**NATIONAL SCIENCE FOUNDATION**
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**ARLINGTON, VIRGINIA 22230**

**NSF 17-099**

# Dear Colleague Letter: NSF/NSFC Joint Research on Environmental Sustainability Challenges

Replaces NSF 16-092

July 17, 2017

Dear Colleagues:

The NSF Engineering and Geosciences Directorates (ENG and GEO) and the National Natural Science Foundation of China (NSFC) Department of Engineering and Material Sciences (DEMS) and Department of Geosciences are partnering to encourage joint research by U.S. - China teams collaborating on fundamental research that addresses critical environmental sustainability challenges.

Among nations, the U.S. and China have the two largest economies on Earth and also have important engineering, technology, business and trade relationships with each other. Both nations face significant environmental sustainability challenges, for example in the food-energy-water (FEW) nexus, urban sustainability, global change, and manufacturing. Fundamental research is needed to provide the foundational knowledge for addressing these challenges.

This call is for research proposals from joint U.S. - China teams in the environmental sustainability themes of:

**"Innovations at the Nexus of Food, Energy, and Water Systems (INFEWS: U.S.-China)"**

1. **Quantitative and computational modeling of a FEW system**
2. **Innovative human and technological solutions to critical FEW systems problems.**

Every proposal must include the participation of researchers from at least one U.S. institution and at least one institution in China. Proposals that do not comply with this requirement will be returned without review. The proposal submitted to NSF must conform to NSF proposal requirements as specified in NSF's posted Proposal and Award Policies and Procedures Guide (PAPPG) (NSF 17-1), and the matching proposal submitted to NSFC must conform to requirements posted by NSFC. NSF will fund the U.S. researchers of winning teams (up to a total of $500K for 4 years for each winning proposal), while NSFC will fund the China researchers of winning teams (up to a total of 3

million yuan for 4 years for each winning proposal). In total, no more than 7 joint NSF-NSFC project grants are expected to be funded. Each proposal must include a management plan that clearly specifies the role of team researchers from both the U.S. and China, and the mechanisms through which close collaboration will be assured. The management plan is not to exceed 3 pages and is to be included in the supplementary document file of the electronic submission.

Cyberinfrastructure proposals are outside the scope of this call.

## INTRODUCTION

Humanity depends upon the physical resources and natural systems of the Earth for the provision of food, energy, and water (FEW). These three fundamental human requirements are intricately interrelated in complex ways that are not considered when each is produced and provided for societal uses; this omission leads to inefficiencies and overuse of resources. FEW systems are increasingly facing multiple stresses, including, but not limited to, increasing global populations, rapid land use change, shifting social, economic and governance norms, and escalating climate variability. Heterogeneous resource distribution and access, increasing resource scarcity, degraded resource quality, and diminished ecosystem services also challenge long-term FEW system sustainability. It is becoming increasingly imperative that we determine how society can best integrate across the natural and built environments to provide for growing demands for food, water and energy while maintaining appropriate ecosystem services. Interconnections and interdependencies associated with the FEW nexus create research grand challenges for understanding how the complex, coupled processes of society and the environment function. To meet these grand challenges, FEW systems must be conceptualized broadly, incorporating physical processes (i.e., built infrastructure and new technologies for more efficient resource utilization), natural processes (i.e., biogeochemical and hydrologic cycles), biological processes (i.e., agroecosystem structure and productivity), and social/behavioral processes (i.e., decision making and governance). Investigations of these complex, interrelated, and overlapping systems may produce discoveries that cannot emerge from research on food or energy or water systems alone. It is the synergy among these components in the context of sustainability that will open innovative science and engineering pathways to produce new knowledge and novel technologies to solve the challenges of scarcity and variability.

The initiative goals for "Innovations at the Nexus of Food, Energy, and Water Systems for US and China (INFEWS:US-China)" are to:

1. significantly advance our understanding of the food-energy-water system through quantitative and computational modeling and
2. enable research that will lead to innovative human and technological solutions to critical FEW systems problems.

These two goals require systems approaches, which may be defined at a wide range of temporal and spatial scales, locally to globally. Each proposal must define the FEW systems intended for study, identifying the systems boundaries and the primary food and energy and water components in these systems. Although many disciplinary challenges remain in FEW systems research, this initiative intends to foster new lines of research that emerge only in an interdisciplinary context.

**Theme 1:** The first theme is to significantly advance understanding of FEW systems with advanced modeling that investigates the coupled biotic, abiotic, engineered and social systems and the couplings and feedback mechanisms among FEW system components. Projects may use a wide variety of different systems analyses and modeling approaches to explore the functional dynamics of FEW systems. Some projects might integrate across models from multiple disciplinary domains, including, but not limited to agricultural, behavioral, computational, cultural, ecological, economic, energy, engineering, geospatial, hydrological, mathematical, and social. Systems chosen for study must be examined to define/quantify spatially heterogeneous FEW systems responses to various internal and external driving factors that occur on both short and long timescales. FEW systems operation must be investigated under the influence of single and multiple driving factors. FEW models should allow for investigation of system resiliency, attempt to identify thresholds, and explore system response to variability among critical parameters singly, in combination, or at extreme values.

**Theme 2:** The second theme is to develop and examine innovative solutions that address specific FEW system challenges and enhance FEW systems" resilience and sustainability. This research may explore sustainable management solutions, examine drivers of resource consumption, and study ways to extend resources via methods such as reducing, recycling, recovery, and reuse. Projects should demonstrate how the envisioned solution will contribute to a healthy balance across sectors and places, and how sectors and places might vary over temporal and spatial scales. Specific areas of interest include, but are not limited to:

- Efficient Use of Resources: Scientific and engineering solutions to improve FEW systems efficiencies should be coupled with new knowledge of how ecological, economic, social, and physical systems interact. Projects can address production, consumption and waste and how FEW systems interact with each other in technical and non-technical domains.
- Conversion and/or Reuse of Waste Materials: New devices, sensors, catalysts, nanomaterials, smart filters, and processes may be required to detect, remove, destroy or convert compounds of concern from waste streams, or to turn waste constituents into valuable primary or secondary products. Both technical aspects and human factors will be important in the decision-making process.
- System Sustainability: INFEWS: US-CHINA aims to encourage research on innovative strategies for appropriate management of natural and physical systems, including consideration of use, access, and governance. Sustainability solutions might incorporate physical sciences, biological sciences, computer sciences, institutional, economic, behavioral, and technical components.

## PROPOSAL SUBMISSION

U.S.-based researchers, through their U.S. institutions, may submit unsolicited proposals to collaborate with China-based researchers on the INFEWS topic described above to a central NSF receiving program for such proposals. The central receiving program is the ENG/CBET Environmental Sustainability (7643) program, and the submission window is October 1 - October 20, 2017. The window closes at 5:00 pm submitter's local time on October 20, 2017. More information on submittal procedures is posted at: https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505338.

Each U.S. - China team is responsible for ensuring that their counterpart submits a matching proposal by the required deadline. Each submitted proposal must include a letter from the collaborator. For NSF proposals, the collaborator letter is to be included in the supplementary documents file of the electronic submission, along with the management plan described earlier.

## REVIEW AND AWARD PROCESS

The review and award process will follow NSF and NSFC guidelines specified in their respective policy documents. NSF and NSFC will conduct separate reviews of eligible submitted proposals in accordance with their review policies and regulations. NSF and NSFC will reach consensus, through discussion, on which projects are high enough priority to both sides to warrant joint funding. NSF and NSFC will make awards to the U.S. and Chinese institutions respectively.

Questions concerning this opportunity may be emailed to the CBET Environmental Sustainability program director, Bruce Hamilton (bhamilto@nsf.gov), the CBET INFEWS program director, James Jones (jwjones@nsf.gov), or the Earth Sciences Division Director, Carol Frost (cfrost@nsf.gov).

Sincerely,

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