

**CORE QUESTIONS and REPORT TEMPLATE**  
**for**  
**FY 2022 NSF COMMITTEE OF VISITOR (COV) REVIEWS**

**Guidance to the COV:** The COV report should provide a balanced assessment of NSF's performance in the integrity and efficiency of the **processes** related to proposal review. Discussions leading to answers of the Core Questions will require study of confidential material such as declined proposals and reviewer comments. ***COV reports should not contain confidential material or specific information about declined proposals.*** The reports generated by COVs are made available to the public.

*We encourage COV members to provide comments to NSF on how to improve in all areas, as well as suggestions for the COV process, format, and questions. For past COV reports, please see <http://www.nsf.gov/od/oia/activities/cov/>.*

**FY 2022 COMMITTEE OF VISITORS (COV) REPORT**  
**Office of Emerging Frontiers & Multidisciplinary Activities**

<i>Table 1 - Summary Information</i>	
<b>Date of COV: June 22<sup>nd</sup>/23<sup>rd</sup>, 2022</b>	
<b>Program/Cluster/Section: Emerging Frontiers in Research and Innovation (EFRI)</b>	
<b>Division: Office of Emerging Frontiers &amp; Multidisciplinary Activities (EFMA)</b>	
<b>Directorate: Engineering (ENG)</b>	
<b>Number of actions reviewed: 157</b>	
<b>EFRI Pre-proposals:</b>	
Invited:	<b>50</b>
Not invited:	<b>45</b>
<b>EFRI Full proposals:</b>	
Awards:	<b>16</b>
Declinations:	<b>21</b>
<b>REM Supplements:</b>	
Awards:	<b>12</b>
Declinations:	<b>3</b>
<b>GERMINATION EAGERS:</b>	
Awards:	<b>2</b>
Declinations:	<b>0</b>
<b>ERVA Proposals:</b>	
Awards:	<b>1</b>
Declinations:	<b>2</b>
<b>COVID-Related Research Proposals:</b>	
Awards:	<b>2</b>
Declinations:	<b>0</b>
<b>Returned w/o review: 3</b>	
<b>Total number of actions within EFMA Office during period under review: 1003</b>	
<b>EFRI Pre-proposals:</b>	
Invited:	<b>250</b>
Not invited:	<b>431</b>
<b>EFRI Full proposals:</b>	
Awards:	<b>65</b>
Declinations:	<b>178</b>
<b>REM Supplements:</b>	
Awards:	<b>60</b>

**Declinations: 4**

**GERMINATION EAGERS:**

**Awards: 3**

**Declinations: 0**

**ERVA Proposals:**

**Awards: 1**

**Declinations: 3**

**COVID-Related Research Proposals:**

**Awards: 5**

**Declinations: 0**

**Returned w/o review: 3**

**Manner in which reviewed actions were selected:**

A random sample was performed on EFMA new proposal actions for FY2018 through 2021, which included:

- EFRI pre-proposals
- EFRI full proposals
- REM supplements
- GERMINATION EAGERS
- ERVA proposals
- COVID-related research proposals
- Proposals returned w/o review

The resulting population comprised a total of **1003 proposal actions** as detailed above.

*Proposal Actions not included in the sampled population set:*

- *Initiatives not led by EFMA or not subject to EFMA merit review process*

The sampling plan entailed randomly selecting a specified percentage of each proposal type (e.g., preliminary proposal, full proposal) submitted in response to each EFRI solicitation, proportionately from each EFRI Topic, or submitted in response to other calls for proposals (i.e., REM Supplement DCL, ERVA solicitation).

**Proposals (Preliminary & Full) submitted in response to the EFRI Solicitation:**

- 20% of Invites/Awards were selected for review
- 10% of Do Not Invites/Declines were selected for review
- Where  $n < 2$  for a given category (e.g., a single Topic in a single year) using these sampling criteria, two proposals were selected for review
- All Returned w/o Review proposals were selected for review.

**Proposals submitted to EFMA other than to the EFRI solicitation (i.e., REM Supplements, GERMINATION EAGERS, ERVA Proposals, COVID-Related Research Proposals):**

- 20% of awards were selected for review
- 20% of declines were selected for review (because  $n$ =small for this group)
- Where  $n < 2$  for a given category using these sampling criteria, two proposals were selected for review (except where total  $n$  for that category was  $<2$ ).
- All Returned w/o Review proposals were selected for review.

Random selections were performed using the following procedure. The RAND function in Excel was used to assign each proposal a random number between 0 and 1, which iteratively changed upon reloading the file or sorting any column. Columns were first sorted to groups by call type and proposal

type, and were then sorted by assigned number within each group, and the first  $n$  proposals were selected, where  $n$  equals the number of proposals required for that subsample category. All selections were made based solely on FY, proposal type or proposal status (AWD, DECL, RWR, etc.), and call type, and were performed blind with respect to PI/co-PI ID, institution, title, and all other identifying information.

## COV Membership

*Table 2 - COV Membership*

Role	Name	Affiliation
<b>COV Chair:</b>	<b>JoAnn Lighty</b>	<b>Boise State University</b>
<b>COV Members:</b>	<b>Diana Chu</b>	<b>San Francisco State University</b>
	<b>Craig Hoffman</b>	<b>Naval Research Labs</b>
	<b>Kimberly Jones *</b>	<b>Howard University</b>
	<b>Cheryl Knobloch</b>	<b>Pennsylvania State University</b>
	<b>César Malavé</b>	<b>Texas A &amp; M Qatar</b>
	<b>T.J. (Lakis) Mountziaris</b>	<b>University of Houston</b>
	<b>Melur (Ram) Ramasubramanian</b>	<b>University of Virginia</b>
	<b>George Truskey</b>	<b>Duke University</b>
	<b>Thomas Tubon</b>	<b>BioMade</b>
	<b>Joseph Whittaker</b>	<b>Jackson State University</b>
	 <i>* Member of NSF/ENG Advisory Committee</i>	

## INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

Briefly discuss and provide comments for *each* relevant aspect of the program's review process and management. Comments should be based on a review of proposal actions (awards, declinations, returns without review, and withdrawals) that were *completed within the past four fiscal years*. Provide comments for *each* program being reviewed and for those questions that are relevant to the program(s) under review. Quantitative information may be required for some questions. Constructive comments noting areas in need of improvement are encouraged.

**I. Questions about the quality and effectiveness of the program's use of merit review process.** Please answer the following questions about the effectiveness of the merit review process and provide comments or concerns in the space below the question.

*Table 3 - Quality and Effectiveness of the Merit Review Process*

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Are the review methods (for example, panel, ad hoc, site visits) appropriate?</p> <p>Comments:</p> <p>The COV felt that the review methods were appropriate for the pre-proposal and full proposal submissions. Each pre-proposal or proposal had at least three reviews. The committee acknowledged that many reviews were conducted during the COVID pandemic, and the program staff did an excellent job of managing reviews during that time.</p> <p>The COV identified two areas for improvement:</p> <ol style="list-style-type: none"> <li>1) quality of reviews for pre-proposals, and</li> <li>2) quality of reviews of broader impacts, specifically.</li> </ol> <p>Generally, the pre-proposal reviews were not comprehensive. In some cases, these reviews were very short and had limited substantive content. There was little difference in the narrative between a pre-proposal that was invited to submit a full proposal and one that was not invited. As a result, unsuccessful applicants did not receive sufficient feedback to assist with future pre-proposals.</p>	<p><b>YES</b></p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>2. Are both merit review criteria addressed?</p> <p>a) In individual reviews?</p> <p>Yes, but there was considerable variation. The Intellectual Merit (IM) criterion generally received considerably more attention than the Broader Impact (BI) criterion. Broader Impacts were mentioned in most individual reviews, but the reviews often just included a sentence or two describing the broader impacts. They often did not have an evaluation of the impact of the proposed activities.</p> <p>b) In panel summaries?</p> <p>In all cases, panel summaries mentioned intellectual merit and broader impact criteria, but similar to the individual reviews, some panel summaries did not provide substantive comments on broader impacts. In some cases, the panel summaries noted strong intellectual merit and weak broader impacts, and the proposal was recommended for funding.</p> <p>c) In Program Officer review analyses?</p> <p>For preliminary proposals and declined proposals, the review analyses tended to consist of a duplicated context statement. The review analysis for proposals recommended for funding was more substantive.</p> <p>In most cases, the reviews of broader impacts were brief, lacking detail and specificity. The lack of standardization of BI creates missed opportunities to identify BI embedded in the narrative but not necessarily identified as a Broader Impact Strength in the reviewer comments.</p> <p><b>Recommendations:</b></p> <p><b>The COV recommends that reviewers receive guidance/training on how to review BIs. The review guidance should include specific questions related to broader impacts, ensuring that specific features of BIs are addressed. Specifically, see "Other," section #1.</b></p> <p><b>The COV recommends that program officers ensure that each panel summary includes a substantive review of broader impacts and that that review criterion is seriously considered when recommending a proposal for funding.</b></p> <p><b>The COV recommends that EFMA highlight BI in the solicitation information for preliminary proposals (see "Other," section #1).</b></p>	<p><b>YES</b></p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>3. Do the individual reviewers giving written reviews provide substantive comments to explain their assessment of the proposals?</p> <p>Comments:</p> <p>The COV observed that individual reviews were of inconsistent quality. Some reviewers included only a bullet list, while others included narratives. In many cases, feedback on proposals that were not recommended for funding was less substantive. While many of the IM comments were substantive, a few reviewers merely restated key points of the proposals as a strength without elaboration. BI statements tended to be less substantive. It would be more useful to ask the question, what about the proposal is transformative versus, is this proposal transformative.</p> <p>As mentioned earlier, the COV noted that IM comments were much more substantive than comments for BI.</p> <p><b>Recommendations</b></p> <p><b>The COV recommends that program directors ensure that the panel addresses BI specifically. Specific questions on BI should be included in the review guidance.</b></p> <p><b>The reviewers should have a template to ensure that specific criteria are addressed more effectively and examples that show the reasoning behind statements, not simply statements.</b></p>	<p><b>YES</b></p>



QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</p> <p>Comments:</p> <p>In some cases, individual reviews for a proposal spanned a large range (i.e., VG to P), but the proposal was recommended for funding. Panel summaries should include a justification for this. The committee acknowledged that, in some cases, reviewers might reconsider their scores after the panel discussion.</p> <p><b>Recommendations</b></p> <p><b>The COV recommends that EFMA allow reviewers to change scores and reviews based on the panel discussion OR clearly explain the consensus in the panel summary. The decision should be consistent across the program.</b></p> <p><b>The COV recommends that EFMA consider using the terms "highly competitive" or "competitive" instead of "highly recommend" or "recommend."</b></p>	<p><b>YES</b></p>
<p>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</p> <p>Comments:</p> <p>Solicitation-specific criteria were not addressed in some cases, specifically for preliminary proposals. In a few cases, the review analysis indicated a "decline." However, the panel summary concluded, "invite if possible."</p> <p>In general, award/decline decisions were consistent with the Panel Summaries. However, there was at least one case in which a proposal rated less highly by one review panel was funded while another proposal rated more highly by a second review panel was not funded. EFMA should be diligent in the Review Analysis and the panel summaries and explain funding decisions when the ratings and results are not clearly aligned.</p>	<p><b>YES</b></p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>6. Does the documentation to the PI provide the rationale for the award/decline decision?</p> <p>Comments:</p> <p>The reviews sufficiently explained why the reviewers did not recommend the proposal, but some did not give feedback that may help the PI in a potential resubmittal. This was particularly true with pre-proposals as compared to full proposals.</p> <p>For full proposals, the documentation to the PI should include sufficient feedback and recommendation to facilitate a revised proposal. The COV did not find consistent evidence of that. Some reviews had generalized comments. Particularly for early-career faculty, substantial feedback is helpful.</p>	<p><b>YES</b></p>
<p>7. Broader Impacts Quality Control pilot: In FY19, reviewers were reminded during proposal review to fully articulate their evaluation of Broader Impacts. Was consideration of Broader Impacts qualitatively different in reviews of FY19 EFRI Proposals compared with FY18 EFRI Proposals?</p> <p>Comments:</p> <p>The COV commends EFMA for initiating the Pilot Study; however, the COV did not notice a significant improvement in the quality of the reviews of Broader Impacts. There was an increase in word count, but not in substance. When comparing the control group, overall, more words were included, but qualitatively, the feedback was not significantly improved. In many cases, the reviews included a restatement of what the PI plans to do for Broader Impacts.</p> <p>NSF should consider expectations around the balance of IM and BI and provide more information to the research community on these expectations. NSF should inform researchers if IM will be prioritized over BI.</p> <p>The COV also noted that funding for BI is often not included or reviewed. Reviewers should be instructed to review the budget allocation for Broader Impacts to provide feedback on the likelihood of implementation and success of the proposed BI activities.</p> <p><b>Recommendations and Suggestions</b></p> <p><b>The COV recommends that NSF provide an assessment tool for Broader Impacts to be used by PIs. Additional instructions/training to either give thoughts on strengths or weaknesses or criteria to evaluate BI would improve the evaluative nature of the BI impacts. The COV suggests that reviewer training might include the NSF ARIS Center ideas and Toolbox.</b></p>	<p><b>NO</b></p>

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>8. Additional comments on the quality and effectiveness of the program's use of merit review process:</p> <p>Comments:</p> <p>The COV was impressed with the short proposal dwell time, especially concerning pre-proposals. EFMA should ensure that review quality remains high while maintaining a relatively short dwell time. The COV commends EFMA for convening panels with a wide range of disciplines for reviews, particularly during the COVID pandemic. The COV observed that panel summaries are more substantial than individual reviews, and documentation in panel summaries was very good.</p>	<p><b>NOT APPLICABLE</b></p>

**II. Questions concerning the selection of reviewers.** Please answer the following questions about the selection of reviewers and provide comments or concerns in the space below the question.

*Table 4 - Selection of Reviewers*

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>The COV members concur that the selection of reviewers is critical to ensuring an ethical proposal review that provides robust feedback from diverse scientific experts. Reviewer expertise should be specific to subject matter yet broadly able to evaluate engineering outcomes, educational engagement, and opportunities for societal impact. Further, optimal review panels should be designed to achieve demographic inclusivity and balance regarding gender, race, institutional type, and geographic distribution.</p> <p>The COV members agreed that jackets provided evidence that reviewer selection was appropriate for intellectual merit review. Yet the COV found consistent evidence that expertise in broader impact was lacking on most panel reviews in CEE, C3SORODCheM, and E3P. [Note: REM panels include BI experts, and GERMINATION reviews are internal.] The COV recommends that future EFMA panels engage at least one broader impact expert to ensure that proposals are evaluated thoroughly for BI and, as importantly, that the PI is given explicit reviewer guidance to strengthen the BI outcomes (awarded) or proposal resubmission (declined).</p> <p>The COV notes that review panels in FY18 – FY21 were comprised of reviewers mostly from PhD granting institutions. The COV recommends expanding the panel expertise to include more industry scientific experts as well as other types of institutions of higher education (IHE). Industry representatives are anticipated to serve multiple favorable purposes and provide valuable perspectives regarding the implementation of research thrusts and technology transfer. Industry representatives also have the potential to elevate implementation of scientific innovation and broader impact. In summary, the COV asserts that the ideal composition of inclusive review panels should ensure representation from academia, national labs, and industry, as well as specific expertise for broader impact.</p>	<p><b>YES</b></p>

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>2. Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>The COV commends the NSF EFMA Program Directors in the Directorate for Engineering for their consistent efforts to identify and resolve conflicts of interest. COV members concur that the jackets under review provided consistent evidence that Program Directors have established and implemented multiple mechanisms to facilitate reviewer disclosure of conflicts of interest (COI). First, it is evident that NSF Program Directors take great measures to ensure reviewers are not assigned to review proposals from investigators from the same institution. Further, panel reviewers are thoroughly educated on identifying instances of COI and are provided with multiple opportunities to disclose the conflict. Upon COI disclosure, panelists are instructed to contact NSF immediately, and access to the proposal is removed. Each panelist is required to submit NSF Form 1230P, Conflicts-of-Interests (COI), and Confidentiality Statement for NSF Panelists. Finally, the NSF Review Record documents the COIs disclosed for the jacket records. These high standards uphold the impeccable credibility of the institution and the high value of the review narratives.</p>	<p><b>YES</b></p>

SELECTION OF REVIEWERS	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
<p>3. Additional comments on reviewer selection and recommended actions:</p> <p>The COV engaged in discussion that appears to mirror feedback from the 2018 COV report regarding reviewer selection. Improvement in reviewer selection methods is noted, but the COV believes that it is necessary to continue to augment these practices to ensure the proposal reviews are thorough. Specific suggestions for improvement are noted herein.</p> <p><b>a. Accurate demographic reporting:</b> The diversity of panel reviewers has improved since the COV report in 2018, and the COV applauds PDs efforts to elevate reviewer reporting of demographic information. Yet it was universally observed that an overwhelming number of reviewers still do not disclose important demographic data such as gender and ethnicity. The COV believes that an intentional laser focus on improved reporting will facilitate an accurate assessment of the diversity and inclusion on respective panels. Thus, one proposed solution is for PDs to increase their intentional pursuit of this information. Although this is optional to report, the COV believes that reminders before and on the first day of the panel review will likely elevate this reporting. Further, a slide dedicated to the importance of this reporting during the panel review introduction may resolve the matter sufficiently. Ultimately, it is important to be able to assess the diversity of review panels, and the limited data to this point does not facilitate that evaluation. [Note: It has come to the attention of the COV that future demographic reporting of reviewers is anticipated to improve with implementing a pilot in FY23. EFMA directors indicated that an FY22 pilot to improve demographic reporting for PIs will be implemented with panel reviewers in FY23. The COV is hopeful that this attention to reviewer reporting will provide the data that has been lacking.]</p> <p><b>b. Targeted broader impact expertise:</b> The COV asserted the importance of engaging BI experts on the EFMA panels. COV jacket reviews from FY18-FY21 revealed substantially less feedback regarding BI compared to the feedback for Intellectual merit. While the BI pilot appeared to increase the number of bullets and/or word count of BI feedback, the COV noted that the content of the BI review lacked the expertise needed to elevate the impact of the proposed work. Thus, a dedicated effort to populate review panels with one or two BI experts is anticipated to provide PIs with important and specific input that will take the broader impact practices to the "next level."</p> <p><b>c. Improved breadth of reviewer experiences:</b> The COV advocates for more industry representation on the review panels. This is anticipated to facilitate collaboration between academia and industry and increase opportunity for impact in areas spanning from scientific innovation to broader impact.</p>	<p><b>NOT APPLICABLE</b></p>

**III. Questions concerning the management of the program under review.** Please comment on the following:

*Table 5 - Management of the Program Under Review*

MANAGEMENT OF THE PROGRAM UNDER REVIEW
<p>1. Management of the program.</p> <p>Comments:</p> <p>In general, the COV found that the EFMA program is well managed. The team was unified in favorably acknowledging the efforts of the EFMA leadership and staff in their continued collaborative approach in leveraging internal and external expertise for creative visioning as well as in developing, maintaining, and managing a complement of high risk, high reward programs instrumental in advancing the frontiers of engineering, scientific research, and education. A great example is the leveraging of Biology to power engineering impact. The program's pursuit of impactful, innovative research, integrating education and other experiences, is commendable and clearly aligned with relevant NSF strategic objectives.</p> <p>The commendable management of the EFMA portfolio is reflected in the average dwell time of less than five months across programs, which is outstanding. The COV recognizes the challenges associated with such efforts but encourages the EFMA leadership to continue to maintain the balance between dwell times and portfolio dynamics.</p> <p>The COV recognizes the protracted challenges in diversifying the scientific workforce. While progress has been made in addressing gender differences, efforts need to continue with regard to other diversity metrics and the COV recommends disaggregation of funding data by institution type. This should align well with the goals of improving access and inclusivity while promoting cultural progress in science and engineering. The program should continue its strategic investments to drive discovery but employ creative strategies to enhance research capability in historically under-resourced institutions.</p>
<p>2. Responsiveness of the program to emerging research and education opportunities.</p> <p>Comments:</p> <p>The COV recognizes the dedicated efforts, value, and impact of continuing and new program solicitations such as ERVA, GERMINATION, and REM. These largely result from engaging with the scientific and engineering communities, and the program appears to be highly responsive to opportunities arising in research and education. The GERMINATION stands out as a key emerging area, and the facilitation of conferences has been instrumental as a platform to drive interdisciplinary research and the convergence of ideas.</p> <p>These efforts should continue as they have transformative impacts program-wide. EFMA leadership is encouraged to elevate the focus on URM engagement to drive and strengthen diversity in STEM expertise/capabilities and capacity development in relevant institutions.</p>

## MANAGEMENT OF THE PROGRAM UNDER REVIEW

3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.

Comments:

The EFMA leadership has demonstrated the benefits of internal collaboration as co-funding. The outcomes of such efforts bode well for both the sustainability and scaling of the programs. However, the COV also noted efforts towards expanding the geographic diversity and intentional outreach to TCU and HBCUs. When considering NSF expansion with the TIP Directorate, the risk of further exclusion of these groups could be potentially higher as these MSI institutions are already recognized as being significantly under-resourced. As technology and scientific R&D advance at a rapid pace, institutions already under-resourced that serve predominantly URM populations will be left further behind. Therefore, strategic and intentional efforts should be made to ensure inclusion in STEM and engineering training and capacity development initiatives.

### Recommendations

**The COV recommends expanded marketing and outreach to industry and inter-governmental entities seeking additional resources and creative funding mechanisms to scale current programs' applied and translation impacts.**

**An additional recommendation would be for the EFMA leadership to intentionally work with HBCU and TCU stakeholders to create benchmarks for diversity/inclusivity achievements/impact; maybe an evaluation beyond REM/training programs focused on outcomes and research capacity development/transformation.**

4. Responsiveness of program to previous COV comments and recommendations.

Comments:

The program has been responsive to previous COV comments and recommendations, in general. However, there are some remaining inconsistencies that are evident in feedback to reviewers, particularly in the IM and BI required sections (see Section I). Program management should be more attentive and intentional in reviewing feedback on IM/BI requirements.

### Recommendations

**The COV recommends that EFMA program leadership reviews the solicitation process and consider making adjustments necessary to reduce inconsistencies in investigators' responses and reviewers' feedback. Specific clarifications are needed for members of the research community. (See "Other," Section 1)**

**The EFMA leadership should consider benchmarking IM and BI as well as criteria and rationale for project selection for funding.**



**IV. Questions about Portfolio.** Please answer the following about the portfolio of awards made by the program under review.

*Table 6 - Resulting Portfolio of Awards*

<p align="center"><b>RESULTING PORTFOLIO OF AWARDS</b></p>	<p align="center"><b>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</b></p>
<p>1. Does the program portfolio have an appropriate balance of awards across disciplines and sub-disciplines of the activity?</p> <p>Comments:</p> <p>The COV commends EFMA for an appropriate balance of awards across disciplines and sub-disciplines of each topic based on the PI discipline. Topics address emerging areas of science and technology with high potential scientific and societal impact. The solicitations were developed to engage experts from various engineering and science fields.</p> <p><b>Recommendation</b></p> <p><b>Bridging to other areas of NSF and industry will further strengthen the program portfolio.</b></p>	<p align="center"><b>APPROPRIATE</b></p>
<p>2. Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments:</p> <p>The duration and scope of the projects are appropriate, but the award size may need to be increased to cover the rising costs of doing research. A total budget of \$2M over four years for Emerging Frontiers in Research and Innovation (EFRI) grants was considered by the COV to be insufficient to support the rising costs of research conducted by multi-investigator teams, especially when multiple institutions are involved.</p> <p><b>Recommendation</b></p> <p><b>The COV recommends that EFMA consider increasing the EFRI awards size to ensure that the program can support genuinely transformative interdisciplinary research. One possible approach to increasing the size of EFRI awards without decreasing the number of awards would be to pursue partnership or teaming arrangements with other federal funding agencies, philanthropic organizations, and industry.</b></p>	<p align="center"><b>APPROPRIATE</b></p>
<p>3. Does the program portfolio include awards for projects that are innovative or potentially transformative?</p>	<p align="center"><b>APPROPRIATE</b></p>

<p>Comments:</p> <p>The selected research topics and the awards in the program portfolio are innovative or potentially transformative. The Engineering Research Visioning Alliance (ERVA) will identify topics of national relevance to a wide variety of diverse stakeholders. The Research Experience and Mentoring (REM) awards are very important for broadening the participation of researchers from underrepresented groups and attracting students from underrepresented groups into STEM careers. ERVA also brings an opportunity for industry engagement and building public-private partnerships.</p> <p>EFMA is meeting the goal of funding high-risk, high-reward ideas and creating exciting topics.</p> <p><b>Recommendation</b></p> <p><b>We recommend that EFMA considers collaborating with ERVA on the selection of topics. We also recommend the development of mechanisms that increase MSI and URM PI involvement to strengthen capabilities at MSIs and diversity expertise in teams (see #6 below).</b></p>	
<p>4. Does the program portfolio include inter- and multi-disciplinary projects?</p> <p>Comments:</p> <p>The vast majority of the awards in the program portfolio support inter- and multi-disciplinary projects. The impact of these awards can be higher if the available budget for each project is increased, especially for EFRI awards.</p>	<p><b>APPROPRIATE</b></p>
<p>5. Does the program portfolio have an appropriate geographical distribution of Principal Investigators?</p> <p>Comments:</p> <p>The geographical distribution of Principal Investigators is appropriate. Higher participation of PIs from the EPSCoR States would be desirable, but when co-PIs are considered, the demographics are more reasonably aligned.</p> <p><b>Recommendation</b></p> <p><b>The COV recommends that EFMA considers using planning grants and Germination to help obtain a broader geographical distribution and diversity in the types of institutions and PIs/co-PIs (see below).</b></p>	<p><b>APPROPRIATE</b></p>
<p>6. Does the program portfolio have an appropriate balance of awards to different types of institutions?</p>	<p><b>APPROPRIATE</b></p>

<p>Comments:</p> <p>The program portfolio has high participation by PhD-granting institutions that are well-equipped to support the focus on fundamental discovery at the frontiers of engineering and education. Given the fundamental discovery focus of EFRI, it seems logical that most institutions receiving EFRI awards will be PhD granting.</p> <p>However, from an institutional diversity perspective, the COV felt that there is an opportunity to broaden the institution type in the portfolio to include minority-serving institutions (HSI, HBCU, Tribal Colleges) as long as they are PhD-granting. Engaging such institutions would strengthen the program and increase the diversity of participating scholars to add valuable expertise and new perspectives to projects.</p> <p><b>Recommendation:</b></p> <p><b>PI demographics and type of institution affiliation of PIs and Co-PIs should be tracked and used to design targeted interventions (e.g., Planning Grant, GERMINATION) and measure their impact. For example, with the data on institutional demographics, one goal for EFRI for the next three years might be to focus on grooming potential PIs at MSIs to lead, or partner to lead, an EFRI. This could be done through a Dear Colleague Letter (DCL) with a track for inviting MSI-based PIs to apply for the planning grant and/or the GERMINATION grant (in collaboration with a well-established research-intensive institution as a partner). This could result in realistically helping the MSI compete for an EFRI award effectively.</b></p>	
<p>7. Does the program portfolio have an appropriate balance of awards to new and early-career investigators?</p> <p>Comments:</p> <p>Yes. The percentage of new and early-career investigators that receive awards from the program is high and appropriate for this program.</p>	<p><b>APPROPRIATE</b></p>
<p>8. Does the program portfolio include projects that integrate research and education?</p> <p>Comments:</p> <p>Yes. The REM addition brings in a mentoring component that balances the portfolio. In addition, EFRI projects support, for the majority, doctoral students, which is building the capacity of the next generation of scholars.</p>	<p><b>APPROPRIATE</b></p>

<p>9. Does the program portfolio have appropriate participation of underrepresented groups?</p> <p>Comments:</p> <p>For the group of PIs and co-PIs that reported demographic information, the program has appropriate participation of underrepresented groups. The data provided suggests that the participation across the EFRI topics mirrors the community data in terms of gender and race. The pilot underway will hopefully reduce the number of unknowns by increasing PI participation in reporting demographic information.</p>	<p><b>APPROPRIATE</b></p>
<p>10. Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</p> <p>Comments:</p> <p>The program is aligned with the mission of NSF. It has supported projects at the frontiers of research and innovation and covers topics that can define future national priorities. One example, among several, is the topic of Quantum Information and Research that EFMA pioneered several years ago. This topic was subsequently adopted broadly by the NSF and by other federal funding agencies. It has become a national priority.</p> <p>It is commendable that truly frontier ideas are generated through a grassroots and inclusive approach. However, aligning with national priorities and grand challenges is almost entirely coincidental.</p> <p><b>Recommendation:</b></p> <p><b>Connect topics to national grand challenges intentionally while not impeding the grassroots approach. The blue-ribbon panel is unique and effective in selecting topics to provide this alignment purposefully. For example, suppose topics are solicited to address the national priority topic of "climate change and its impact on society". In that case, the grassroots approach may still come up with topics from green chemistry, recycling of plastics, and distributed chemical manufacturing as topics that will fit the national priority by design and not impede on the creativity of the research community, only gently direct them towards a grand challenge. The blue-ribbon panel can have the big picture in mind when selecting topics.</b></p> <p>Relevant Recent External Reports:</p> <p>National Academies: Chemical Engineering Challenges and Opportunities in the 21st Century (2022).  <a href="https://www.nationalacademies.org/our-work/chemical-engineering-challenges-and-opportunities-in-the-21st-century">https://www.nationalacademies.org/our-work/chemical-engineering-challenges-and-opportunities-in-the-21st-century</a></p> <p>Congressional Report on The Bioeconomy: A Primer (2021)</p>	<p><b>APPROPRIATE</b></p>

<a href="https://crsreports.congress.gov/product/pdf/R/R46881">https://crsreports.congress.gov/product/pdf/R/R46881</a>	
<p>11. Additional comments on the quality of the projects or the balance of the portfolio:</p> <p>The selection of topics and overall quality and balance of funded projects are appropriate and have the potential for transformative impact on research, education, and innovation. The COV commends the work of EFMA leadership, program directors, and staff members for their outstanding program stewardship.</p>	<b>APPROPRIATE</b>

## OTHER TOPICS

1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The instructions for proposal preparation have two parts in the solicitation, namely, the preliminary proposal preparation instructions and the full proposal preparation instructions. The preliminary proposal's instructions for the project summary state, "Describe the broader impacts of the proposed work, including the potential long-term impact on national needs or a grand challenge." It does not ask for a broadening participation plan. The instructions for the project description, under the transformative impact section, state, "Include a **succinct statement** of your preliminary Broadening Participation Plan."

For the full proposal instruction, however, the instruction is clear and requires a broadening participation plan both in the Project Summary and in the Project Description. In addition, the instructions state, "If needed, you may include additional information, up to five pages, about your Broadening Participation Plan as a Supplementary Document."

It appeared to the COV members that the requirements for the broadening participation plan in the preliminary proposals were unevenly interpreted by the proposers and reviewers, whereas there was uniformity of understanding around Intellectual Merit. Some have literally written one sentence (succinct), and some had a paragraph. Some reviewers seemed to have wanted more when they saw only a sentence, and some did not expect more than a sentence and called it a strong broader impacts plan in their review.

This presents an opportunity for additional guidance and resources to close this gap, clarify the solicitation, and provide resources for reviewers so they understand what to expect in the preliminary proposals they will be evaluating.

### Recommendations:

- We recommend that both proposers and reviewers are provided with additional guidance (with reference to NSF ARIS, BI Guidelines, and Toolbox) to help define these expectations, which may lead to better articulation and review of how the proposal addresses the specific BI criteria.
- Harmonize solicitation language describing the requirements for the expression of BI and BP ideas and the review criteria communicated to the reviewers/panelist. (Examples below)
  - Align the written requirements in different parts of the program solicitation to those found in the current Introduction: "The Broadening Participation Plan must be described as part of Broader Impacts of the proposal both in the Project Summary and in the Project Description. It may include, but is not limited to, any of the following menu of activities as appropriate for your project and the circumstances of your institution(s)..." as described below:
    - In proposal preparation instructions, the Project Summary section currently states, "Describe the *broader impacts* of the proposed work, including the potential long-term impact on national needs or a grand challenge."  
**Recommended change:** "Describe the *broader impacts* of the proposed work, including the potential long-term impact on national needs or a grand challenge and plans for broadening participation."
    - The current statement in the Project Description section reads: "The project description of the preliminary proposal is limited to five pages and should include the following three sections: Vision and Goals, Approach and Methodology, Transformative Impact." **Recommended change:** Add an

additional section: "...four sections: Vision and Goals, Approach and Methodology, Transformative Impact, and Broader Impacts including Broadening Participation."

2. Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

none

3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

- More emphasis and demonstration that BI is important and taken seriously are needed if we want to see a change. e.g., returning a proposal that was poor on BI but outstanding on IM declined.
- Reviews should be more evaluative than observational.

4. Please provide comments on any other issues the COV feels are relevant.

none

5. NSF would appreciate your comments on how to improve the COV review process, format, and report template.

- Sharing the data with the new OneDrive is outstanding. Easy, robust, and modern compared to the SharePoint we have used in the past. Recommendation: Don't go back.
- The informal chat at the end of COV is a brilliant idea. While the COV has been immersed in COV deeply for the moment, it is wise to draw out thoughts and ideas before we forget all this (supposed to!) and go about our regular business.

*The Committee of Visitors is part of a Federal advisory committee. The function of Federal advisory committees is advisory only. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the Advisory Committee, and do not necessarily reflect the views of the National Science Foundation.*

**SIGNATURE BLOCK:**



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For the EFMA 2022 Committee of Visitors  
Dr. JoAnn S. Lighty  
Chair

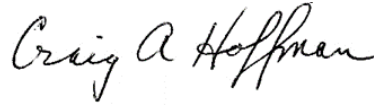
**SIGNATURE BLOCK:**

For the EFMA 2022 Committee of Visitors (Other than the Chairs)



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Diana Chu



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Craig Hoffman

Kimberly L Jones

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Kimberly L. Jones



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Cheryl Knobloch

César Malavé

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T.J . M ountziaris

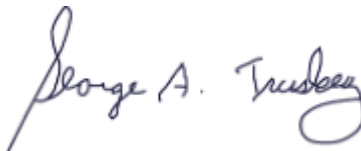
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T.J. (Lakis) Mountziaris



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Melur (Ram) Ramasubramanian



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George Truskey

Thomas Tubon

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Thomas Tubon



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Joseph Whittaker