Research at NSF Addressing the Needs in Agriculture and Natural Resources: Past, Present, Future Thoughts

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Co-Chair, INFEWS Working Group
Past - SEES
Science, Engineering, and Education for Sustainability

- Established FY 2010
- Cross-NSF effort
- Partnerships (e.g., other federal agencies, international)
- Goals
  - To support interdisciplinary research and education that can facilitate the move towards global sustainability
  - To build linkages among existing projects and partners and add new participants in the sustainability research enterprise
  - To develop a workforce trained in the inter-disciplinary scholarship needed to understand and address complex sustainability issues
SEES - FY15 examples

Urban Sustainability Research Networks – April 2014 proposal deadline.

SusChEM

ArcSEES – July 2014 deadline.

Hazards SEES – December 2014 proposal deadline; 150 proposals received.

CyberSEES – February 2015 proposal deadline

Dimensions of Biodiversity - April 2015 proposal deadline

Coastal SEES – October 2015 proposal deadline
Food-Energy-Water in SEES

17 workshop grants, approx. $1 M

- Held across the country – unique situations exist
- Designed to facilitate partnerships among researchers
- Integrate Scientific Communities, including those at other federal agencies; enhance communication
- Define fundamental science and engineering research needs/questions in FEW Systems

Press Release 15-090
New grants foster research on food, energy and water: a linked system

Amid population growth, drought and increased urbanization, understanding food, energy and water availability is increasingly important

How food, water and energy systems interact: a photo gallery.
Credit and Larger Version

August 14, 2015
In a world where a growing number of people lack food, water and sources of energy, providing these resources has become a challenge.

To find new answers, the National Science Foundation (NSF) has funded 17 grants, totaling $1.2 million, to support workshops on the interactions of food, energy and water, or FEW. Additionally,
Food-Energy-Water in SEES

- Supplements, approx. $6 M
  - Awarded to existing grants (27) to incorporate F/E, W/E, F/W into FEW

Ken Carlson, Colorado State Univ.
Current Initiatives and Some Future Thoughts

• Risk and Resilience
  – Prediction of and Resilience against Extreme Events (PREEVENTS)
  – Critical Resilient Interdependent Infrastructure Systems (CRISP)

• Innovations at the Nexus of Food, Energy, and Water (INFEWS)
PREEVENTS – Prediction of and Resilience against Extreme Events

- Better understand risks posed by GEO-relevant natural hazards and extreme events through basic geoscience research, in order to help increase resilience and reduce impacts on life, society, and the economy.
- Proposed PREEVENTS Projects
  - Enhance understanding of fundamental processes underlying natural hazards and extreme events on various scales, and variability inherent in such hazards/events
  - Improve capability to model and forecast such hazards and events
Natural Disasters show no sign of Decreasing

- **Geophysical Events**
  (Earthquake, tsunami, volcano)
- **Meteorological Events**
  (tropical storm, extratropical storm, convective storm)
- **Hydrological Events**
  (flood, mass movement)
- **Climatological Events**
  (extreme temperature, drought, forest fire)

2016 Munich Re (as of July 2016)
Prediction of and Resilience against Extreme Events (PREEVENTS)

PROGRAM SOLICITATION
NSF 16-562

National Science Foundation
Directorate for Geosciences
Division of Atmospheric and Geospace Sciences
Division of Earth Sciences
Division of Ocean Sciences
Division of Polar Programs

Letter of Intent Due Date(s) (required) (due by 5 p.m. submitter’s local time):

July 29, 2016

Last Friday in July, Every Other Year Thereafter

Required for Track 2 Proposals

Full Proposal Deadline(s) (due by 5 p.m. submitter’s local time):

September 20, 2016

Third Tuesday in September, Every Other Year Thereafter

Track 2 Proposals

Submission Window Date(s) (due by 5 p.m. submitter’s local time):

August 01, 2016 - January 04, 2017

Track 1 (conferences): see proposal preparation instructions for further details

January 05, 2017 - January 04, 2018

January 5 - January 4, Annually Thereafter

Track 1 (conferences): see proposal preparation instructions for further details
CRISP - Critical Resilient Interdependent Infrastructure Systems and Processes

Critical Resilient Interdependent Infrastructure Systems and Processes FY17 (CRISP)

PROGRAM SOLICITATION
NSF 16-618

REPLACES DOCUMENT(S):
NSF 16-519

National Science Foundation

Directorate for Engineering
Division of Civil, Mechanical and Manufacturing Innovation
Division of Electrical, Communications and Cyber Systems
Division of Chemical, Bioengineering, Environmental and Transport Systems
Emerging Frontiers and Multidisciplinary Activities

Directorate for Social, Behavioral & Economic Sciences
Division of Behavioral and Cognitive Sciences
Division of Social and Economic Sciences

Directorate for Computer & Information Science & Engineering
Division of Computer and Network Systems
Division of Advanced Cyberinfrastructure

Full Proposal Deadline(s) (due by 5 p.m. submitter’s local time):
February 08, 2017

IMPORTANT INFORMATION AND REVISION NOTES

IMPORTANT WEBCAST: The NSF will hold an informational webcast on Monday, December 5, 2016 at 1:30pm EST to discuss the CRISP program and answer questions about this solicitation. More details about the webcast will be posted on the CMMI website, https://www.nsf.gov/od/divr/cmmi, as they become available.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 17-1). NSF anticipates release of the PAPPG in the Fall of 2016 and it will be effective for proposals submitted, or due, on or after January 30, 2017. Please be advised that proposers who opt to submit prior to January 30, 2017, must also follow the guidelines contained in NSF 17-1.
CRISP Objectives
ENG, CISE, SBE

1. Create new knowledge, approaches, solutions to increase resilience, performance, readiness in ICIs
2. Create theoretical frameworks/multidisciplinary models of ICIs, processes and services for prediction of complex behaviors
3. Develop frameworks to understand interdependencies created by interactions between physical, cyber, social, behavioral and economic elements of ICIs
4. Understand organizational, social, psychological, legal, economic, technical obstacles and enablers to improving ICIs
5. Undertake creation, curation or use of publicly accessible data on ICIs
CRISP: Past Funding

Energy
Transportation
Communications
Water
Information Technology
Nuclear Reactors, Materials and Waste
Healthcare and Public Health
Government Facilities
Defense Industrial Base
Banking and Finance
Chemical
Commercial Facilities
Critical Manufacturing
Dams
Emergency Services
Food and Agriculture
National Monuments and Icons
Postal and Shipping

2014
2015
2016
Growing populations, changes in land use, and increasing geographic and seasonal variability in precipitation patterns are placing ever-increasing stresses on the critical resources of food, energy and water (FEW).

Amy Landis studies the feasibility of restoring soils degraded by industrial wastes and other pollutants for growing bioenergy crops. Credit: Jessica Hochreiter/Arizona State University
Nexus: System of Systems

K. Carlson, Colorado State Univ.

J. Crittenden, et al., Georgia Tech

D. Aguscinata,
Northern Illinois Univ.
INFEWS Goals

- Understand the FEW system (of systems) through integrated systems modeling;
- Create methodologies for effective data integration/cyber elements;
- Research innovative solutions; and,
- Support education, workforce, and community development.
INFEWS in FY16 – “Options”

• Dear Colleague Letter - focuses the community on responding topically in a “core”, unsolicited program in a specific directorate; normally $300-500K for 3-5 years

• Solicitations – directed toward specific needs; cross directorate; larger $$
  – NSF Research Traineeship
  – EPSCoR
  – INFEWS
Recycle, Reuse: “The availability of nitrogen, phosphorus, and water are the three main factors that limit our ability to produce enough food to feed the growing population of the planet”
INFEWS in FY16 - NRT

Approx. $9M for 3 awards

Priority Area in Traineeship Track

- Development of innovative and potentially transformative approaches to graduate education
- Dissemination of outcomes and gained insights from NRT training approaches.
- Comprehensive training of STEM graduate students, including the development of technical and professional skills for both research and research-related careers within and outside academia.
- Evidence-based strategies to broaden participation of students from diverse backgrounds.
- Robust formative assessment that is central to the traineeship and routinely informs and improves practice.

New Solicitation: LOI were due in Dec.

NRT-INFEWS: STEM Training for Actionable Research and Global Impact

NRT INFEWS: UM BRIDGES: Bridging Divides across the Food, Energy, and Water Nexus

NRT-INFEWS: Paths to Sustainable Food-Energy-Water Systems in Resource-Limited Communities
INFEWS in FY16 – EPSCoR

Approx. $30M for 7 awards

EPSCoR Research Infrastructure Improvement Program:
Track-2 Focused EPSCoR Collaborations (RII Track-2 FEC)

PROGRAM SOLICITATION
NSF 16-511

REPLACES DOCUMENT(S):
NSF 15-517

Letter of Intent Due Date(s) (required) (due by 5 p.m. proposer's local time): January 11, 2016
Full Proposal Deadline(s) (due by 5 p.m. proposer's local time): February 04, 2016

Sustainable socio-economic, ecological, and technological scenarios for achieving global climate stabilization through negative CO2 emission policies

Sensing and Educating the Nexus to Sustain Ecosystems (SENSE)

Emergent Polymer Sensing Technologies for Gulf Coast Water Quality Monitoring

Center for a Sustainable Water, Energy, and Food Nexus (SusWEF)

Improving Water Management, Treatment and Recovery in Oil and Gas Production

Collaborative Research and Education on Synergized Transformational Solar Chemical Looping and Photo-Ultrasonic Renewable Biomass Refinery

Assembling Successful Structures: Lignin Beads for Sustainability of Food, Energy, and Water Systems
INFEWS in FY16 – INFEWS
Approx. $40M for 17 awards – Partnership with USDA NIFA

- Interdisciplinary
  - NSF represents a broad base of science and engineering disciplines
- Investigation of the system
- Education and workforce
  - Preparing the next generation of scientists and engineers
  - Community outreach

Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

PROGRAM SOLICITATION
NSF 16-524

National Science Foundation
Directorate for Geosciences
Directorate for Engineering
Directorate for Computer & Information Science & Engineering
Directorate for Mathematical & Physical Sciences
Directorate for Social, Behavioral & Economic Sciences
Directorate for Education & Human Resources
Office of International Science and Engineering
Office of Integrative Activities

USDA
National Institute of Food and Agriculture

Full Proposal Deadline(s) (due by 5 p.m. proposer’s local time):
March 22, 2016

IMPORTANT INFORMATION AND REVISION NOTES
Any proposal submitted in response to this solicitation should be submitted in accordance with the revised NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 16-1), which is effective for proposals submitted, or due, on or after January 25, 2016. Please be advised that proposers who opt to submit prior to January 25, 2016, must also follow the guidelines contained in NSF 16-1.

New Solicitation: 3 tracks, due March 6
| T1: Monitoring and managing food, energy, and water systems under stress: The California crucible |
| T1: Understanding multi-scale resilience options for climate-vulnerable Africa |
| T1: Increasing regional to global-scale resilience in FEW systems through coordinated management of storage in concert with innovations in technology and institutions |
| T1: Mesoscale Data Fusion to Map and Model the U.S. FEW system (INFEWSion) |
| T2: iNFEWCoordNet – A secure decision support system for coordination of adaptation planning among FEW actors in the Pacific Northwest |
| T2: Flexible Model Compositions and Visual Representations for Planning and Policy Decisions at the Sub-regional level of the food-energy-water nexus |
| T2: The sustainability-productivity tradeoff: Water supply vulnerabilities and adaptation opportunities in California’s coupled agricultural and energy sectors |
| T3: A multi-scale platform for technology evaluation and decision-making in the dairy-water-energy nexus |
| T3: Advancing Technologies and Improving Communication of Urine-Derived Fertilizers for Food Production Within a Risk-Based Framework |
| T3: Rethinking Dams: Innovative hydropower solutions to achieve sustainable food and energy production, and sustainable communities |
| T3: Managing Energy, Water, and Information Flows for Sustainability across the Advanced Food Ecosystem |
| T3: Climate Change Mitigation via Reducing Household Food, Energy and Water Consumption: A Quantitative Analysis of Interventions and Impacts of Conservation |
| T3: Social-ecological-technological solutions to waste reuse in food, energy, and water systems (ReFEWS) |
| T4: Educational immersive simulations to enhance understanding of corn-water-ethanol-beef system nexus |
| T4: The INFEWS-ER: a Virtual Resource Center Enabling Graduate Innovations at the Nexus of Food, Energy, and Water Systems |

Note: gray row indicates USDA/NIFA funding in total
INFEWS/T3: Solar Powered Integrated Greenhouse (SPRING) System - 1639429
Brendan O’Connor (PI), North Carolina State University

Research spans a range of disciplines to achieve a new food-energy-water paradigm
Credit: Brendan O’Connor, North Carolina State University
Future Thoughts: INFEWS

The teams are led by a broad variety of scientists and engineers

- Scientists: geological, computer, atmospheric, anthropologists
- Engineers: civil, computer, chemical, environmental, agricultural

Each team has at least three different disciplines represented

The teams have addressed the SYSTEM

- F and E and W

Many of the team members participated in workshops

There are some international projects
Sustainable Urban Global Initiative (SUGI): Food-Water-Energy Nexus

The Sustainable Urban Global Initiative (SUGI)/Food-Water-Energy Nexus is a call jointly established by the Belmont Forum and the Joint Programming Initiative Urban Europe. The cooperation was established in order to bring together the fragmented research and expertise across the globe to find innovative new solutions to the Food-Water-Energy Nexus challenge.

The call aims to develop more resilient, applied urban solutions that bring inter- and trans-disciplinary research and innovation together from across the globe, to benefit a much wider range of stakeholders. The rapid urbanization of the world’s population underscores the importance of this focus. International partners are invited to develop solutions targeting this Food-Water-Energy Nexus challenge.
The Belmont Challenge

This guiding principle of all Belmont Forum Collaborative Research Actions is called the Belmont Challenge:

To deliver knowledge needed for action to mitigate and adapt to detrimental environmental change.

The Challenge requires:

- Assessments of risks, impacts and vulnerabilities, through regional and decadal-scale analysis and prediction;
- Information on the state of the environment, through advanced observing systems;
- Interaction of natural and social sciences;
- Enhanced environmental information service providers to users;
- Effective international coordination mechanisms.

Timeline

- Call opening 9 December 2016
- Pre-proposal deadline 15 March 2017
- Invitations to submit full proposal May 2017
- Funding decisions announced December 2017
- Start of projects December 2017-March 2018
- Projects end January 2021
Website

https://foodenergywater.wordpress.com/

FOOD ENERGY WATER

NSF INNOVATIONS AT THE NEXUS OF FOOD + ENERGY + WATER SYSTEMS

FUNDING • EVENTS • ABOUT • WHAT'S NEW WITH FEW