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

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

• World population projected to reach 9 billion by 2050; corresponding US population 400 million.
• Population growth and economic growth leading major increases in demand for 3 critical resources: energy, water, and food.
• Increased variability in precipitation and temperatures will add to the coupling and stress on these resources.
More Food, Water, and Energy will be Needed

- 60% more food will be needed by 2050
- 80% more energy consumption by 2050
- 50% more water withdrawals in the developing nations by 2025
- 18% more water withdrawals in the developed nations by 2025
CHANGE IN PRECIPITATION BY END OF 21st CENTURY
inches of liquid water per year

as projected by NOAA/GFDL CM2.1

Source: NOAA
Nexus Thinking

• Globally, 70% of all fresh water withdrawals for agriculture
• 30% of energy used for food production and supply chains
• Bioenergy concepts couple food to energy production
Nexus: System of Systems

K. Carlson, Colorado State Univ.

D. Aguscinata, Northern Illinois Univ.

J. Crittenden, et al., Georgia Tech
Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS)

- Advance understanding of the FEW system through quantitative and computational modeling
- Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability
- Enable research that will lead to innovative solutions to critical FEW problems
- Grow the scientific workforce capable of studying and managing the FEW systems
Food-Energy-Water in FY15

- 17 workshop grants
  - 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
<table>
<thead>
<tr>
<th>Proposal</th>
<th>Title</th>
<th>PI</th>
<th>PI institution</th>
<th>Amount</th>
<th>Confirmed Dates</th>
<th>Workshop Location</th>
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</thead>
<tbody>
<tr>
<td>1542770</td>
<td>FEW NSF Workshop: Closing the Human Phosphorus Cycle</td>
<td>Platz</td>
<td>U Hawaii Hilo</td>
<td>$87,873</td>
<td>Jun 8 - 9, 2015</td>
<td>Arlington</td>
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<tr>
<td>1541876</td>
<td>FEW: A Workshop to Identify Interdisciplinary Data Science Approaches and Challenges to Enhance Understanding of Interactions of Food Systems and Water Systems</td>
<td>Shekhar, Shashi</td>
<td>UMN</td>
<td>$50,000</td>
<td>Oct. 5 - 6, 2015</td>
<td>Washington DC or MN</td>
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<tr>
<td>1541883</td>
<td>FEW: Food-Energy-Water Nexus Workshop to Develop System Approaches and Sustainability Metrics for Evaluation</td>
<td>Schuster, Darlene S</td>
<td>American Institute of Chemical Engineers</td>
<td>$94,929</td>
<td>Oct. 7-9, 2015</td>
<td>Washington, DC</td>
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<tr>
<td>1541790</td>
<td>FEW: Coupling Economic Models with Agronomic, Hydrologic, and Bioenergy Models for Sustainable Food, Energy, and Water Systems</td>
<td>Catherine King</td>
<td>Iowa State University</td>
<td>$45,922</td>
<td>Oct 11-12, 2015</td>
<td>Iowa State University; Ames, Iowa</td>
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<tr>
<td>1541807</td>
<td>FEW: Workshop to Identify Opportunities and Challenges for Nanotechnology to Optimize and Unify Food, Energy and Water Systems</td>
<td>Stone, James J</td>
<td>South Dakota School of Mines and Technology</td>
<td>$50,000</td>
<td>Oct 19 - 20, 2015</td>
<td>SDGM&amp;Tin Rapid Cty, SD</td>
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<td>1541736</td>
<td>FEW: A sustainable rural framework workshop for the upper Great Plains</td>
<td>McNider, Richard</td>
<td>University of Alabama in Huntsville</td>
<td>$56,335</td>
<td>Oct 21-23, 2015</td>
<td>NCAR, Boulder</td>
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<td>1541868</td>
<td>FEW Workshop: Water- and Energy-efficient Food Production: Solutions for America’s Bread Basket</td>
<td>Rezac, Mary E</td>
<td>Kansas State University (EPSCoR)</td>
<td>$50,000</td>
<td>Nov 19-20, 2015</td>
<td>Manhattan, Kansas; Governor’s Conference Nov. 18 - 19</td>
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<td>1541863</td>
<td>FEW: Technology and Information Fusion Needs to Address the Food, Energy, Water Systems (FEWS) Nexus Challenges</td>
<td>Ebert, David</td>
<td>Purdue</td>
<td>$60,105</td>
<td>Nov. 5-6</td>
<td>Napa Valley Marriott Hotel and Spa</td>
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<tr>
<td>1541694</td>
<td>FEW: River FEWS: Workshop to explore the nexus between food, energy and water in a large international river system</td>
<td>Holtgrieve, G.W.</td>
<td>University of Washington</td>
<td>$98,367</td>
<td>Dec. 10-12, 2015</td>
<td>U. Washington, Seattle</td>
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</tbody>
</table>
Food-Energy-Water in FY15

Supplements to existing grants to incorporate food components

Ken Carlson, Colorado State Univ.

R. Luthy et al., Stanford Univ.

D. Reinhart, Univ. of Central Florida
INFEWS in FY16

- Interdisciplinary
- Investigation of the coupled system
- Partnership with USDA NIFA
- Education and workforce
  - Preparing the next generation of scientists and engineers
  - Community outreach
INFEWS in FY16

“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

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.
INFEWS in FY16 - EPSCoR

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

National Science Foundation
Office of Integrative Activities

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

IMPORTANT INFORMATION AND REVISION NOTES

The following EPSCoR jurisdictions are RII eligible for the FY 2016 RII Track-2 FEC competition: Alabama, Alaska, Arkansas, Delaware, District of Columbia, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Hampshire, New Mexico, North Dakota, Oklahoma, Puerto Rico, Rhode Island, South Carolina, South Dakota, Vermont, US Virgin Islands, West Virginia, and Wyoming.

- There is a limit of a single proposal from each submitting organization.
- Each proposal must have at least one collaborator from an academic institution or organization in a different RII-eligible EPSCoR jurisdiction as a co-Principal Investigator (co-PI). Proposals with a PI and all co-PIs from the same jurisdiction will be returned without review.
- For FY 2016, RII Track-2 FEC proposals promote collaborations among researchers in EPSCoR jurisdictions on these topics: 1) Understanding the Brain, or 2) Sustainable Food, Energy, and Water Systems.
- The recruitment and/or development of diverse early-career faculty is a critical component of successful proposals.
- The extent and quality of the interjurisdictional collaborations must be clearly articulated.
- A Letter of Intent (LOI) is required for the FY 2016 RII Track-2 FEC competition. LOIs must be submitted by the Sponsored Project Officer (SPO) and must be in electronic format.
- PIs and co-PIs on current NSF EPSCoR RII awards with end dates later than October 31, 2015 are not eligible to submit proposals as a PI or co-PI in this competition.
- Support for nonlead collaborating institutions should be requested as subawards. Separately submitted collaborative proposals are not allowed.
- Proposal titles must begin with “RII Track-2 FEC” and follow with an informative title in the treecode area.
- Allowable RII Track-2 FEC award amounts depend on the size of the collaboration. If two RII-eligible EPSCoR jurisdictions collaborate on a proposal, the award amount may not exceed $1 million per year. If three or more RII-eligible EPSCoR jurisdictions collaborate on a proposal, the award amount may not exceed $1.5 million per year. In either case, awards are for a maximum of four years.
- Awards will be expected to participate in a joint project data collection effort. See Section V.B for corresponding budget requirements.
- Page limits apply. See Section V.
- No letters of commitment should be included in the Supplementary Documents. See Section V.A.10.
- A maximum of five letters of support may be included. See Section V.A.10.
- Collaborators and Other Affiliations Information is now required to be submitted with the proposal as a Single Copy Document. This replaces the List of Contacts required in Supplemental Documentation in prior solicitations. See GPO Chapter II Section C.1.6.
Innovation Corps (I-Corps)

• Designed to foster entrepreneurship that will lead to the commercialization of NSF-funded research
  – Uses customer discovery and business model development to validate commercialization opportunities
  – Successful I-Corps projects will be prepared for business formation
• Distinct components of I-Corps program
  – Teams - Composed of Principal Investigator (PI), Entrepreneurial Lead (EL), and Mentor (M)
  – Nodes - Hubs for education, infrastructure, and research that engage academic scientists and engineers in innovation
  – Sites - Academic institutions that catalyze the engagement of local teams in technology transition and strengthen local innovation
I-Corps process

Pool of eligible PIs & projects: ~50,000 projects (NSF)

Pool of eligible Teams (from NSF):
- EL
- PI
- Mentor

Recruiting processes (NSF)

Team Selection (NSF)

Node Assignment (NSF)

Curriculum Delivery & Refinement (Nodes)

Business Model Canvasses (Teams)

Customer Discovery (Teams/Nodes)

“Go” Decision (Teams)

“No-Go” Decision (Teams)

Resource Infusion

Private Sector

Strategic Partnership

Private Capitalization

Public Funding (e.g., SBIR, STIR, ...)

Pool of eligible Teams (from I-Corps Sites)

Awarded I-Corps Teams (NSF)
I-Corps Nodes and Sites

- 7 Nodes
- 51 Sites
- 645 Teams trained to date
- 220 startups created