVERIES BEGIN