

# EMERGING FRONTIERS IN RESEARCH AND INNOVATION 2009 (EFRI-2009)

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1. BioSensing & BioActuation: Interface of Living and Engineered Systems (BSBA)
2. Hydrocarbons from Biomass (HyBi)

## PROGRAM SOLICITATION NSF 08-599

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**REPLACES DOCUMENT(S):**  
NSF 07-579

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### National Science Foundation

Directorate for Engineering  
Emerging Frontiers in Research and Innovation

**Letter of Intent Due Date(s) (required)** (due by 5 p.m. proposer's local time):

October 14, 2008

**Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. proposer's local time):

December 02, 2008

**Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

April 30, 2009

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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**Program Title:**

Emerging Frontiers in Research and Innovation (EFRI)

1. BioSensing & BioActuation: Interface of Living and Engineered Systems (BSBA)
2. Hydrocarbons from Biomass (HyBi)

**Synopsis of Program:**

The Directorate for Engineering at the National Science Foundation has established the Office of Emerging Frontiers in Research and Innovation (EFRI) to serve a critical role in focusing on important emerging areas in a timely manner. The EFRI Office is launching a new funding opportunity for interdisciplinary teams of researchers to embark on rapidly advancing frontiers of fundamental engineering research. For this solicitation, we will consider proposals that aim to investigate emerging frontiers in the following two specific research areas: (1) BioSensing & BioActuation: Interface of Living and Engineered Systems (BSBA), and (2) Hydrocarbons from Biomass (HyBi).

EFRI seeks proposals with transformative ideas that represent an opportunity for a significant shift in fundamental engineering knowledge with a strong potential for long term impact on national needs or a grand challenge. The proposals must also meet the detailed requirements delineated in this solicitation.

**INFORMATION WEBCAST:** The EFRI Office plans to hold an information workshop on September 10, 2008, to answer any questions about the EFRI Office and this solicitation. Details will be posted on the EFRI website ([www.nsf.gov/eng/efri](http://www.nsf.gov/eng/efri)) as they become available.

**Cognizant Program Officer(s):**

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**Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):**

- 47.041 --- Engineering

## Award Information

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**Anticipated Type of Award:** Standard Grant

**Estimated Number of Awards:** 11 (4-year awards)

**Anticipated Funding Amount:** \$22,000,000 to \$29,000,000 in FY 2009, pending the availability of funds.

## Eligibility Information

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**Organization Limit:**

Proposals may only be submitted by the following:

- EFRI proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers and with private and public sector organizations, government laboratories, and scientists and engineers at foreign organizations where appropriate, though no NSF funds will be provided to those organizations.

**PI Limit:**

Principal Investigators (PI) must be at the faculty level and the lead PI must have a primary appointment in an engineering department. In addition, a minimum of two Co-PIs must participate.

**Limit on Number of Proposals per Organization:**

None Specified

**Limit on Number of Proposals per PI: 1**

The principal investigator and co-principal investigators may participate in one proposal submitted to this solicitation. It is the responsibility of the submitting institution to insure that the PI and all co-PIs are participating only in one proposal submitted to this solicitation.

## Proposal Preparation and Submission Instructions

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**A. Proposal Preparation Instructions**

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.

- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg).
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf>)

## B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required under this solicitation.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

## C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. proposer's local time):  
October 14, 2008
- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. proposer's local time):  
December 02, 2008
- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):  
April 30, 2009

## Proposal Review Information Criteria

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**Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

## Award Administration Information

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**Award Conditions:** Additional award conditions apply. Please see the full text of this solicitation for further information.

**Reporting Requirements:** Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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## I. INTRODUCTION

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*BioSensing and BioActuation (BSBA): Interface of Living and Engineered Systems*. Advances in informatics, nanotechnology, and deeper understanding of biological systems has provided new opportunities to make fundamental advances in sensing and dynamic control of engineered systems. These advances could lead to the development of intelligent systems that will address a number of national needs including protection of critical and aging infrastructures, early detection and treatment of currently incurable diseases, counterterrorism, and mitigation of environmental hazards and pollution. BSBA provides an opportunity for partnerships among engineers, biologists, mathematical and physical scientists, and computer scientists to address the key elements of the fundamental research needed to understand the sensing, actuation and dynamic control employed by living things. It is expected that research proposals submitted to this solicitation will contribute to the development of a rigorous engineering framework for the design and realization of topically-relevant engineered systems and provide an intellectual framework for education in this emerging area.

*Hydrocarbons from Biomass (HyBi)* As world oil reserves diminish and concern over climate change increases, the ability to domestically produce renewable energy for transportation fuels and electricity will have great impact on energy independence, national security, the environment, and jobs for America. Potentially affordable, sustainable, non-food sources for bioenergy include energy crops such as algae, switchgrass and poplar trees, and forest and agricultural residues; the 2005 "Billion Ton Study" estimated that over 1.3 billion tons per year of biomass is currently available. The energy contained in this biomass is equivalent to about 3.8 billion barrels of oil, about one-half of the oil consumed by the U.S. in 2006. Interdisciplinary research is needed to understand the most effective pathways to convert this biomass into biofuel and biopower that fit into the country's existing energy infrastructure.

## II. PROGRAM DESCRIPTION

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### 1. BioSensing and BioActuation (BSBA)

The EFRI topic on *BioSensing and BioActuation (BSBA): Interface of Living and Engineered Systems* provides an opportunity for partnerships among engineers, biologists, mathematical and physical scientists, and computer scientists to address the key elements of the fundamental research needed to understand the sensing, actuation and dynamic control employed by living things. It is expected that research proposals submitted to this solicitation will contribute to the development of a rigorous engineering framework for the design and realization of topically-relevant engineered systems and provide an intellectual framework for education in this emerging area. Proposals to develop devices or systems outside the context of such a fundamental framework will be considered unresponsive to this topic area.

Current engineering designs of autonomous systems are often primitive compared to those of humans and other complex biological systems. All bio-organisms and bio-systems employing sensors, actuators and control approaches are essentially superior to the best human-engineered systems. For example, the sense of smell of humans and insects is achieved through a network of cells that provides an incredible dynamic range; muscles are capable of large deformation and power output, with very low energy consumption; the dragonfly's muscles move its flexible wing with unique and rapid 6-degree-of-freedom maneuverability that can not be achieved in human-made systems; and the human nervous system performs adaptive and distributed situational analysis and prediction by extracting essential information from highly stimulus-rich environments. Clearly, a compelling new research frontier exists in revealing the basic science and engineering of sensing and actuation in biological systems and in applying what is discovered to new bio-derived and bio-inspired engineered systems. The proposed research topics in BioSensing and BioActuation are expected to revolutionize our quality of life, elucidate the nature of biological systems, as well as improve U.S. competitiveness in the global economy through advanced technology development; the research on these topics is also expected to create a new cadre of graduate students with true interdisciplinary education, as well as innovative businesses and entrepreneurs.

To develop a useful intellectual structure for exploiting the transformative nature of the proposed EFRI topic, researchers with expertise in many fields, including biology, advanced materials, distributed sensing and actuation, cognitive and neuroscience, transducer physics, cyber-enabled algorithms, dynamical systems, communications and control, and nano-mechanics, cell-mechanics, tissue engineering, and medical technology must work together in integrated cross-disciplinary teams. Thus, this initiative requires not only the understanding of basic principles behind the operation of biological systems in nature, but also demands more integrative system thinking and fundamental research among engineers and scientists to transform the concepts and operating principles that nature has evolved over millions of years into technologies and engineered systems. The focus of this cross-disciplinary program is to promote nontraditional research interactions to provide the new knowledge, discoveries, and understanding needed to accelerate the advancement of bio-inspired engineered systems.

While bio-inspiration has motivated research in materials, actuation and sensing, and dynamic control, it has not yet matured to encompass system-level considerations in a broad-based way. In this EFRI topic, *BioSensing and BioActuation: Interface of Living and Engineered Systems*, researchers are encouraged to engage in compelling and challenging system-level problems, arriving at new approaches, frameworks, and enabling technologies by learning from biological solutions to related problems and then taking a step back to integrate and generalize the knowledge gained before assessing and optimizing the path to an engineered solution. It is expected that the resulting knowledge will provide a viable means for responding to a broad range of problems, leading to revolutionary new autonomous engineered systems that are self-regulating, self-regenerative, self-adaptive, and self-healing. Areas of opportunity crossing the spectrum include the following four topical components, and proposals targeted at any one or an integration of more than one of these components will be accepted and considered:

#### **Hierarchical Organization of Biological Systems:**

This component of BSBA seeks bio-inspired research to uncover the unifying aspects underlying hierarchical bio-structures and bio-systems and use them for sensing and actuation. The nature of these hierarchical organizations is likely to be multi-scale in time and space and to exploit multi-functional engineered materials and

systems. The research challenges include, for example: characterization of hierarchical structures, principles leading to multi-functionalities and design and fabrication of hierarchically structured sensors.

#### **Sensor Informatics Guided by Life:**

This component of BSBA seeks bio-inspired research to create new knowledge that will be exploited in novel bio-inspired data mining and dynamic control, including capabilities to monitor, assess, and control living and engineered systems in sensor-rich environments. The research challenges include, for example, cellular signal transduction and communication processes among organisms, data mining in massively parallel biological systems, robust handling of rich, noisy data, anomaly detection, and scalable algorithms and protocols for on-line decision making.

#### **Multi-Functional Materials and Devices for Distributed Actuation and Sensing:**

This BSBA component focuses on the understanding of biological systems and the mechanisms that lead to their ability to exhibit fault-tolerant actuation with a wide dynamic range, the production of practical means for producing artificial structures that exhibit similar behaviors, and their incorporation into useful engineered systems. The research challenges include, for example, digitalization of biochemical signals to interface with electronic systems, biological computational processes for cooperative and hierarchical communication, computing and control, and new models, languages, and verification methods for bio-digital computer systems. This research component will entertain proposals to develop completely synthetic materials as biological materials for distributed actuation and sensing.

#### **Forward Engineering & Design of Biological and Biomedical Components & Systems:**

This BSBA component is focused on the synthesis of hybrid synthetic-living systems through systems-level integration of biological and engineered components that sense, actuate, compute, regenerate and efficiently allocate resources to achieve desired responses and functions. It aims to increase capacity to manipulate and program biological systems to address major social challenges such as health and medical treatment. Technical approaches to meeting these challenges include design and synthesis of modular and programmable parts that perform sensing, actuation, and computation in biological systems, and physical models of cells and systems including regulatory, signaling, mechanical and biochemical sensing and actuating properties. Two way interfaces of living tissue machine could contribute to a superior understanding of cell mechanics and tissue interfaces in living systems, and more generally of how living systems adjust or reject micro and nano-engineered devices and systems. In the long term, a real-time understanding of the progressive response of the living host will be necessary for in vivo systems, so that one can develop the required abilities to communicate with cells around the implant and have the means to alter the conditions in a selective, controlled, localized and predictable manner.

These topical components constitute a framework for a transformative research frontier that is seemingly boundless, and can provide a firm foundation for rapid technological innovation that will impact the nation's economy, quality of life, and societal security. All application areas are of interest, including but not limited to critical infrastructure protection, disaster mitigation, sustainable environment, manufacturing, and human and society protection, safety and security, and smart implantable and wearable medical devices.

#### **Required BSBA Elements:**

**To advance the frontier within the proposed EFRI topic, proposals must address the following five elements:**

- Define a unifying intellectual focus for synergistic innovation involving interdisciplinary research on the EFRI BSBA topic, or their integration, at the interface of living and engineered systems;
- Provide a unique framework through which components of diverse disciplines can connect and relate to each other;
- Address the need for interdisciplinary research;
- Address the anticipated research outcome and questions on how the resulting new discoveries will provide answers to problems leading to revolutionary autonomous self-regulating, self-regenerative, and self-healing engineered devices and systems;
- Identify new motivation, new instruments and tools, and new validation vehicles for bio-engineering interfaces investigations.

**The BSBA topic also strongly encourages the consideration of two or more of the following elements:**

- Proposed breakthroughs in new bio-inspired materials, devices and systems, and how engineers will be able to achieve quantum leap in their performance;
- Paradigm shift in practices and applications in engineering, health care, medicine, and biological research. If the anticipated outcome is expected to change a particular practice or application, identify the current state-of-the-art and list benchmarks that will be used to illustrate the success of the project;
- Sensing at the nanoscale, novel photonic techniques for detecting, identifying, characterizing, and understanding subcellular structures and processes at nanoscale;
- Use of bio-material, or their synthesis, or use of various detection devices (microelectronics, optics, MEMS, NSMES, etc.); or use of chemical properties and reactions, and use of mathematical or statistical analysis to sense, detect, monitor, control and mimic natural phenomena for sensing and actuation;
- Integration of nano and micro scale sensors into existing bio-materials for healing surface property control; and interfaces for implantable systems that interact with the human body and other biological environments; and
- Computational algorithms, protocols, and tools for data mining, storage, compression, fusion, feature extraction under uncertainties, diagnosis and prognosis for optimal use of sensed information.

Proposals will be judged on the relevance of the engineering disciplines or their interfaces with biological, computer, information, mathematical, and physical sciences in the proposed research. A proposed study targeting incremental improvements or a proposed study along single disciplinary or traditional lines will not make a competitive proposal. The synthesis of diverse disciplinary knowledge, concepts, methodologies, and technologies must be clearly described and the quality of overall integration will be evaluated.

## **2. Hydrocarbons from Biomass (HyBi)**

The synthesis of hydrocarbon biofuels from non-food biomass represents a transformational paradigm away from bioethanol and biodiesel. These biofuels have provided a good start to the nation's movement away from imported oil but they are now faced with issues of sustainability and CO<sub>2</sub> emissions. Green gasoline, green diesel, and

green jet fuel will fit into the existing infrastructure (motors, pipelines, and refineries) and will not incur the gas mileage penalty of ethanol-based biofuels. Potentially they are less expensive to manufacture, use less process water and have lower greenhouse gas emissions. The biomass sources for hydrocarbon biofuels are lignocellulosic energy crops such as switchgrass and poplar trees, as well as forest waste, agricultural residue and nonfood oils from plants such as jatropha and from algae. Not only can catalytic routes typical of petroleum refineries be used for the conversion of biomass into hydrocarbons, but also novel microbial routes through synthetic biology.

An additional benefit of the mass production of biofuels stems from the distributed nature of their production. Since biomass is not dense and cannot be economically transported over large distances, a system of rural biorefineries throughout farmlands and forests is envisioned. One such system might involve processing of agricultural or forest residue via pyrolysis and upgrading it into biocrude, which can then be transported through existing pipelines to existing petroleum refineries. The recovery of heat from such processes, or even from the pyrolysis oil itself, may be used for the generation of electricity. A range of fuel and electricity cogeneration may be considered; typically, biofuels will be the main product and electricity will be generated from heat recovery, but some circumstances may call for electricity to be the main product with biofuel produced to store energy in off-peak operation.

Research and development on next generation hydrocarbon biorefineries will be inherently interdisciplinary; all of the science and engineering disciplines utilized in petroleum refineries and the power grids associated with them are needed to implement biorefineries. Engineering of the biomass itself will be needed to optimize both its growth and its deconstruction into sugars or other intermediates. Enzymatic and/or inorganic catalytic reactions can be used to break down lignocellulose and convert them into hydrocarbon fuels. New types of multiphase reactors and other unit operations will have to be developed, and new types of energy conversion devices can be designed for heat recovery. The individual distributed biorefinery cogenerators need to be integrated into the electric power distribution systems. On the systems scale, life cycle analyses of plant designs to examine all facets from feedstock logistics to process water use and greenhouse gas emissions are needed to determine the sustainability of distributed biorefinery systems.

The HyBi program seeks to elicit the synergies represented in these various fields. Examples of such synergies may be as follows:

*Biomass engineering with synthetic biology or chemical catalysis*

- How can biomass be engineered to optimize deconstruction into sugars or other intermediates, and which conversion pathways will maximize yields of intermediates and hydrocarbon products?

*Enzymatic or catalytic chemistry with reactor design*

- How can batch processes be made continuous and scalable?

*Process design with energy conversion*

- What sort of energy conversion system will optimize heat recovery for a particular unit operation?

*Distributed cogeneration of hydrocarbon fuels and electric power*

- How can cogeneration in distributed biorefineries be optimally designed to contribute to efficient electric power generation and distribution?

**Required HyBi Elements:**

To be considered for the HyBi EFRI program, proposals must contain at least two distinct synergies, as exemplified above or in other facets, and involve at least three disciplines. As an example, researchers in catalytic chemistry and reaction engineering may work on a continuous process to produce pyrolysis oil suitable for existing pipelines. In another example, researchers on energy conversion, plant design, and electric power systems may work on optimal designs for biofuel and electric power cogeneration.

**Resources:**

Recent advances in next generation biofuels have been reported in key areas:

- Overcoming the recalcitrance of lignocellulose toward deconstruction into sugars is a major theme in the "Breaking the Biological Barriers to Cellulosic Ethanol" report, see <http://genomicsgtl.energy.gov/biofuels/b2bworkshop.shtml>. It is noted that cellulosic ethanol is not within the scope of this EFRI topic; however, the breakdown of lignocellulose into sugar or sugar-like intermediates for subsequent conversion to hydrocarbons is.
- In a complementary work, gasification, pyrolysis, and liquid phase reforming processes for the conversion of biomass into hydrocarbons are found in the "Breaking the Chemical and Engineering Barriers to Lignocellulosic Biofuels" report, see <http://www.ecs.umass.edu/biofuels>.

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### III. AWARD INFORMATION

- Anticipated Type of Award: Standard Grant
- Estimated Number of Awards: 11, 4-year awards.
- Anticipated Funding Amount: A total of \$22,000,000 to \$29,000,000 in FY 2009 pending the availability of funds. Anticipated Funding Level: It is anticipated that 11 or more standard grants will be made in FY 2009. Each project team may receive support of up to a total of \$500,000 per year for up to four years, pending the availability of funds. It is not expected that all awards will receive the maximum amount; the size of awards will depend upon the type of research program proposed.

## IV. ELIGIBILITY INFORMATION

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### Organization Limit:

Proposals may only be submitted by the following:

- EFRI proposals may be submitted by a single organization or a group of organizations consisting of a lead organization in partnership with one or more partner organizations. Only U.S. academic institutions with significant research and degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Principal investigators are encouraged to form synergistic collaborations among researchers and with private and public sector organizations, government laboratories, and scientists and engineers at foreign organizations where appropriate, though no NSF funds will be provided to those organizations.

### PI Limit:

Principal Investigators (PI) must be at the faculty level and the lead PI must have a primary appointment in an engineering department. In addition, a minimum of two Co-PIs must participate.

### Limit on Number of Proposals per Organization:

None Specified

### Limit on Number of Proposals per PI: 1

The principal investigator and co-principal investigators may participate in one proposal submitted to this solicitation. It is the responsibility of the submitting institution to insure that the PI and all co-PIs are participating only in one proposal submitted to this solicitation.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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#### Letters of Intent (required):

A one-page Letter of Intent is required. Letters of Intent are not reviewed but are used to judge the overall response and requirements for reviewers. The letter should be submitted via FastLane no later than the date specified in this solicitation. The subject heading of the letter should include a brief title of the proposal and the name of the lead institution. Each letter must include the following:

1. THE TITLE- Title of the EFRI proposal preceded by the words "EFRI-BSBA" or "EFRI-HyBi" as appropriate.
2. THE TEAM- Names, departmental and university affiliation, and disciplinary expertise of the Principal Investigator and at least two co-Principal Investigators. At least three different disciplines need to be represented.
3. THE SYNOPSIS (GOALS)- Brief description of the specific goals of the proposal (maximum of 250 words).

These letters of intent help NSF anticipate review requirements for preliminary proposals. They are not used as pre-approval mechanisms for the submission of preliminary proposals and no feedback is provided to the submitters.

#### Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through FastLane in response to this Program Solicitation please note the conditions outlined below:

- Sponsored Projects Office (SPO) Submission is not required when submitting Letters of Intent
- A Minimum of 2 and Maximum of 4 Other Senior Project Personnel are allowed
- A Minimum of 0 and Maximum of 3 Other Participating Organizations are allowed
- Submission of multiple Letters of Intent is not allowed

**Preliminary Proposals (required):** Preliminary proposals are required and must be submitted via the NSF FastLane system, even if full proposals will be submitted via Grants.gov.

Preliminary proposals must be submitted via FastLane in accordance with the instructions below. Preliminary proposals that are not compliant with this solicitation will be returned without review. It is the submitting organization's responsibility to ensure that the proposal is compliant with all applicable requirements. If there is more than one university involved in a preliminary proposal, it must be submitted as a single proposal and not as multiple collaborative proposals. Preliminary proposals must contain the items listed below and strictly adhere to the specified page limitations. No additional information may be provided as an appendix or by links to web pages. Figures and tables must be included within the applicable page limit. All elements of the proposal, including legends and tables, must meet all formatting requirements for font size, characters per inch as specified in the NSF Grant Proposal Guide (GPG).

Preliminary proposals will be reviewed by panels of outside experts. Based on the reviews, a limited number of PIs will be invited to submit full proposals. By March 1 of 2009, successful PIs should expect to receive an invitation from the EFRI Office to submit full proposals.

Preliminary proposals should provide a brief overview of the project and should include sufficient information to allow assessment of the main ideas and approaches and how it is appropriate as an EFRI proposal as opposed to existing programs. Preliminary proposals must include the following items:

**Cover Sheet:** Select the EFRI program solicitation number from the pull down list. Check the box indicated for preliminary proposal. Entries on the Cover Sheet are limited to the principal investigator and a maximum of four co-principal investigators. A minimum of

two co-principal investigators must participate. Additional project leaders or senior personnel should be listed on the Project Summary page and entered into FastLane as senior investigators.

**Title of Proposed Project:** The title for the proposed EFRI project must begin, as appropriate, with **EFRI-BSBA Preliminary Proposal:** or **EFRI-HyBi Preliminary Proposal:**. The title must state clearly and succinctly the major emerging frontier in research and innovation that is the focus for the project.

**Project Summary:** May not be more than one page in length and must consist of three parts: (1) At the top of this page include the title of the project, the name of the PI and the lead institution and a list of co-PIs and senior personnel along with their institutions; (2) provide a succinct summary of the intellectual merit of the proposed project. This should include the transformative nature of the proposed research the significant leap or a paradigm shift in fundamental engineering knowledge it will achieve; and (3) describe the broader impacts of the proposed work including the potential long-term impact on national needs or a grand challenge. **Proposals that do not separately address in the project summary both intellectual merit and broader impacts will be returned without review.**

**Project Description.** Project Description of the Preliminary Proposals is limited to five pages and will include the following three sections:

1. **Vision and Goals-** Describe the vision and specific goals of the proposed research in approximately one page.
2. **Approach and Methodology-** Describe in approximately three pages the approach and methodology that will be used to achieve the vision and goals.
3. **Impact-** Describe in approximately one page how the synergy of experts from different disciplines in the proposed research will achieve a significant advancement in fundamental engineering knowledge and will have a strong potential for long term impact on national needs or a grand challenge.

**References Cited.** Indicate with an asterisk any cited publications that resulted from prior research funded by NSF for the PI, or co-PI (s).

**Biographical sketches.** The standard NSF two-page biographical sketches must be prepared for the PI, co-PIs and other senior personnel listed on the Project Summary page.

**Current and Pending Support** for the PI, co-PIs, and senior personnel must be included.

**Budget:** The preliminary proposal will include a budget for each of the four years proposed. FastLane will automatically provide a cumulative budget. Preliminary proposals should not include any subcontracts; however the budget justification should include planned levels for subcontracts to any partner institution. Enter the anticipated total level of subcontract support on line G5, Subawards.

In the Special Information and Supplementary Documentation section, include the following:

1. List of key personnel involved (maximum one page), with a succinct description of what each person uniquely brings to the project and how they are integrated to produce positive synergies; and
2. A list, in a single alphabetized table, with the full names and institutional affiliations of all people with conflicts of interest for all senior personnel (PI and co-PI's) and any named personnel whose salary is requested in the project budget. Conflicts to be identified are (1) Ph.D thesis advisors or advisees, (2) collaborators or co-authors, including postdoctoral researchers, for the past 48 months, and (3) any other individuals with whom or institutions with which the PIs have financial ties (please specify type).

In addition to the FastLane instructions, the proposers must send the following two documents via email immediately after submission of their proposal. After receipt of the proposal number from FastLane, send an email to [efri2009@nsf.gov](mailto:efri2009@nsf.gov). The subject heading of the email should note the proposal number and the lead institution. Attach the following documents prepared on templates that will be available at <http://www.nsf.gov/eng/efri>:

1. An Excel spreadsheet containing two lists: one lists the last names, first names and institutional affiliations of all senior personnel (PI and co-PI's) and any named personnel whose salary is requested in the project budget; the second one lists the full names and institutional affiliations of all people having conflicts of interest with any senior personnel (PI and co-PI's) or named personnel whose salary is requested in the project budget. These lists will be used by NSF to check for conflicts of interest in assembling the review community.
2. A single Power Point slide summarizing the vision of the EFRI proposal. This will be used during review panel discussions.

Remember to email these two documents to [efri2009@nsf.gov](mailto:efri2009@nsf.gov); do not use FastLane.

**Full Proposal Instructions:** Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg) . Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov). Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (<http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf> ). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

Based on the review of preliminary proposals, a limited number of PIs will be invited to submit full proposals. If there is more than one university involved in an invited full proposal, it must be submitted as a single full proposal not as multiple collaborative proposals.



The review of invited full proposals will include both ad hoc and panel reviews. The following exceptions and additions to the GPG or the NSF Grants.gov Application Guide apply to full proposals submitted to this Program:

Full proposals will be accepted only from PIs who have submitted preliminary proposals in the current review cycle. Submission of full proposals by PIs whose preliminary proposals received a review recommendation of 'Not Invited' will be returned without review.

**Cover Sheet:**

- **FastLane Users:** Select the EFRI program solicitation number from the pull down list. Check the box indicated for full proposal. Entries on the cover sheet are limited to the principal investigator and a maximum of four co-principal investigators. Additional project leaders or senior personnel should be listed on the Project Summary page and entered into FastLane as senior investigators.
- **Grants.gov Users:** The EFRI program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page. NSF allows one principal investigator and a maximum of four co-principal investigators to be identified on a proposal. Instructions for entering additional senior project participants are included in Section V.5. of the NSF Grants.gov Application Guide.

**Title of Proposed Project:** The title for the proposed EFRI project must begin, as appropriate, with **EFRI-BioSA:** or **EFRI-HyBi:**. The title must state clearly and succinctly the major emerging frontier in research and innovation that is the focus for the project.

**Project Summary** (one-page limit): Provide the following information: (1) the title of the project, the name of the PI and the lead institution or organization, and a list of co-PIs and senior personnel along with their institutions and organization or both; (2) a succinct summary of the intellectual merit of the proposed project. This should include the transformative nature of the proposed research, and the significant leap or a paradigm shift in fundamental engineering knowledge; and (3) the broader impacts of the proposed work, including the potential long-term impact on national needs and a grand challenge or both. Proposals that do not separately address in the project summary both intellectual merit and broader impacts will be returned without review.

**Project Description** (maximum 15 pages) must include the following subsections.

1. **Results from Prior Research:** Describe prior research of PI or co-PIs funded by NSF that is directly relevant to the proposed project.
2. **Proposed Research:** Describe the vision and goals of the proposed research, approaches and methodologies to attain the goals, and the expected outcomes. Project Description should end with a subsection labeled **Impact** that describes how the proposed project will lead to significant shift in fundamental engineering knowledge and have strong long term potential for significant impact on a national need or a grand challenge. Concisely articulate unifying and integrative aspects of the proposed research as well as the innovative ideas of the research.

**References Cited.** Indicate with an asterisk any cited publications that resulted from prior research funded by NSF for the PI, or co-PI(s).

Biographical sketches for key personnel (PI, co-PIs, and each of the senior personnel listed on the Project Summary page). Use the standard format.

Current and Pending support information must be provided for the PI and each of the co-PIs and Senior Personnel listed in the Project Summary page.

**Budget.** Develop a realistic project budget that is consistent with the proposed activities. Provide detailed budget justifications separately for the lead institution's budget (up to 3 pages of budget justification), and for each subawardee budget (up to 3 pages of budget justification for each subaward). Proposed budgets must include funds for travel by the PI and one researcher or a student to attend an annual EFRI grantees' meeting.

**Facilities and Equipment:** Provide a description of available facilities and priorities for its use, if applicable. For EFRI projects requiring additional equipment, justify the need for these resources in the context of the innovative work proposed.

In the Special Information and Supplementary Documentation section, include the following:

1. List of key personnel involved (maximum three pages), with description of what each person uniquely brings to the project and how they are integrated to produce positive synergies;
2. Provide a detailed management plan (maximum three pages) including means of communication and data tracking or management within the group, management of intellectual property resulting from the project, and timeline of activities;
3. Proposals that would generate significant digital data for preservation must include a data management plan (maximum one page). The contents of the data management plan should include: (1) the types of data to be produced, (2) the standards that would be applied for data format and metadata content, and (3) access policies and provision;
4. Means of sharing the outcome of the research with the rest of the scientific community, e.g. publications, web sites, and significant data bases, etc. (maximum two pages). The description should be specific and describe what, how, and when the community would have access to the outcome of the project. This is particularly important for the projects that will produce tangible research tools and resources;
5. A list, in a single alphabetized table, with the full names and institutional affiliations of all people with conflicts of interest for all senior personnel (PI and co-PI's) and any named personnel whose salary is requested in the project budget. Conflicts to be identified are (1) Ph.D. thesis advisors or advisees, (2) collaborators or co-authors, including postdocs, for the past 48 months, and (3) any other individuals or institutions with which the investigator has financial ties (please specify type).

In addition, the proposers **must send the following two documents via email immediately after submission of their proposal**. After receipt of the proposal number from FastLane or Grants.gov, send an email to [efri2009@nsf.gov](mailto:efri2009@nsf.gov). The subject heading of the email should note the proposal number and the lead institution. Attach the following documents prepared on templates that will be available at <http://www.nsf.gov/eng/efri/>:

1. An Excel spreadsheet containing two lists: one lists the last names, first names and institutional affiliations of all senior personnel (PI and co-PI's) and any named personnel whose salary is requested in the project budget; the second one lists the full names and institutional affiliations of all people having conflicts of interest with any senior personnel (PI and co-PI's) or named personnel whose salary is requested in the project budget. These lists will be used by NSF to check for conflicts of interest in assembling the review community.
2. A single Power Point slide summarizing the vision of the EFRI proposal. This will be used during review panel discussions.

Remember to email these two documents to [efri2009@nsf.gov](mailto:efri2009@nsf.gov); do not use FastLane or Grants.gov. Please submit these documents even if the information has not changed since submission of the preproposal.

## B. Budgetary Information

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**Cost Sharing:** Cost sharing is not required under this solicitation.

## C. Due Dates

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- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. proposer's local time):  
October 14, 2008
- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. proposer's local time):  
December 02, 2008
- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):  
April 30, 2009

## D. FastLane/Grants.gov Requirements

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- **For Proposals Submitted Via FastLane:**

Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

**Submission of Electronically Signed Cover Sheets.** The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: <https://www.fastlane.nsf.gov/fastlane.jsp>.

- **For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: <http://www.grants.gov/CustomerSupport>. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: [support@grants.gov](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

## VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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Proposals received by NSF are assigned to the appropriate NSF program where they will be reviewed if they meet NSF proposal preparation requirements. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal.

### A. NSF Merit Review Criteria

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All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which the reviewer is qualified to make judgements.

**What is the intellectual merit of the proposed activity?**

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

**What are the broader impacts of the proposed activity?**

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: <http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf>.

NSF staff also will give careful consideration to the following in making funding decisions:

**Integration of Research and Education**

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

**Integrating Diversity into NSF Programs, Projects, and Activities**

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

**Additional Review Criteria:**

- In addition to the two NSF review criteria (intellectual merit and broader impacts), the following criteria will be used in the review of all EFRI proposals:

**TRANSFORMATIVE** - Does the proposed research represent an opportunity for a significant leap or paradigm shift in fundamental engineering knowledge?

**NATIONAL NEED/GRAND CHALLENGE** - Is there potential for making significant progress on a current national need or grand challenge?

Effectiveness of the proposed plan for management and integration.

- **The following additional criteria will be used in the review of BSBA proposals:**

- Responsiveness of the proposal to address the "Required BSBA Proposal Elements" listed in the program description; interdisciplinary synergies in the form of well-integrated "systems" approach to research is vital.
- The potential impact of the proposed work to address major societal needs, to revolutionize quality of life, to elucidate the nature of biological systems, as well as to improve US competitiveness in the global economy through advanced technology development.

- **The following additional criteria will be used in the review of HyBi proposals:**

- Responsiveness of the proposal to address the "Required HyBi Proposal Elements" listed in the program description; interdisciplinary synergies are vital.
- The potential impact of the proposed work to answer the national challenge for biofuels, both technical and in terms of sustainability, for next-generation, non-alcohol hydrocarbon biofuels.

## B. Review and Selection Process

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Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the date of receipt. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In developing its recommendations for awards, review panels as well as NSF staff will consider: the relative merit of the EFRI proposals using the criteria listed above, the potential national impact of the proposed activity, the balance of awards among scientific fields, geographical distribution, and the combined ability of the proposals to meet the objectives of the EFRI Office. The EFRI Office will not normally award more than one proposal from any one lead institution in this competition.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from

technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

## VII. AWARD ADMINISTRATION INFORMATION

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### A. Notification of the Award

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Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

### B. Award Conditions

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An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (GC-1); \* or Research Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

\*These documents may be accessed electronically on NSF's Website at [http://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide (AAG)* Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

**Special Award Conditions:** Awardees must include in the proposal budget funds for travel by PI and one researcher or a student to attend an annual EFRI grantees' meeting.

### C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report.

Failure to provide the required annual or final project reports will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational) publications; and, other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete.

Awardees will be required to attend and present their research results and plans annually at an annual EFRI grantees' conference for the duration for their award.

## VIII. AGENCY CONTACTS

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General inquiries regarding this program should be made to:

- Sohi Rastegar, Director, Office of Emerging Frontiers in Research and Innovation (EFRI), 505, telephone: (703) 292-8305, email: [srastega@nsf.gov](mailto:srastega@nsf.gov)
- TOPIC 1 BIOSENSING/BIOACTUATION, telephone: (703) 292-7017, email: [sliu@nsf.gov](mailto:sliu@nsf.gov)
- Shih C. Liu, Program Director, Sensor Innovation and Systems, Division of Civil, Mechanical and Manufacturing Innovation (CMMI), 545 S, telephone: (703) 292-7017, fax: (703) 292-9053, email: [sliu@nsf.gov](mailto:sliu@nsf.gov)
- Yogesh B. Gianchandani, Program Director, Integrative, Hybrid & Complex Systems, Division of Electrical Communications & Cyber Systems (ECCS), 525, telephone: (703) 292-8339, fax: (703) 292-9147, email: [ygiancha@nsf.gov](mailto:ygiancha@nsf.gov)
- Leon Esterowitz, Program Director, Biophotonics, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), 565 S, telephone: (703) 292-7942, fax: (703) 292-9098, email: [lesterow@nsf.gov](mailto:lesterow@nsf.gov)

- Rajinder Khosla, Program Director, Electronics, Photonics and Device Technologies (EPDT), Division of Electrical Communications & Cyber Systems (ECCS), 525, telephone: (703) 292-8339, fax: (703) 292- 9146, email: [rkhosia@nsf.gov](mailto:rkhosia@nsf.gov)
- Eduardo Misawa, Program Director, Dynamic Systems, Division of Civil, Mechanical and Manufacturing Innovation (CMMI), 545 S, telephone: (703) 292-5353, fax: (703) 292-9053, email: [emisawa@nsf.gov](mailto:emisawa@nsf.gov)
- Lynn Preston, Deputy Division Director, Division of Engineering Education & Centers (EEC), 585 N, telephone: (703) 292-5358, fax: (703) 292-9051, email: [lpreston@nsf.gov](mailto:lpreston@nsf.gov)
- TOPIC 2 HYDROCARBONS FROM BIOMASS, telephone: (703) 292-7047, email: [jregalbu@nsf.gov](mailto:jregalbu@nsf.gov)
- John Regalbutto, Program Director, Catalysis and Biocatalysis, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), 565 S, telephone: (703) 292-7047, fax: (703) 292-9098, email: [jregalbu@nsf.gov](mailto:jregalbu@nsf.gov)
- Dagmar Niebur, Program Director, Power, Controls and Adaptive Networks (PCAN), Division of Electrical Communications & Cyber Systems (ECCS), 525, telephone: (703) 292-8339, fax: (703) 292- 9146, email: [dniebur@nsf.gov](mailto:dniebur@nsf.gov)
- Maria K. Burka, Program Director, Process and Reaction Engineering (PRE), Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), 565 S, telephone: (703) 292-7030, fax: (703) 292-9098, email: [mburka@nsf.gov](mailto:mburka@nsf.gov)
- Clark Cooper, Program Director, Material Design and Surface Engineering, Division of Civil, Mechanical and Manufacturing Innovation (CMMI), 545 S, telephone: (703) 292-7899, fax: (703) 292- 9053, email: [ccooper@nsf.gov](mailto:ccooper@nsf.gov)
- Bruce Hamilton, Program Director, Environmental Sustainability, Division of Chemical, Bioengineering, Environmental, and Transport Systems (CBET), 565 S, telephone: (703) 292-8320, fax: (703) 292- 9098, email: [bhamilto@nsf.gov](mailto:bhamilto@nsf.gov)
- Paul Werbos, Program Director, Power, Controls and Adaptive Networks (PCAN), Division of Electrical Communications & Cyber Systems (ECCS), 525, telephone: (703) 292-8339, fax: (703) 292 - 9146, email: [pwerbos@nsf.gov](mailto:pwerbos@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@nsf.gov).

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: [support@grants.gov](mailto:support@grants.gov).

## IX. OTHER INFORMATION

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The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, MyNSF (formerly the Custom News Service) is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. MyNSF also is available on NSF's Website at <http://www.nsf.gov/mynsf/>.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities* provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
  - Send an e-mail to: [pubs@nsf.gov](mailto:pubs@nsf.gov)
  - or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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