NSF/DOE PARTNERSHIP ON ADVANCED FRONTIERS IN RENEWABLE HYDROGEN FUEL PRODUCTION VIA SOLAR WATER SPLITTING TECHNOLOGIES 2014-2016

PROGRAM SOLICITATION
NSF 14-511

National Science Foundation

Directorate for Engineering
Division of Chemical, Bioengineering, Environmental, and Transport Systems

U.S. Dept. of Energy

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

December 13, 2013

October 06, 2014

October 07, 2015

First Wednesday in October, Annually Thereafter

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

February 10, 2014

Full Proposal Target Date(s):

December 11, 2014

December 08, 2015

Second Tuesday in December, Annually Thereafter

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

NSF/DOE PARTNERSHIP ON ADVANCED FRONTIERS IN RENEWABLE HYDROGEN FUEL PRODUCTION VIA SOLAR WATER SPLITTING TECHNOLOGIES 2014-2016

Synopsis of Program:

The Directorate for Engineering at the National Science Foundation (NSF) has established a partnership with the Fuel Cell Technologies (FCT) Office of the U.S. Department of Energy (DOE) in order to address critical fundamental and applied research challenges associated with advanced technologies for the production of hydrogen fuel via solar water splitting processes. The goal of the partnership is to leverage the complementary missions of applied research, development and demonstration (DOE) and use-inspired fundamental research and education (NSF) to address issues of national importance that impact the sustainable production of fuels using renewable resources. The Directorate for Engineering seeks proposals with transformative ideas that meet the detailed requirements delineated in this solicitation.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Ram B. Gupta, Program Director, Energy for Sustainability Program, NSF/ENG/CBET, telephone: (703) 292-2407, email: ragupta@nsf.gov
- George J. Antos, Program Director, Catalysis & Biocatalysis Program, NSF/ENG/CBET, telephone: (703) 292-4997, email: gantos@nsf.gov
- Colby A. Foss, Program Director, Chemical Catalysis Program, NSF/MPS,CHE, telephone: (703) 292-8404, email: cfoss@nsf.gov
- Eric Miller, Hydrogen Production Technology Development Manager, DOE/EERE/FCTO, telephone: (202) 287-5829, email:

eric.miller@ee.doe.gov

- Sara Dillich, Hydrogen Production and Delivery Team Leader, DOE/EERE/FCTO, telephone: (202) 586-7925, email: sara.dillich@ee.doe.gov
- Sunita Satyapal, Office Director, DOE/EERE/FCTO, telephone: (202) 586-2336, email: satyapal@ee.doe.gov

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

- 47.041 --- Engineering
- 81.049 --- Office of Science Financial Assistance Program

Award Information

Anticipated Type of Award: Continuing Grant

Estimated Number of Awards: 3 to 5 each of up to 3-years duration

Total Funds Available: $6,000,000 to $18,000,000 equally distributed in FY 2014, 2015, and 2016 ($2 million to $6 million each year up to 3 years)

Anticipated Funding Amount: $150,000 to $250,000

Each project team may receive support up to between $150,000 and $250,000 per year for up to three years on a continuing basis, pending availability of funds and research progress made. It is not expected that all awards will receive the amounts stipulated above; the size of awards will depend on the type of research program that is proposed, and the PIs are encouraged to provide adequate budget justification related to the tasks proposed.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

Who May Serve as PI:

Principal Investigators (PIs) must be at the faculty level as determined by the submitting organization. While participation from non-engineering disciplines is encouraged and may be essential for some proposals, projects should fundamentally contribute to engineering research.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

The principal investigator and co-principal investigators may participate in only 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 in only one proposal submitted to this solicitation. If more than one proposal is submitted by the PI or co-PI, NSF reserves the right to return without review the last proposal received or all proposals received from the PI or co-PI.

Proposal Preparation and Submission Instructions

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 Proposal Submission:** Not required
- **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.
  - 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/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:** Inclusion of voluntary committed cost sharing is prohibited.
- **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)*:*

  December 13, 2013

October 06, 2014

October 07, 2015

First Wednesday in October, Annually Thereafter

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

  February 10, 2014

- **Full Proposal Target Date(s):**

  December 11, 2014

  December 08, 2015

  Second Tuesday in December, Annually Thereafter

Proposal Review Information Criteria

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

Award Conditions: Standard NSF award conditions apply.

Reporting Requirements: Standard NSF reporting requirements apply.

TABLE OF CONTENTS

I. INTRODUCTION

The United States Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) and the National Science Foundation (NSF) are jointly funding university/industry R&D in the area of renewable hydrogen technology development through this program solicitation issued by the NSF Chemical, Bioengineering, Environmental and Transport Systems (CBET) Division. Proposals are invited to specifically address discovery and development of advanced materials systems and chemical processes for direct photochemical and/or thermochemical water splitting for application in the solar production of hydrogen fuel. Projects are encouraged which advance scientific frontiers in photochemical and/or thermochemical materials systems and interfacial processes utilizing state-of-the-art methodologies in theory, synthesis and characterization to enhance scientific understanding of the important fundamental physical, thermal, chemical, electrochemical and opto-electronic processes which are critical to efficient and durable solar hydrogen production. A key benefit of this joint effort is the direct coordination of NSF-funded use-inspired basic research and EERE-funded applied R&D toward the development of cost-effective large-scale systems for the low-carbon production of hydrogen through advanced solar water-splitting technologies.

Widespread use of hydrogen and fuel cells can play a substantial role in overcoming our nation's key energy challenges, including

significant reductions in greenhouse gas emissions and oil consumption as well as improvements in air quality. A study by the National Academies has shown that by 2050, fuel cell electric vehicles could provide the largest reduction in emissions and oil consumption of any advanced vehicles [National Research Council. 2008: http://www.nap.edu/catalog/12222.html]. In addition, hydrogen and fuel cells provide a significant economic opportunity for the United States, with various studies projecting up to 900,000 new jobs in the U.S. by 2030- 2035 [The US DOE Hydrogen and Fuel Cells Program Plan. 2011: http://www.hydrogen.energy.gov/pdfs/program_plan2011.pdf]. Growing interest and investment among leading world economies, such as Germany, Japan, and South Korea, underscores the global market potential for these technologies and the need for continued investment for industry to remain competitive. To achieve the broadest commercialization of fuel cells, it will be necessary to have an affordable and abundant supply of fuel that can be used in all sectors and for diverse applications.

Of all possible fuels for fuel cells, hydrogen can be produced from the most diverse pathways, utilizing the most abundant resources, and it can be used in all fuel cell applications. However, hydrogen also poses the most significant technical challenges, including the high cost of production and delivery, and the need for improved performance and lower cost hydrogen storage systems. R&D investments that seek to improve the performance and cost of a broad portfolio of technologies for producing, delivering, and storing hydrogen are essential for large-scale realization of the significant national benefits of widespread fuel cell deployment. As indicated in the US DOE Multi-year Research, Development and Demonstration (MYRD&D) plan [http://www1.eere.energy.gov/hydrogenandfuelcells/mypp/pdfs/production.pdf] cost-effective pathways to renewable, low-carbon hydrogen production will be necessary. The photochemical and thermochemical technologies for large-scale solar water-splitting are promising, but advanced materials systems and processes need to be discovered and developed for these technologies to be cost competitive.

The sub-programs within DOE and NSF that will manage this joint program solicitation to promote the discovery and development of advanced technologies for solar hydrogen production are the Hydrogen Production & Delivery (HPD) Sub-Program within the DOE EERE Fuel Cell Technologies (FCT) Office, and the Catalysis and Biocatalysis Program and Energy for Sustainability Program both in the NSF Engineering Directorate, CBET Division. The FCT Office supports the U.S. DOE mission to strengthen America's energy security, environmental quality, and economic vitality. These goals are achieved through activities that address the full range of barriers facing the development and deployment of hydrogen and fuel cells with the ultimate goals of decreasing our dependence on oil, reducing carbon emissions, and enabling clean, reliable power generation. Office activities include research, development, demonstration, testing, technology validation, and manufacturing innovation. The CBET Systems Division supports the NSF's mission of research and education with activities that involve the transformation and/or transport of matter and energy by chemical, thermal, or mechanical means. CBET research and education contributes significantly to the development of the workforce for major components of the United States economy, including chemicals, pharmaceuticals, medical devices, forest products, metals, petroleum, food, textiles, utilities, and microelectronics. Support for environmental work encompasses pollution prevention and remediation as well as life cycle analysis.

With this joint program solicitation, the NSF-CBET and DOE-FCT programs establish the basis to develop joint industry/university/laboratory partnerships of funded research to improve performance and ultimately reduce cost of photochemical and/or thermochemical systems for solar hydrogen production. A key benefit will be direct coordination of NSF-funded use-inspired basic research and EERE-funded applied R&D. In this way, the expectation is that it will be possible to provide greater relevance to the discovery and development of advanced materials and materials systems for solar hydrogen production than would be possible by each program developing projects independently of the other.

II. PROGRAM DESCRIPTION

This NSF/DOE Partnership is formed with the goal to advance scientific frontiers through the discovery and development of advanced materials systems and processes for photochemical and/or thermochemical solar hydrogen production. Transformative ideas are solicited in several targeted areas listed below with the potential to enable an increase in the efficiency and durability of materials systems and processes for direct photochemical and/or thermochemical decomposition of water into hydrogen and oxygen via solar energy input. Proposals are encouraged that advance transformative ideas to develop the enabling fundamental understanding of materials, materials systems and interfaces key to advancing frontiers in highly-efficient, durable and cost-effective solar water-splitting based on photochemical and/or thermochemical processes.

The overarching goal is the reduction of the discovery and development cycle for innovative materials systems, interfaces and unit process needed to enable efficient, stable, and ultimately cost-effective solar hydrogen production via photochemical and/or thermochemical chemical plants. This goal will be facilitated by use-inspired fundamental research to establish the basis for new concepts, design elements and tools performed through university/industry/national laboratory partnerships.

Within this context, projects will be encouraged which integrate state-of-the-art methodologies in theory, synthesis and characterization to facilitate the discovery and optimization of novel materials, materials systems and interfacial processes through enhanced scientific understanding of important fundamental unit processes, such as material/photon interactions (across the full solar spectrum); materials interactions at the nano- through meso-scales; bulk material heat and charge transport mechanisms; as well as interfacial reactions, kinetics, and corrosion.

There are various criteria and elements which are important to this Solicitation, and they are described in the Areas of Interest and Required Elements sections below. PI teams should adhere to these in their proposals. Sponsors may return proposals without review if the proposal is deemed not to be in compliance with these criteria and element inclusions.

Areas of Interest:

This solicitation promotes the science and technology of advanced materials systems and interfacial processes as key enablers for highly efficient and durable photochemical and/or thermochemical solar water-splitting. Specific topical areas are listed below though other aspects that hold promise to improve solar-to-hydrogen conversion efficiency, durability and cost with respect to traditionally-studied photochemical and thermochemical processes may also be considered.

Key fundamental processes that must be better understood to enable the enhancement of efficiency, stability and ultimately cost in photochemical and/or thermochemical solar water-splitting processes include, but are not limited to, the following:

- Material/light interactions over the full solar spectrum fundamental to photon absorption and to the conversion of photon energy to thermal and electrochemical energy;
- Thermodynamic properties of materials systems fundamental to driving thermal, chemical and electrochemical processes and sub-processes;
- Thermal and radiative properties of materials systems fundamental to heat transfer efficient thermal management;
- Optoelectronic properties of materials systems fundamental to efficient separation and transport of photo-excited charge carriers to relevant reaction sites for the reactions and sub-reactions in water dissociation cycles;

- Kinetic properties of materials at interfaces fundamental to the facilitation of chemical and electrochemical reactions and sub-reactions in water dissociation cycles, as well as the mitigation of corrosion and other competing side-reactions;
- Physical and surface chemistry of multi-phase materials systems fundamental to compound and inter-phase formation, mass diffusion properties, and junction and interface formation and properties;
- Validated ab-initio models to support "Materials by Design" methodologies for bulk materials and interfaces with physical, optical, chemical and electronic properties optimized for solar to hydrogen conversion.

Projects are encouraged which integrate state-of-the-art theory, synthesis and characterization methodologies to facilitate the discovery and optimization of novel materials systems and interfaces through enhanced scientific understanding of important unit processes such as material/photon interactions materials interactions at the nano- through meso-scales; bulk material heat and charge transport mechanisms; as well as interfacial reactions, kinetics, corrosion, and phase separation.

Relevant topic areas considered responsive to this solicitation include, but are not limited to the theory-guided discovery and development of:

- Novel multi-component solid-state materials with physical, optical, chemical and electronic properties optimized for photochemical and/or thermochemical solar to hydrogen conversion;
- Innovative materials junctions and interfaces with physical, optical, chemical and electronic properties optimized for photochemical and/or thermochemical solar to hydrogen conversion;
- Innovative catalysts, co-catalysts and appropriate linking apparatus to optimize reaction kinetics of the primary and secondary reactions in photochemical and/or thermochemical cycles for stable and efficient water dissociation;
- Efficient and stable materials and sub-systems for separation of multi-phase reactants and products, including hydrogen/oxygen gas separation in direct photochemical water dissociation and reactant/product management in electrolytic stages of hybrid thermochemical cycles for water splitting.

Proposals for incremental improvements to traditionally-studied solar water-splitting materials systems incapable of achieving solar hydrogen fuel production rates of 100 J/s of chemical energy per m^2 of solar energy collection (e.g., thermochemical processes based on ceria or zinc oxide, or photochemical processes based on titanium dioxide, tungsten trioxide or iron oxide) will NOT be considered responsive. Additionally, proposals relying on precious metals or other non-sustainable materials systems for enhancement of efficiency or durability will NOT be considered.

Of interest are innovative materials and catalyst systems and processes capable of solar hydrogen production rates equal to or greater than 100 J/s-m^2. The research should focus, though, on the fundamental thermal/physical/chemical/electrochemical/opto-electronic processes of the problem to be investigated including performance assessment rather than on a larger demonstration and testing effort. It is expected that fundamental connections will be made between the understanding of the problem to be studied on a sub-process scale and the associated efficiency and durability gains projected for integrated solar-to-hydrogen processes based on photochemical and/or thermochemical conversion.

Required Elements:

Successful proposals will involve collaborations between a lead academic PI and with industry, and/or other academic and/or national laboratory collaborators that provide complementary experimental/modeling/facility capabilities. PI teams will not be at a disadvantage in the proposal competition if they do not have access to solar-to-hydrogen validation facilities to demonstrate the efficacy of their approach. However, it is expected that proposed concepts will establish a clear connection to advancing scientific frontiers in solar-to-hydrogen efficiency and durability in photochemical and/or thermochemical conversion processes, specifically beyond traditionally-studied systems incapable of solar hydrogen production rates over 100 J/s-m^2 . This connection may be accomplished by system-level modeling, by employing modifications yielding self-evident efficiency improvements by bench-scale experiments, or by testing in an actual bench-scale solar-to-hydrogen system with the unit-process under investigation operated under simulated conditions consistent with stand-alone field operations under sunlight.

The proposal narrative should detail what each collaborator contributes to the project, and how the collaboration will be effectively coordinated and managed. Budgets must include travel for at least one PI to attend DOE's Annual Merit Review in Washington, DC, and up to two additional technical meetings, including the NSF CBET Division Annual Grantee's Meeting in Washington, D.C., and an appropriate technical conference/symposium (preferably ones held in conjunction with a DOE Working Group Meeting on Photoelectrochemical or Solar Thermochemical Hydrogen Production).

In preparing proposals in response to this solicitation, the text should not devote considerable space to background and motivation related to the importance of improving the efficiency and durability of solar hydrogen production in the context of the National and Global energy picture; rather, the narrative should, within the page limit established by these guidelines, discuss in sufficient detail the research plans to enable evaluation of the approach and methods that would be brought to bear to meet project objectives. The intellectual merit and the innovation of the research proposed in the context of the existing state-of-the-art should be clearly emphasized.

III. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

Who May Serve as PI:

Principal Investigators (PIs) must be at the faculty level as determined by the submitting organization. While participation from non-engineering disciplines is encouraged and may be essential for some proposals, projects should fundamentally contribute to engineering research.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or Co-PI: 1

The principal investigator and co-principal investigators may participate in only 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 in only one proposal submitted to this solicitation. If more than one proposal is submitted by the PI or co-PI, NSF reserves the right to return without review the last proposal received or all proposals received from the PI or co-PI.

Additional Eligibility Info:

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 which perform research and with degree-granting education programs in disciplines normally supported by NSF are eligible to be the lead organization. Academic institutions are defined as universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the United States, acting on behalf of their faculty members. Principal investigators are encouraged to form synergistic collaborations with industrial researchers, government laboratories, and engineers and scientists at foreign organizations where appropriate. For interaction with industry, when appropriate for the proposed research, the GOALI mechanism (Grant Opportunities for Academic Liaison with Industry NSF 12-513) may be used. Alternatively, subcontracts may be included in the award to the lead institution.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent*(required):*

A one-page Letter of Intent (LOI) is required. Letters of Intent are not reviewed but are used to anticipate 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 proposal preceded by the words "NSF/DOE Solar Hydrogen Fuel:"
2. THE TEAM - Names, affiliations, and expertise of the Principal Investigator and all additional participants.
3. SYNOPSIS (GOALS) - Brief description of the specific goals of the proposal (maximum of 250 words).
4. The LOIs are not used as pre-approval mechanisms for the submission of 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 0 and Maximum of 4 Other Senior Project Personnel are allowed.
- A Minimum of 0 and Maximum of 10 Other Participating Organizations are allowed.
- Submission of multiple Letters of Intent is not allowed.

Full Proposal Preparation 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. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@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/publications/pub_summ.jsp?ods_key=grantsgovguide). 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 nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Important Proposal Preparation Information: FastLane will check for required sections of the full proposal, in accordance with *Grant Proposal Guide* (GPG) instructions described in Chapter II.C.2. The GPG requires submission of: Project Summary; Project Description; References Cited; Biographical Sketch(es); Budget; Budget Justification; Current and Pending Support; Facilities, Equipment & Other Resources; Data Management Plan; and Postdoctoral Mentoring Plan, if applicable. If a required section is

missing, **FastLane will not accept the proposal.**

Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions. If the solicitation instructions do not require a GPG-required section to be included in the proposal, insert text or upload a document in that section of the proposal that states, "Not Applicable for this Program Solicitation." Doing so will enable FastLane to accept your proposal.

Please note that per guidance in the GPG, the Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the proposed activities. Unless otherwise specified in this solicitation, you can decide where to include this section within the Project Description.

Full Proposal Instructions:

If there is more than one institution involved in a proposal, it may be submitted as a single full proposal (with subawards), or as separately submitted collaborative proposals. In either case, the roles, responsibilities and qualification of all team members must be clearly identified.

The following exceptions and additions to the GPG apply to proposals submitted to this Program:

Cover Sheet: Select the CBET program solicitation number from the pull down list. Entries on the Cover Sheet are limited to the principal investigator and co-principal investigators. Additional project leaders or senior personnel should be listed on the Project Summary page and entered as senior personnel in FastLane or Grants.gov.

Title of Proposed Project: The title of the proposed project must begin with ″ NSF/DOE Solar Hydrogen Fuel:″ The title must state clearly and succinctly the major focus of the project.

Project Summary: 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) succinct summary statements comprising the following information. The Project Summary consists of an overview, a statement on the **intellectual merit** of the proposed activity, and a statement on the **broader impacts** of the proposed activity.

The overview includes a description of the activity that would result if the proposal were funded and a statement of objectives and methods to be employed. The statement on intellectual merit should describe the transformative nature of the proposal research and the potential of the proposed activity to advance knowledge. Significant interdisciplinary approaches in the research plans should be summarized. The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes, especially the potential impact on solar-to-hydrogen conversion efficiency. Teaching, education and outreach plans are to be included. The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically or technically literate lay reader. It should not be an abstract of the proposal.

Elaboration of the intellectual merit and broader impacts merit review criteria are included in VI.A NSF Merit Review Criteria. In addition, the strength of the collaborations, and the potential demonstrable impact on conversion efficiency must be identified.

Proposals that do not contain the Project Summary, including an overview and separate statements on intellectual merit and broader impacts will not be accepted by FastLane or will be returned without review. Additional instructions for preparation of the Project Summary are available in FastLane.

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

1. Results from Prior Research: Describe prior research of PI and co-PIs funded by NSF or DOE that is directly relevant to the proposed project; and
2. Proposed Research: Describe specific goals of the proposed research, its relevance to the current literature, the research plan including approaches and methodologies to attain the goals, tasks, roles and responsibilities, and the expected synergy outcomes. The Project Description should end with a subsection labeled **Impact** that describes the fundamental research contributions as well as the technological impact of the proposed effort. The research plan should be sufficiently detailed and well thought out, with supporting data and references, in order to project a credible outcome for success.

References Cited: Indicate with an asterisk any cited publications that resulted from prior research funded by NSF or DOE for the PI or co-PIs.

Biographical Sketches: Required for key personnel (PI, co-PIs, and each of the senior personnel listed on the Project Summary page). Use the standard format described in the GPG.

Current and Pending Support: Information must be provided for the PI and each of the co-PIs and Senior Personnel listed on the Project Summary page. For grants that are related, a short description must be provided to allow evaluation.

Facilities and Equipment: Provide a description of available facilities and priorities for their use, as applicable. For projects requiring additional equipment, justify the need for these resources in the context of the research proposed.

In the **Supplementary Docs** section, include the following:

1. List the key personnel involved. Describe the qualifications of each person and how they uniquely contribute to the project. Describe how personnel are integrated to produce positive synergies. (maximum of two pages total).
2. Provide a detailed management plan including means of communication and coordination, and data tracking or management within the group, management of intellectual property resulting from the project, and timeline of activities. (maximum three pages).
3. Proposals involving metrology components must include a description of how the uncertainty in, and repeatability of measured data will be determined and reported. Similar elements of validation, verification and uncertainty quantification must be provided for proposals that include numerical simulations. (maximum two pages).
4. For proposals that include support for post-doctoral researchers, a Post-Doc Mentoring Plan must be included as a supplementary document. Proposals that include post-doctoral researchers but do not include the mentoring plan as a supplementary document will be returned without review. (maximum one page).
5. Include a Data Management Plan section, that describes a means of sharing the outcome of the research with the scientific and engineering communities including but not limited to publications, web sites, and significant data bases, etc. The description should be specific and describe what, how, and when the community will have access to the results. (maximum two pages).
6. An alphabetized list of 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 and advisees, (2) collaborators and coauthors, including post-doctoral researchers,

during the preceding 48 months, and (3) any other individuals with whom, or institutions with which the investigator has financial ties (please specify type of ties).

7. Academic and industry partners must agree in advance as to how intellectual property rights will be handled. An industry university agreement on intellectual property including publication and patent rights must be submitted prior to an award. Documentation outlining the IP agreement should be submitted with the proposal, and the signed agreement must be submitted by the date of award.

Supplementary materials may not be used to circumvent the 15-page limit on the Project Description. Information in the supplementary materials will be evaluated as part of the review process, as needed.

Pre-submission Check List:

- No principal investigator or co-principal investigator is listed as a principal investigator or co-principal investigator on any other NSF/DOE *Advanced Frontiers in Renewable Hydrogen Fuel Production via Solar Water Splitting* Partnership Proposal.
- The Lead PI must be at the faculty level, as determined by the submitting institution.
- A Data Management Plan is included as supplementary documents.
- Each annual budget must not exceed $250,000 and the duration of the research must not exceed three years.
- The proposal and the LOI must be submitted by the deadline specified (5:00p.m local time at the proposer's institution).
- Note: Proposals not meeting the above requirements will be returned without review.

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

Budget Preparation Instructions: Budgets must include travel for at least one PI to attend DOE's Annual Merit Review in Washington, DC, and up to two additional technical meetings, including the NSF CBET Division Annual Grantee's Meeting in Washington, D.C., and an appropriate technical conference/symposium (preferably ones held in conjunction with a DOE Working Group Meeting on Photoelectrochemical or Solar Thermochemical Hydrogen Production).

C. Due Dates

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

  December 13, 2013

  October 06, 2014

  October 07, 2015

  First Wednesday in October, Annually Thereafter

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

  February 10, 2014

- **Full Proposal Target Date(s):**

  December 11, 2014

  December 08, 2015

  Second Tuesday in December, Annually Thereafter

D. FastLane / Grants.gov Requirements

For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions 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. 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.

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. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www.grants.gov/web/grants/applicants.html. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical 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. 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.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational

Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. 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 either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with 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. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://nsf.gov/bfa/dias/policy/merit_review/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission 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 variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which 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.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.i., prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

The proposal should define a bold (multidisciplinary) research agenda consistent with the goals and deliverables described in the solicitation. The evaluation of potentially transformative nature of the project and its translational impacts will be emphasized as well.

The proposal should also draw on productive intellectual partnerships that capitalize upon knowledge and expertise synergies in multiple fields or sub-fields in science or engineering and/or in multiple types of organizations.

Reviewers will also be asked to provide an evaluation of whether the proposed project has the potential for significant advances in fundamentals and the demonstrable potential for improving on the existing technology for hydrogen production via solar water splitting. Special emphasis will be placed on proposals that promise to enhance competitiveness or innovation in the United States.

NSF will manage and conduct the review process of proposals submitted in accordance with NSF standards and procedures. Relevant information about proposals and reviews of proposals will be shared with DOE/FCTO.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by 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.

NSF will manage and conduct the review process of proposals submitted in accordance with NSF standards and procedures. Relevant information about proposals and reviews of proposals will be shared with DOE/FCTO.

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 strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

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. After an administrative review has occurred, Grants and Agreements Officers perform 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.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, 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.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

An NSF award consists of: (1) the award notice, 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 notice; (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 notice. 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. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@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.

C. Reporting Requirements

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 prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. 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 Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements 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.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Ram B. Gupta, Program Director, Energy for Sustainability Program, NSF/ENG/CBET, telephone: (703) 292-2407, email: ragupta@nsf.gov
- George J. Antos, Program Director, Catalysis & Biocatalysis Program, NSF/ENG/CBET, telephone: (703) 292-4997, email: gantos@nsf.gov
- Colby A. Foss, Program Director, Chemical Catalysis Program, NSF/MPS,CHE, telephone: (703) 292-8404, email: cfoss@nsf.gov
- Eric Miller, Hydrogen Production Technology Development Manager, DOE/EERE/FCTO, telephone: (202) 287-5829, email: eric.miller@ee.doe.gov
- Sara Dillich, Hydrogen Production and Delivery Team Leader, DOE/EERE/FCTO, telephone: (202) 586-7925, email: sara.dillich@ee.doe.gov
- Sunita Satyapal, Office Director, DOE/EERE/FCTO, telephone: (202) 586-2336, email: satyapal@ee.doe.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: 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.

IX. OTHER INFORMATION

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, "NSF Update" 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 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. "NSF Update" also is available on NSF's website at https://public.govdelivery.com/accounts/USNSF/subscriber/new?topic_id=USNSF_179.

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 Fuel Cell Technologies Office

The Fuel Cell Technologies Office (FCTO) is a key component of the Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy (EERE) portfolio. The FCTO aims to provide clean, safe, secure, affordable, and reliable energy from diverse domestic resources, providing the benefits of increased energy security and reduced criteria pollutants and green-house gas emissions. More detailed descriptions of the FCTO Hydrogen Production and Delivery (P&D) Program, including technical and cost targets, can be found in the Multi-Year Research, Development and Demonstration Plan (MYRD&D) Chapter for Production.[1]

Fuel cells powered by hydrogen from renewable or low-carbon resources can lead to substantial energy savings and reductions in imported petroleum and carbon emissions. The FCTO Hydrogen P&D Program supports the goals of the DOE and FCTO by addressing critical challenges to integrating hydrogen technology and developing new and advanced technologies to produce hydrogen from diverse, domestic, and renewable resources and additionally, delivering it from where it is produced to the point of end use.

The objective of the FCTO Hydrogen Production Program is to develop technologies to produce hydrogen from clean, domestic resources at a delivered and dispensed cost of $2-$4/gge H_2 by 2020. As a strategy to achieve this objective, the program supports a balanced research and development (R&D) portfolio encompassing various near-, mid- and long-term hydrogen production technologies at distributed, semi-central and central scales. In the near term, reforming of domestically-abundant natural gas (NG) is viewed as a bridge-technology for producing low-cost hydrogen at high volumes, although with greenhouse gas (GHG) emissions commensurate with the fossil fuel feedstock. In the near- to mid-term, R&D innovations in hybrid systems for NG reforming have the potential to reduce GHG emissions substantially as compared to conventional steam methane reforming while still providing a means for low cost hydrogen production. The Program's R&D strategy for longer-term hydrogen production with near-zero GHG emissions focuses on technology pathways utilizing renewable, domestic feedstocks and energy sources. Of particular interest with regards to longer term hydrogen production pathways are photoelectrochemical processes based on wide-bandgap semiconductor materials systems and solar thermochemical cycles based on closed-loop chemical reactant materials. Appropriate balance in the R&D portfolio, which leverages research efforts across DOE Offices and with other agencies (such as NSF), is informed and refined by technoeconomic analysis as well as stakeholder input. [2]

---

[1] 2012 DOE-FCTP MYRD&D cost status and targets for Hydrogen Production http://www1.eere.energy.gov/hydrogenandfuelcells/mypp/pdfs/production.pdf .

[2] Stakeholder input is obtained through a number of mechanisms including meetings, workshops and requests for information (RFIs). For example, A Hydrogen Production Expert Panel (HPEP) workshop was held May 2012 to assess technology status of production technologies and formulate recommendations for enabling pathways forward for the widespread production of affordable low-carbon hydrogen; and an RFI on R&D needs and challenges for Biohydrogen production is planned.

ABOUT THE NATIONAL SCIENCE FOUNDATION

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 55,000 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 Arctic 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: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Office of the General Counsel
National Science Foundation
Arlington, VA 22230