

Accelerating Innovations in Biomanufacturing Approaches through Collaboration Between NSF and the DOE BETO funded Agile BioFoundry (NSF-DOE/ABF Collaboration)

PROGRAM SOLICITATION NSF 22-549



National Science Foundation

Directorate for Biological Sciences
Division of Molecular and Cellular Biosciences

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



U.S. Dept. of Energy

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

April 04, 2022

April 18, 2023

IMPORTANT INFORMATION AND REVISION NOTES

Any proposal submitted in response to this solicitation must include a supplementary document containing the outcome of a **required feasibility review** from the Agile Biofoundry. A request for a feasibility review can be submitted any time on or before **February 15, 2023**. Instructions for requesting the feasibility review are provided in the Proposal Preparation Instructions below.

Any proposal submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Accelerating Innovations in Biomanufacturing Approaches through Collaboration Between NSF and the DOE BETO funded Agile BioFoundry (NSF-DOE/ABF Collaboration)

Synopsis of Program:

The National Science Foundation (NSF) and the Department of Energy's Bioenergy Technologies Office (DOE BETO) recognize the critical roles that synthetic and engineering biology play in advancing the U.S. Bioeconomy. To translate advances in synthetic and engineering biology into products and processes that will impact the U.S. bioeconomy, there is a need to accelerate innovation and adopt new biomanufacturing approaches. The integrated Design-Build-Test-Learn (DBTL) capabilities of the DOE BETO funded Agile BioFoundry (ABF) offer a unique resource to the academic community to develop and implement innovative biodesign and biomanufacturing technologies and practices.

To help advance the U.S. bioeconomy, these agencies invite proposals from researchers at institutions of higher education and non-profit organizations (eligible PIs). The proposals must leverage the unique DBTL capabilities available at the ABF to translate the latest advances in synthetic biology and engineering biology basic research into testable prototype processes and products that are potentially scalable and manufacturable and can be appropriately validated. Of particular interest are proposals that both leverage the DBTL capabilities of the ABF to translate basic science into bioeconomy-relevant innovation and also lead to the development of generalizable rules or theories of biological systems that enhance our understanding of basic science.

In order to facilitate the utilization of the integrated DBTL capabilities available at the ABF and ensure the readiness of basic research projects

for their translation to ABF platforms, NSF would support efforts of eligible PIs and their students, postdoctoral fellows, and other lab personnel on projects that can leverage the unique capabilities of the ABF. NSF support would be for all activity at the institution of higher education or non-profit organization that occurs in parallel to, or prior to, the work at ABF that readies the project for translation to practice. In order to increase collaboration across sectors and workforce development, NSF, through this program, can also support short term faculty fellows, post-doctoral fellows, graduate students or undergraduate student interns that are hosted by national laboratories or ABF. DOE BETO will cover the costs for implementation of approved projects at ABF. Partnering with industry is encouraged for technologies both to facilitate eventual scale up and regulatory approval.

Investigators are advised to consult with ABF early in their proposal planning process. More information on the capabilities of the Agile BioFoundry can be found at <https://agilebiofoundry.org/capabilities/>. The required mechanism for collaboration with the Agile BioFoundry is to use [https://agilebiofoundry.org/capabilities/the-Agile-BioFoundry-Cooperative-Research-and-Development-Agreement-\(CRADA\)](https://agilebiofoundry.org/capabilities/the-Agile-BioFoundry-Cooperative-Research-and-Development-Agreement-(CRADA).). For more information about the CRADA, including a template CRADA, please visit <https://agilebiofoundry.org/work-with-us/>.

NSF will coordinate and manage the review of proposals. Proposals will be shared with DOE BETO Technology Managers.

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.

- David Rockcliffe, NSF/BIO/MCB, telephone: (703) 292-7123, email: drockcli@nsf.gov
- Steven W. Peretti, NSF/ENG/CBET, telephone: (703) 292-8320, email: speretti@nsf.gov
- Ramon Gonzalez, NSF/BIO/MCB, telephone: (703) 292-8046, email: ramgonza@nsf.gov
- Mamadou Diallo, NSF/ENG/CBET, telephone: (703) 292-4257, email: mdiallo@nsf.gov
- Raymond A. Adomaitis, NSF/ENG/CBET, telephone: (703) 292-8320, email: radomait@nsf.gov
- Gayle Bentley, DOE BETO, telephone: (202) 586-5188, email: Gayle.Bentley@ee.doe.gov

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

- 47.041 --- Engineering
- 47.074 --- Biological Sciences
- 81.049 --- Office of Science Financial Assistance Program

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 4 to 8

Anticipated Funding Amount: \$4,000,000 to \$5,000,000

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

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI:

There are no restrictions or limits.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide (PAPPG)* guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - 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: https://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

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):
 - April 04, 2022
 - April 18, 2023

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria. Additional merit review criteria apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions:

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

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

Innovations and discoveries associated with synthetic and engineering biology have the potential to transform the U.S. bioeconomy. Too frequently, new discoveries are not translated into products. The adoption of integrated Design-Build-Test-Learn tools and access to biofoundry infrastructure could accelerate innovation in biomanufacturing approaches as well as stimulate new approaches to biological and bioengineering research. The utilization of biofoundry tools to rapidly prototype a biological design and machine learning tools to mine data for generalizable rules could transform the practice of synthetic and engineering biology. The widespread adoption of such approaches not only for biomanufacturing but also for basic research could transform the biology, biotechnology and bioengineering workforce, such that they are equally adept at traditional hypothesis-driven experimental design *and* modular workflows that take advantage of high throughput capacity, automation, and machine learning algorithms to uncover patterns in complex data sets.

To this end, NSF, DOE BETO, and the Agile BioFoundry (ABF) are collaborating to support proposals from the science community that would utilize the integrated design-build-test-learn capabilities of the ABF to translate basic research in synthetic and engineering biology into products and processes that will impact the U.S. bioeconomy. NSF support would be for all activity at the institution of higher education or non-profit organization that occurs in parallel to or prior to the work at ABF that readies the project for translation to practice. In order to increase collaboration across sectors and workforce development, including for people with disabilities, NSF, through this program, can also support post-doctoral fellows, graduate students or undergraduate student interns that are hosted by national laboratories or ABF. Trainees with disabilities (sensory, cognitive, movement-related, or others) are encouraged to participate. DOE BETO will support the costs of work performed at ABF as performed under the CRADA (see section VI).

Highest funding priority is given to proposals that have outstanding intellectual merit and broader impacts, while proposals with weaknesses in either category (or those that are perceived as likely to have an incremental impact) will not be competitive. Effective broader impacts activities can include educational, workforce development, broadening participation, or outreach activities, including participation via existing institutional infrastructure for education, training, and outreach. The most competitive broader impacts activities include assessment. Well-conceived broader impacts activities take time and resources; thus proposers are encouraged to include appropriate costs for broader impacts in the budget.

NSF is particularly interested in increasing the participation of underrepresented groups in science, technology, engineering, and mathematics (STEM) such as women, persons with disabilities, and underrepresented minorities,[1], [2] and those from geographically underrepresented areas in STEM. Proposals submitted to any theme described in this solicitation are strongly encouraged to involve PIs, co-PIs, postdoctoral fellows, students, and other personnel who are members of these groups. Proposers are also strongly encouraged to consider involving veterans of the U.S. Armed Forces as part of NSF's broader effort to promote veteran involvement in STEM research and education.

[1] <https://nces.nsf.gov/pubs/nsf19304/digest/introduction>

[2] https://nsf.gov/resources/nsf.gov/2022-03/2019-2020-ceose-biennial-report-508_1.pdf

II. PROGRAM DESCRIPTION

Over the past decade, there has been a tremendous explosion in the growth of tools for synthetic and engineering biology, and in the basic and exploratory research these tools enable. The potential of synthetic and engineering biology to advance the bioeconomy has been recognized, yet that potential has not been realized. The infrastructure needed to facilitate the translation of exploratory synthetic and engineering biology research is not widely available to the U.S. academic community. To that end, NSF and DOE BETO funded Agile BioFoundry are partnering to enable broader access to the Agile BioFoundry's world class Design-Build-Test-Learn capabilities.

The goal of this solicitation is to support synthetic and engineering biology research projects that have the potential to leverage the unique resources of the Agile BioFoundry to further the development of the project towards eventual translation. The topical areas of interest should align with the broad interests of both NSF and DOE BETO. Thematic areas of particular interest include: 1) expansion of the range of host organisms amenable to the tools of synthetic and engineering biology; 2) development of novel biotechnology approaches to mitigate climate change; 3) projects which advance a circular bioeconomy; 4) the development of affordable, bio-based, sustainable aviation fuel (SAF) or other products of interest to NSF and DOE BETO that can demonstrate significant climate change mitigation and/or greenhouse gas reductions over a petroleum baseline. The potential economic and environment impact of the project is also a consideration.

Successful projects should either further the translation of a particular project or create new capabilities or technologies that could broadly impact the Design-Build-Test-Learn biomanufacturing and biodesign cycle.

The experimental design associated with utilizing the tools of a biofoundry are significantly different than the traditional research methodologies utilized in a single investigator laboratory. Thus, successful projects could also include developing novel educational or training material that will facilitate the adoption of biofoundry tools by a new generation of synthetic and engineering biology researchers.

To be responsive to this solicitation, proposers must

- Propose the translation of a basic synthetic and engineering biology research project into a process or product that will advance the bioeconomy;
- Have a project that can leverage the unique integrated Design-Build-Test-Learn cycle tools or non-model host organisms available at the ABF and describe the plan for implementation at ABF;
- Describe how the proposed scope of work directly fits within the ABF, e.g. developing a host of interest to ABF, improving production of an ABF product or strategic central metabolite (designated Beachhead molecules), developing methods to support ABF machine learning approaches, or clearly identifying a gap in fundamental knowledge that will broadly enable ABF efforts;
- Include with their submission evidence of a positive outcome of the **required feasibility review** by ABF, submitted as supplementary documentation, in which ABF has reviewed the overall scope of the project and preliminary plans for the utilization of ABF capabilities (more details of the feasibility review are provided under Proposal Preparation Instructions);

- Include a plan for development of generalizable rules associated with their biological system;
- Include a plan for leveraging the unique workforce development capabilities associated with the ABF;
- Be prepared to execute a Cooperative Research and Development Agreement (CRADA) for the work to be performed at the ABF including the terms and conditions of the CRADA that apply to Intellectual Property (IP) resulting from the awardee's collaboration with the ABF.

Investigators are highly encouraged to explore topics aimed at sustainable processes or products that will lead to greenhouse gas reduction, aligned with NSF climate change priorities and the DOE BETO goals of emission reduction in the transportation or industrial sector.

III. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. The anticipated annual funding amount includes funding from NSF and DOE.

NSF will support proposers via the standard or continuing award mechanisms.

DOE BETO Process:

DOE BETO support will be directed through a Cooperative Research and Development Agreement (CRADA) with the ABF. In conjunction with NSF program support, proposers will use ABF capabilities across the consortium of national labs to develop novel microbial hosts and bioproducts and develop new capabilities and approaches that will advance all aspects of the Design-Build-Test-Learn biomufacturing cycle. Proposers should submit a proposal that identifies the technical challenges, approaches, and impacts to the mission of the ABF. Prior to submission of the full proposal, projects are required to undergo a feasibility review in coordination with the ABF (see section V). After completion of the feasibility review, projects which have gained ABF support will then undergo merit review of the full proposal.

After NSF merit review has been completed, PIs of projects that are recommended for funding by NSF will be directed to the appropriate Technology Manager at DOE BETO who will provide instructions for completion of the CRADA. All projects selected for an award will have both an award from NSF and an executed CRADA from DOE BETO.

The DOE BETO CRADA defines ownership of Intellectual Property. For parts of a project funded by DOE BETO, the terms and conditions of the CRADA will apply to the IP resulting from the awardee's collaboration with the ABF.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI:

There are no restrictions or limits.

Additional Eligibility Info:

The partner laboratories in the Agile BioFoundry consortium are: Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory, Oak Ridge National Laboratory, Los Alamos National Laboratory and Argonne National Laboratory. The budget for the Agile BioFoundry partners through CRADA can make up no more than 49% of the total combined NSF and DOE BETO proposed work budget.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- 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: (https://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) 292-8134 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 Research.gov. PAPPG Chapter II.E.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.D.2 for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the PAPPG instructions.

Feasibility review: There is a **mandatory technical feasibility review** that must be requested by the proposer from the Agile Biofoundry using the instructions at <https://www.nsf.gov/bio/mcb/ABF.jsp>. **The request for feasibility review must be submitted no later than 11:59 pm February 15, 2023.** This solicitation will provide funding for collaborative projects between a proposer, supported by NSF, and the Agile BioFoundry, supported by DOE BETO, to address critical biomanufacturing challenges. The proposer must clearly articulate which Agile BioFoundry National Laboratory partners they plan to work with and which capabilities they plan to use. Interested parties should coordinate with the Agile BioFoundry at <https://agilebiofoundry.org/work-with-us/>. Prior to submitting a proposal, proposers must submit to the ABF a description of the scope of the project along with the expected ABF facilities that will be used in the project following the template located at <https://www.nsf.gov/bio/mcb/ABF.jsp>. The project scope, in no more than 2 pages, must outline the aims of the project the expected outcomes and the alignment of the project with NSF and DOE BETO priorities highlighted in this solicitation. There should also be included a detailed listing of the ABF capabilities that will be used during the course of the project with some description of how those capabilities contribute to the project. This section can be an additional 2 pages. Investigators are advised to consult with ABF early in their proposal planning process. ABF will provide the PI with an initial outcome of the feasibility review by March 1, 2023. After the initial feasibility review, PIs will have the opportunity to coordinate directly with the ABF team to refine scope and budget for the ABF relevant parts of the project. ABF reserves the right to reevaluate feasibility prior to final submission and communicate such outcomes to the applicant and the NSF. More information on the capabilities of the Agile BioFoundry can be found at <https://agilebiofoundry.org/capabilities/>. The preferred mechanism for collaboration with the ABF is to use the ABF CRADA. For more information about the partnership agreements, please visit <https://agilebiofoundry.org/work-with-us/>.

Budget: The partner laboratories in the Agile BioFoundry consortium are: Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory, Pacific Northwest National Laboratory, Sandia National Laboratory, Oak Ridge National Laboratory, Los Alamos National Laboratory, and Argonne National Laboratory. The budget for the Agile BioFoundry partners through CRDA can make up no more than 49% of the total combined NSF and DOE BETO proposed work budget. This solicitation will focus specifically on challenges which are precompetitive in nature and not adequately addressed in the private sector.

Proposals are invited that address early-stage R&D challenges that are best addressed with the resources (equipment and personnel) based within the Agile BioFoundry consortium.

Project Description: In addition to the requirements specified in the Proposal and Award Policy and Procedure Guide (PAPPG), the Project Description should:

- Provide a breakdown of the work that will be done at the PI's institution and the work that will be done at ABF.
- Detail how resources at ABF will be utilized to advance the project.
- Highlight how the proposed work is responsive to the solicitation as described in section II Program Description.

Supplementary Documentation: Proposers must include evidence of a positive technical feasibility review by ABF in which ABF has reviewed the overall scope of the project and preliminary plans for the utilization of ABF capabilities.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):
 - April 04, 2022
 - April 18, 2023

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov 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: <https://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 Research.gov for further processing.

Proposers that submitted via Research.gov may use Research.gov 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 PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://www.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 *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. 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 strategic objectives 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 must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of 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. (PAPPG Chapter II.D.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 PAPPG Chapter II.D.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 other underrepresented groups 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

In addition to the standard NSF review criteria, reviewers will be asked to evaluate: 1) does the project enable the translation of basic research; 2) does this project leverage the resources of ABF; 3) is the project technically feasible; 4) does the project generate new knowledge or basic research such as rules governing biological systems; 5) does the project leverage the unique workforce development capabilities associated with ABF; and 6) does this project work toward NSF and DOE BETO goals in green house gas emissions reduction in the transportation or industrial sectors?

PIs must submit evidence of a positive preliminary technical feasibility review by ABF with their proposal. An additional technical feasibility assessment for implementation at ABF will be undertaken at the time of review of the full proposal.

B. Review and Selection Process

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

The Department of Energy (DOE) is a collaborating agency for the FY 2023 solicitation.

NSF will coordinate and manage the review of proposals with input from DOE BETO. Representatives from DOE BETO will be permitted to view full proposals, recommend reviewers, and attend review panels as observers, and receive unattributed proposal reviews. Relevant information about proposals and reviews of proposals will be shared between the participating organizations via secure file transfer.

DOE BETO Process: DOE BETO support will be directed through a Cooperative Research and Development Agreement (CRADA) with the ABF and the Awardee. In conjunction with NSF program support, proposers will use ABF capabilities across the consortium of national laboratories to develop novel microbial hosts and bioproducts and develop new capabilities and approaches that will advance all aspects of the Design-Build-Test-Learn biomanufacturing cycle. Proposers should submit a proposal that identifies the technical challenges, approaches, and impacts to the mission of the ABF.

After merit review has been completed, PIs of projects that are recommended for funding will be directed to the appropriate Technology Manager at DOE BETO who will provide instructions for completion of the CRADA. All projects selected for an award will have both an award from NSF and will be required to execute a CRADA without substantive modifications from the template found here: <https://agilebiofoundry.org/work-with-us/>. CRADA execution will be a first quarter milestone in the Award.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. 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 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 or the Division of Acquisition and Cooperative Support 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 an NSF Grants and Agreements Officer. 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 https://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-8134 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 *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

Administrative and National Policy Requirements

Build America, Buy America

As expressed in Executive Order 14005, [Ensuring the Future is Made in All of America by All of America's Workers](#) (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) webpage.

Special Award Conditions:

DOE BETO Process: DOE BETO support will be directed through a Cooperative Research and Development Agreement (CRADA) with the ABF. The DOE BETO CRADA defines ownership of Intellectual Property. For parts of a project funded by DOE BETO, the terms and conditions of the CRADA will apply to the IP resulting from the awardee's collaboration with the ABF.

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 no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 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 Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

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:

- David Rockcliffe, NSF/BIO/MCB, telephone: (703) 292-7123, email: drockcli@nsf.gov
- Steven W. Peretti, NSF/ENG/CBET, telephone: (703) 292-8320, email: speretti@nsf.gov
- Ramon Gonzalez, NSF/BIO/MCB, telephone: (703) 292-8046, email: ramgonza@nsf.gov
- Mamadou Diallo, NSF/ENG/CBET, telephone: (703) 292-4257, email: mdiallo@nsf.gov
- Raymond A. Adomaitis, NSF/ENG/CBET, telephone: (703) 292-8320, email: radomait@nsf.gov
- Gayle Bentley, DOE BETO, telephone: (202) 586-5188, email: Gayle.Bentley@ee.doe.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-673-6188
- Research.gov Help Desk e-mail: rgov@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](#).

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

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 (FASSED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.F.7 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 <https://www.nsf.gov>

- **Location:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **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) 292-8134
- **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 [System of Record Notices](#), NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." 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
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
Alexandria, VA 22314

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National Science Foundation, 2415 Eisenhower Avenue, Alexandria, Virginia 22314, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (703) 292-5090 or (800) 281-8749

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