U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

# DOE Advanced Manufacturing Office 2018 Peer Review

January 2019

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# Department of Energy

## Washington, DC 20585

September 27, 2018

Dear Stakeholders,

In July 2018, the Advanced Manufacturing Office (AMO) conducted a review of the technology research and development (R&D) and technical partnerships supported by our office. Thank you researchers and the entire peer review team for your participation. These annual peer reviews not only help us to evaluate and strengthen our portfolio of work, they also help us communicate our goals and objectives and lay the groundwork for how we are working to accomplish them.

This year, we debuted a reorganization of the peer review. We split reviewers into three subpanels across two tracks to give each subpanel an extended break after each set of presentations. This gave reviewers the opportunity to record and discuss their thoughts immediately following presentations while the information was still fresh in their minds. This overhaul of the peer review structure made the event more effective and efficient and enabled reviewers to provide more detailed feedback to the presenters and AMO leadership. I am encouraged by the positive feedback I received from reviewers about the new structure.

During this year's peer review, we made a point to better explain the role of our Multi-Year Program Plan (MYPP) in our decision making, and we asked presenters to clearly communicate how their program and project outcomes align with the opportunities and goals laid out in our MYPP and analysis work. In the future, we look forward to effectively conveying our analysis work at a more detailed level.

As we look ahead to the future, our programs and projects will continue to provide key support for the Administration's R&D priorities, specifically in the areas of smart manufacturing, cybersecurity for manufacturing, supercomputing, and critical materials. A strong industrial base is crucial to our national security and global competitiveness. Strategic investments in early-stage R&D – in partnership with industry, national laboratories, and universities – can help bring revolutionary innovations to the manufacturing sector resulting in more high-quality jobs, better products, and a reduced energy footprint.

Again, thank you to the entire peer review team and research participants for helping AMO maximize the effectiveness of our resources to provide real results for the American people.

Sincerely,

Rob Ivester
Director, Advanced Manufacturing Office
Energy Efficiency and Renewable Energy
U.S. Department of Energy

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# Executive Summary

The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) requires each program to conduct periodic peer reviews to enhance EERE program planning. The EERE Advanced Manufacturing Office (AMO) held a peer review of its program activities in Washington, DC on July 17-19, 2018. The purposes of the peer review were to: learn from each other, provide feedback to AMO, continue to baseline efforts for comparison over time, and identify possible course correction and new direction. To the extent possible, the peer review process followed the guidelines set forth in EERE 810: Peer Review Guidance (June 2016) and the EERE Peer Review Guide (2004). An independent panel of experts attended the meeting and provided comments on AMO activities. Their findings are summarized in this report.

As noted in the 2017 AMO Program Peer Review report, the AMO vision, mission, and strategic goals are solid, and the AMO program is well designed from the top level and aimed at the right subject matter to achieve the AMO objectives, as described in the Draft Multi-Year Program Plan (MYPP). As such, this year's review and report focus predominantly on the implementation of the AMO strategy to achieve program goals and objectives. As would be expected with any external review process, the panel also identified and noted potential opportunities for strengthening program implementation.

In summary, AMO is commended for having instituted this yearly review meeting, modifying the review process over time including the transition this year to a MYPP-based review focus, and for implementing strong active project management processes to ensure the best possible outcomes from program activities. AMO is now effectively investing in 12 of the 14 Advanced Manufacturing Technology Areas (core, impactful manufacturing technologies) identified in the Draft MYPP. From an AMO "Pillar" perspective, the R&D Consortia are achieving significant progress and generally have strong leadership and industrial support. R&D Projects that are ending were predominantly conducted effectively and many achieved considerable success; and the newly selected early-stage research projects, while just getting underway, are pursuing interesting concepts to improve energy productivity. The quality of the Technical Partnerships activities are generally very good, and AMO also supports valuable workforce development efforts that are injecting new ideas and energy into the manufacturing space. The strategic analysis efforts are robust, and provide critical foundational knowledge in guiding strategic planning efforts. With respect to future efforts, AMO is encouraged to continue its efforts to develop and strengthen its medium and longer term research portfolio through a prioritized process addressing all critical Advanced Manufacturing Technology Areas as the MYPP transitions from its current "Draft" status to a final, approved version.

The review panel made a number of recommendations to AMO for consideration to further strengthen the program; the following specific suggestions were noted to be of particular importance:

- AMO is encouraged to expand the use of techno-economic assessment (analyzing the anticipated technical and economic performance of a process or product by combining process modeling, engineering design and economic evaluation) in proposal selection and initial project implementation, particularly for early-stage research efforts.
- AMO is also encouraged to expand involvement of process engineering capabilities necessary for scale-up in proposal selection and initial project implementation, particularly for small-scale, early-stage research efforts.
- For projects with a very low Technology Readiness Level (TRL) and/or Manufacturing Readiness Level (MRL) – such as those barely achieving Level 2 on the 1-9 Readiness scales, AMO should consider partnering with the Office of Basic Energy Sciences within DOE and/or investing more in fundamental understanding before advancing significant applied development efforts.
- The panel encourages greater use of high performance computing (modeling) and machine learning to support R&D project efforts.

- Considering the emphasis on early-stage research, the panel encourages AMO to focus more time and effort on strategies designed to provide a clear transition path to higher TRL/MRL values; thus increasing the likelihood of eventual technology transition to the marketplace after R&D project completion.
- The panel encourages expanded collaboration among AMO Technology Managers to identify best practices across the various Pillar portfolios and disseminate to other projects or activities that may benefit from those best practices.

# Introduction

The U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE) requires each program to conduct periodic peer reviews to enhance EERE program planning. The EERE Advanced Manufacturing Office (AMO) held a peer review of its activities in Washington, DC on July 17-19, 2018. The purposes of the peer review were to: learn from each other, provide feedback to AMO, continue to baseline efforts for comparison over time, and identify possible course correction and new direction. To the extent possible, the peer review process followed the guidelines set forth in forth in EERE 810: Peer Review Guidance (June 2016) and the EERE Peer Review Guide (2004). An independent panel of experts attended the meeting and provided comments on the overall AMO Program. Their findings are summarized in this report.

## EERE Peer Review Requirements

The EERE Peer Review Guide sets forth a number of guidelines for program and project peer reviews. EERE requires all programs to conduct a peer review, on average, every two years. Program reviews should consider budget, output generated, management structure and complexity, stakeholder participation, and information needed to support management decisions. Activities reviewed should typically cover 80-90% of the program's funding, supporting business analysis, and management programs.

EERE Peer Review guidelines also require a minimum of three reviewers for each discrete program element or smallest unit that is assessed and reported on. Each reviewer should be independent, competent, and objective, selected by a transparent, credible process that involves external parties. Together, the reviewers cover the subject matter.

After the review, the peer review panel is expected to produce and submit a peer review report to AMO management of the findings, and obtain his or her feedback on the draft, including actions to be taken. After AMO's review and comment, the report is finalized and submitted to senior EERE management, associated staff and researchers involved with the R&D program or project, and all persons involved in the review. The report is to be made available publicly.

## 2018 AMO Program Peer Review Process

The AMO Program Peer Review was held on July 17-19, 2018 in Washington, DC. The agenda is listed in Appendix A. The review panel attended the opening session on Day 1 in which a Senior Adviser in EERE provided welcoming comments, the AMO Office Director presented a brief overview of AMO, including priorities and outlook. A briefing was also provided on key aspects of the AMO Multi-Year Program Plan (MYPP), including success indicators and recently executed actions supporting AMO's three pillar approach; which was followed by a brief presentation of AMO strategic analysis efforts. Afterwards on Day 1 and Day 2, presentations were provided primarily in two separate tracks focusing on individual R&D Projects, R&D Consortia, and Technical Partnerships activities. Each time slot consisted of a presentation by the Principal Investigator or AMO staff, along with time for questions and answers. A poster session for several other R&D Projects and Analysis activities was held at the end of Day 1.

Prior to the meeting, the review panel was provided with information about the upcoming peer review, the AMO Program, and the 2017 Peer Review report. An online evaluation tool allowed reviewers to comment on strengths, weaknesses, and provide other recommendations for each activity during the review meeting. Separate sets of feedback responses were developed for the Program and for individual activities (based on criteria in Appendix B and Appendix C); the observations on individual activities have been provided to AMO separately.

As part of the peer review process, AMO management is provided an opportunity to respond to the peer review findings. Appendix D provides AMO's management response.

## Review Panel Membership

| Name | Position |
| --- | --- |
| **Frank Pfefferkorn** | Associate Professor of Mechanical Engineering, University of Wisconsin-Madison (previously served as Assistant Director for Research Partnerships, Advanced Manufacturing National Program Office) |
| **Thomas Kurfess** | Professor of Mechanical Engineering and the HUSCO/Ramirez Distinguished Chair in Fluid Power and Motion Control at the Georgia Institute of Technology |
| **James Lyons** | Principal, Farmington River Technologies; and Chief Technologist for venture investment teams at Capricorn Investment Group and Energy Innovation |
| **Bill Powers** | Management consultant and investor; retired Vice President of Research at Ford Motor Company |
| **Mike McGrath** | Independent consultant; (former Vice President at Analytic Services Inc.) |
| **Sharon Nolen** | Manager, Global Natural Resource Management at Eastman Chemical Company |
| **Kelly Perl** | Industrial Team Leader in the Office of Energy Consumption and Efficiency Analysis at the U.S. Energy Information Administration |
| **Jim Lancaster** | Acting Director of the National Materials and Manufacturing Board (NMMB) at the National Academy of Engineering; Director of the Board on Physics and Astronomy (BPA) at the National Academy |
| **Steve Sciamanna** | Teaches in the Product Development Masters Program at the Department of Chemical Engineering at UC-Berkeley; previously had an extensive career at Chevron |
| **Francis Via** | Senior consultant at Fairfield Resources; previously served as a Research Manager at GE Corporate R&D |

Appendix E contains the biographies of each panel member.

# AMO Portfolio

The AMO portfolio has good distribution across key issues, potential solutions, company sizes, academia, labs, and industries. The vast majority of projects and programs address a particular knowledge gap. The majority of projects satisfy both the administration's focus on early-stage applied R&D in addition to the program's mission. Most program areas were strong and matched well to the AMO Multi-Year Program Plan (MYPP) and targets and goals contained within, including but not limited to sustainable manufacturing, additive manufacturing, composites, to roll-to-roll manufacturing. The strategic analysis program is a real strength of AMO and is the foundation for the program's strategic plan (MYPP) by providing context for the portfolio. The strategic analysis team, which is drawn from experts across many national labs, is an example of a best practice.

Overall, AMO is now effectively investing in 12 of the 14 Advanced Manufacturing Technology Areas (core, impactful manufacturing technologies) identified in the Draft MYPP. Going forward, AMO is encouraged to continue its efforts to develop and strengthen its research portfolio through a prioritized process to cover all of the Advanced Manufacturing Technology Areas as the MYPP transitions from its current "Draft" status to a final, approved version.

More specifically, the large majority of the activities show evidence that they will have an impact on improving U.S. energy productivity. AMO has successfully transitioned from a program focused primarily on making manufacturing operations more energy efficient to a program where it is now also including more activities to improve energy efficiency through manufactured products, which is very positive. AMO is investing to help accelerate technology development, in order to give U.S. industry a competitive advantage. For the most part, the portfolio is of significant value to improving U.S. manufacturing competitiveness; though there were some projects that did not provide sufficient evidence of their potential impact. The quality of the Technical Partnerships activities are generally very good.

Additionally, AMO workforce development efforts are very valuable. For example, the Lab Embedded Entrepreneurial Partnerships (LEEP) program not only helps develop young entrepreneurs, but also injects new ideas and "energy" into the national labs that are participating. And the Industrial Assessment Centers (IACs) provide training for engineering students that can be immediately beneficial for manufacturing firms hiring new technical staff.

Operationally, the three-pronged AMO Pillar approach (R&D Projects, R&D Consortia, and Technical Partnerships) is a solid construct. AMO is managing its portfolio actively and at an appropriate level; redirection of individual projects and activities occurs when appropriate, for example, as a result of peer review activities. Cancellation of a project or activity only happens upon mutual agreement between AMO and the award recipient. The fundamental knowledge generated by AMO funded projects is generally published and made available to industry and other interested stakeholders.

# AMO Pillar-Level Observations

## R&D Projects:

- Four successful projects by large companies particularly impressed the review panel. It is clear that these projects could not be initiated by the U.S. industrial base as the risk was deemed too high without the DOE funding, even though the funding levels were rather modest. All of these projects are now entering early stages of commercialization with market development. Products resulting from these projects are being manufactured and sold in the United States; helping to make the United States more competitive and economically vibrant.
  - PPG advanced novel coatings formulations combined with intensified production, improves energy efficiency and reduces cost and VOCs for automotive OEM paint shops.
  - GE developed new insulation for electric motors that can be used with high speed wide band-gap power devices to improve energy efficiency and extend lifetimes.
  - AK Steel is developing new high performance alloys to improve energy efficiency for electric motors.
  - Boeing is advancing new composite technology for aerospace structures with improved manufacturing intensity and energy efficiency.
- The review panel was impressed that one of the AMO SBIR projects was awarded the 2017 SBIR project of the year award from DOE. The flash-heat treating project for strengthening plain carbon steel is impressive and is commended for now pursuing high-performance computing funding, in collaboration with ORNL, to better understand the creation of the unique microstructure.

## R&D Consortia:

- The Critical Materials Institute is focused on a critical, ongoing issue; hence accommodations should be made to avoid budget sunsetting of this activity area. More broadly, if the materials under investigation are truly critical to the security and economy of the United States, then other activities should also be considered including stockpiling materials, opening or reopening domestic mines, processing tailings, and partnering with other countries that have these materials.
- Wide band-gap power electronics is very important and appears to be on a path to success. PowerAmerica is a very strong institute. It possesses great leadership and strong participation by its membership; and appears to be successfully commercializing technology for a range of applications including inverters, heavy duty vehicles, and electric vehicles; along with playing a crucial role in industry standards development.
- The ORNL Manufacturing Demonstration Facility (MDF) has state-of-the-art capabilities, including a strong brain-trust. The MDF, which focuses on additive manufacturing, has been very successful in assisting U.S. companies. The additive manufacturing landscape continues to grow and become more crowded, hence it is vital that the MDF plan its future focus areas. The MDF could be the hub of a hub-and-spoke model that includes new materials development, equipment manufacturers, and powder production for additive manufacturing. The MDF is an excellent model for best practices of a national lab engaging with U.S. industry and educational institutions.
- The Composite Materials Institute (IACMI) and Carbon Fiber Test Facility at ORNL are important assets to foster the continued growth of the composites industry in the United States by driving down the cost and energy necessary for their production.
- The emerging emphasis on water is very important from both a national security and economic perspective; and the panel looks forward to the establishment of the Clean Water Hub.

## Technical Partnerships:

- The quality of most of the Technology Partnerships activities is very good, and well aligned with the MYPP. There is a concern about the small number of companies being reached by Technology Partnerships programs. AMO should continue to assess how to scale these activities to reach more companies, especially smaller manufacturers.
- The Industrial Assessment Centers (IAC) provide useful service to small and medium manufacturers that may otherwise not be able to get access to energy efficiency services. In addition, the IAC program provides excellent workforce development for undergraduate and graduate engineers.
- The Tools initiative is important to leverage years of DOE investment in tools and ensure their availability and widespread use for years to come. Industry energy efficiency will benefit from increased accessibility. DOE will need to ensure the tools remain current and relevant.
- The Lab-Embedded Entrepreneurship Program (LEEP) is a highly effective way to leverage entrepreneurial talent and financing in support of DOE objectives. Continued patient investment is needed, since LEEP will take a few years to mature.
- Continuation of the Combined Heat and Power (CHP) program is justified by the remaining unrealized potential for energy savings. Greater emphasis is needed on reaching small companies who need assistance to become smart buyers of CHP systems. Future metrics should track adoption of CHP in addition to counting the number of engagements.
- Better Plants has an impressive record of accomplishment in attracting partners who, so far, account for 12% of the US manufacturing energy footprint and are committed to voluntary goals for 25% savings. The plans to expand this success through the Supply Chain Initiative has the potential to involve many more partners in future years.

# General Recommendations

- AMO is encouraged to expand the use of techno-economic assessment (analyzing the anticipated technical and economic performance of a process or product by combining process modeling, engineering design and economic evaluation) in proposal selection and initial project implementation, particularly for early-stage research efforts.

- AMO is encouraged to expand involvement of process engineering capabilities necessary for scale-up in proposal selection and initial project implementation, particularly for small-scale, early-stage research efforts. At the outset, projects need to have a clear path to a workable solution at the scale that they envision commercially producing material at, not just the size they will be testing at. External engineering support may also help smaller start-up companies in moving forward successfully.

- For projects with a very low Technology Readiness Level (TRL) and/or Manufacturing Readiness Level (MRL) – such as those barely achieving Level 2 on the 1-9 Readiness scales, AMO should consider partnering with the Office of Basic Energy Sciences within DOE and/or investing more in fundamental understanding before advancing significant applied development efforts. This was noted in particular for two areas of activity:

    - Covetic materials, which are next generation materials that could be critical to the U.S. economy, as well as national security. It is clear that some of the successes in this area are not well understood from a fundamental perspective. That is to say, that the materials perform quite well, but we do not understand why this is so. This indicates that there is a need for basic or fundamental research into covetic materials to better understand them. This understanding will enable U.S. researchers and companies to efficiently and effectively develop significantly improved covetic materials, securing a leadership position in the development, scaling, and deployment of such materials in U.S. products.

    - Atomically precise manufacturing is critical in areas such as photonics, optics and micro-electronics, which are critical to the success of many of the reviewed portfolio sectors. Some of the more fundamental questions regarding atomically precise manufacturing should be considered as they relate to the overall portfolio. Furthermore, this area is critical to the success of a wide variety of other DOE programs, and should be appropriately highlighted and shared with these other elements of the DOE.

- The panel would encourage greater use of high performance computing (modeling) and machine learning to support R&D project efforts. In addition, workforce development for advanced manufacturing needs to include more training in high-performance computing. There is insufficient knowledge in the manufacturing sector to appreciate how high-performance computing can help with manufacturing challenges. There is also insufficient training in the computer science areas to support the future need for the high performance computing application development in the manufacturing sector that will be driven by "big Data" generated from the Internet of Things (IoT) as it is applied to manufacturing operations.

- Considering the emphasis on early-stage research, the panel encourages AMO to focus more time and effort on strategies designed to increase likelihood of eventual technology transition to the domestic marketplace after R&D project completion. A concern is that if nobody (public or private) in the United States takes successes further, foreign companies and governments will.

- The panel encourages collaboration among AMO Technology Managers to identify best practices across the various Pillar portfolios and disseminate to other projects or activities that may benefit from those best practices.

- Projects that work in fast-moving technologies need to ensure they link their project plan and design cycle with industry technology roadmaps; otherwise final results may deliver something that is already obsolete or made irrelevant by the changing market space or new technological advances.

- AMO should be careful that their desire to help small and medium manufacturers does not clash with the program's requirement for individual projects to demonstrate a large impact on U.S. energy productivity. AMO should also ensure that small and medium manufacturers are not disadvantaged in the proposal development process.

- The panel has some concern regarding whether consortia conducting early-stage research should be targeting self-sufficiency within five years. AMO should spend some time evaluating and addressing this concern.
- While providing information to the public about program activities is essential, AMO needs to ensure that in sharing project details, competitive advantage is not being giving away. A balance needs to be struck regarding the openness of operations vs. providing the technology to the competition. Once the new technology has been scaled and implemented, it is much more difficult and expensive for others to compete. Thus, greater care should be taken regarding the release of information at lower TRLs/MRLs.
- AMO should make sure that portfolio activities are not overemphasizing areas that represent smaller portions of the manufacturing sector's energy use, and overlooking large, energy-intensive industries. The balance between current and future economic impact and national security should be monitored and clarified as much as possible.

# Specific Activity Recommendations

Comments on individual projects and activities have been provided separately to AMO through the online evaluation tool. Activities with specific recommendations that the panel wanted to highlight are summarized here:

- In wide band-gap power electronics, one target for new materials is the development of a viable GaN ingot and substrate. This is a big opportunity to leap ahead and create this new manufacturing capability in the United States. AMO should take advantage of its investments to help address this opportunity.
- The panel was very interested in the Combined Heat & Power (CHP) and Distributed Generation (DG) projects. It would be nice to see an overall CHP and DG plan that shows where the opportunities are now and how current and future projects will contribute to increasing the penetration of the technology.
- The panel would encourage the Critical Materials Hub to collaborate with PowerAmerica in order to increase participation of toolmakers in their activities.
- The REMADE Institute is encouraged to collaborate with other AMO activity areas to discuss ways of handling plastics at end-of-life, if they cannot be recycled. Some polymers have a very high energy content and all appropriate solutions to recover or utilize this energy should be considered.
- Coordination between the CHP TAPs and CHP R&D efforts could be improved; and effort should be undertaken to improve the focus of the CHP TAPs.
- For Technical Partnership activities, additional metrics to evaluate program performance would be of interest. For example, spending per certification for ISO 50001 program, or capacity of CHP deployed as a result of CHP Technology Assistance Partnerships (TAP) efforts.
- The results coming out of AMO strategic analysis activities need to be disseminated more widely. For example, the project investigators would benefit from knowing more about results from other project areas that might be beneficial to their work.

# Feedback on the Peer Review Process

## Review process overall:

- AMO is commended for having instituted this yearly program review. The review panel acknowledges that not all government offices/programs do this. The annual program review is a very important activity because it provides independent feedback to the AMO that enable it to stay on plan. In other words, this is one important mechanism that enable the AMO to implement closed-loop feedback control of its project portfolio. The review panel also acknowledges that the annual review is valuable because a significant amount of work occurs in projects in the months leading up to the review.
- AMO is commended on doing a good job of presenting adjustments to the portfolio from the prior year during the annual review.

## Review presentations and posters:

- The reviewers would like to see at the beginning of every presentation and at the top of every poster what MYPP core topic they are addressing. Additionally, they should also ensure to mention what metric they are using to assess success.
- The slide template was adhered to by most of the presenters and was very well organized and informative.
- Many poster presenters did not seem aware of the evaluation questions that the review panel was given; AMO should ensure the review questions are well communicated to all presenters.
- The posters that are presented must be carefully reviewed by the Technology Manager and edited prior to the program review. Some posters were too dense. And some did not provide adequate project management aspects (e.g., Gantt chart with subtask breakdown, milestones, spending).
- The review panel would benefit from better understanding why one project is chosen for a poster presentation, while another is giving an oral presentation. There was a perception that posters were deemed as "second-class citizens."
- There was a limited amount of time available for reviewers to spend with each poster, and it was challenging to adequately interact with the presenter given the amount of people milling around, and in some cases, dense poster content.

## Review meeting format and structure:

- The review team would be interested in having a closed-session session with AMO leadership to better understand the program at a higher level.
  - In this session, the reviewers would like to learn more about: (1) what AMO leadership is trying to accomplish, (2) how they are trying to accomplish it, (3) the number of proposals submitted to FOAs, what kind of projects were not selected and why, and (4) existing projects that were cancelled or significantly changed because of poor performance.
  - While the strategic analysis activities are solid, AMO should present how those efforts tie into focus areas or individual projects.
  - AMO should provide an organizational chart, detailed budget, and how projects are mapped against the AMO multi-year plan. An alternative for presenting each technical area is an overview slide followed by one slide on each project that is underway. For example, what are you trying to achieve in roll-to-roll manufacturing, what projects are funded, and what are the metrics from each project?

  - Management could also advise reviewers of broader technical and political issues or concerns impacting the program.

- The panel would propose the following for next year's review meeting format:

  - First half day – program overview with top management. Followed by 1.5 days of project and activity presentations. Then on the third day the peer review team would meet for a half day or less, then bring in the AMO management team for a debrief (provide observations and initial recommendations).

## Reviewer assignments:

- When there is a major program review (for example, roll-to-roll manufacturing, and wide-band-gap power electronics) it would be beneficial for one review team (made up of three reviewers) to see all of the oral presentations and posters within that program.

- It is suggested that the online review evaluation tool contain a single box for entering comments. This will make the job of the reviewers easier.

- The four review questions need to be re-evaluated. Do they really apply to all types of projects? Some modifications may be appropriate.

## Review meeting logistics:

- AMO should strive to ensure projectors used have sufficiently high resolution; the screens are of an appropriate size for the rooms; and the use of presentations clickers/pointers is encouraged instead of laser pointers for rooms utilizing multiple screens.

# Appendix A: Final Agenda

| Day 1 (July 17) | | |
|---|---|---|
| 8:00 – 8:45 am | **Peer Reviewer Briefing Breakfast**<br>**Rob Ivester, Valri Lightner, Isaac Chan, Mike McKittrick and Jay Wrobel, DOE-AMO** | |
| 8:45 – 9:00 am | **BREAK** | |
| 8:00 – 9:00 am | **REGISTRATION FOR ATTENDEES** | |
| 9:00 – 9:20 am | Welcome and AMO Overview | **Alex Fitzsimmons**<br>Senior Advisor to the EERE Principal Deputy Assistant Secretary<br><br>**Rob Ivester**<br>AMO Director |
| 9:20 – 9:40 am | Overview of the AMO Multiyear Program Plan | **Valri Lightner**<br>Acting AMO Deputy Director |
| 9:40 – 10:00 am | AMO Strategic Analysis Activities | **Joe Cresko**<br>AMO Analysis Lead |
| 10:00 – 10:10 am | **BREAK AND TRANSITION TO TRACKS** | |

| TRACK A | |
|---|---|
| **Sustainable Manufacturing** | |
| 10:10 – 10:50 am | Reducing Embodied-energy and Decreasing Emissions (REMADE) Institute<br>*Sustainable Manufacturing Innovation Alliance* |
| **Composite Materials** | |
| 10:50 – 11:30 am | Institute for Advanced Composite Materials Innovation<br>*Collaborative Composite Solutions Corporation* |
| **Critical Materials** | |
| 11:30 – 11:50 am | Advanced Manufacturing of Alpha Double Prime Iron Nitride: An Innovative Rare Earth Element Free Ultra-High Performance Permanent Magnet for Clean Energy Applications<br>*FeNix Magnetics, Inc.* |
| **Motor-Driven Systems: Enabling Technologies** | |
| 11:50 am – 12:10 pm | Process Innovations for 2G HTS Wire Manufacturing<br>*Superconductor Technologies Inc* |
| 12:10 – 1:15 pm | **LUNCH**<br>(Private Lunch for Reviewers) |
| 1:15 – 1:35 pm | Enhanced 2G HTS Wire for Electric Motor Applications<br>*American Superconductor* |
| 1:35 – 1:55 pm | Highly Efficient Conical Air Gap Axial Motor Using Soft Magnetic Composites and Grain-Oriented Electrical Steel<br>*Regal-Beloit* |

| TRACK B | |
|---|---|
| **Materials for Harsh Service Conditions** | |
| 10:10 – 10:30 am | Ultra-High Temperature Thermal Barrier Coating Development and Validation<br>*Solar Turbines* |
| 10:30 – 10:50 am | Low Cost Ceramic-Matrix Composites for Harsh Environment Heat Exchanger Applications<br>*UTRC* |
| 10:50 – 11:10 am | Boride-carbon Hybrid Technology to Produce Ultra-Wear and Corrosion Resistant Surfaces for Applications in Harsh Conditions<br>*Michigan State University* |
| 11:10 – 11:30 am | Novel Corrosion and Wear Resistant Coatings Using Innovative Cold Plasma Jet Surface Treatment to Enable Improved Bonding Performance of Dissimilar Material Joints Subject to Harsh Environmental Exposure<br>*Starfire Industries LLC* |
| **Additive Manufacturing** | |
| 11:30 am – 12:10 pm | Manufacturing Demonstration Facility<br>*Oak Ridge National Laboratory* |
| 12:10 – 1:15 pm | **LUNCH**<br>(Private Lunch for Reviewers) |
| 1:15 – 1:35 pm | Powder Synthesis and Alloy Design for Additive Manufacturing<br>*Ames Laboratory* |
| 1:35 – 1:55 pm | In-Situ Data Analysis and Tool Development for Additive Manufacturing Metal Powder Systems<br>*SLAC* |

<table>
<tr><th colspan="4">Day 1 (July 17) Continued</th></tr>
<tr><th colspan="2">TRACK A</th><th colspan="2">TRACK B</th></tr>
<tr><td rowspan="2">1:55 – 2:15 pm</td><td rowspan="2">Nanometal-Interconnected Carbon Conductors for Advanced Electric Machines<br>Rochester Institute of Technology</td><td colspan="2">Critical Materials</td></tr>
<tr><td rowspan="2">1:55 – 2:35 pm</td><td rowspan="2">Critical Materials Institute<br>Ames Laboratory</td></tr>
<tr><td rowspan="2">2:15 – 2:35 pm</td><td rowspan="2">Metal (Cu, Al) CNT Composite Wires for Energy Efficient Motors<br>University of Central Florida</td></tr>
<tr><td colspan="2">Composite Materials</td></tr>
<tr><td>2:35 – 2:55 pm</td><td>Cost-effective Conductor, Cable, and Coils for High Field Rotating Electric Machines<br>Florida State University</td><td>2:35 – 2:55 pm</td><td>Carbon Fiber Test Facility<br>Oak Ridge National Laboratory</td></tr>
<tr><td>2:55 – 3:15 pm</td><td>Flexible Carbon Conductors for Lightweight Motors and Generators<br>Rice University</td><td>2:55 – 3:15 pm</td><td>Energy Efficient Thermoplastic Composite Manufacturing<br>The Boeing Company</td></tr>
<tr><td>3:15 – 3:35 pm</td><td>BREAK</td><td>3:15 – 3:35 pm</td><td>BREAK</td></tr>
<tr><td rowspan="2">3:35 – 3:55 pm</td><td rowspan="2">Amorphous and Nanocomposite Magnets for High Efficiency, High Speed Motor Designs<br>Carnegie Mellon University</td><td colspan="2">Roll-to-Roll Processing</td></tr>
<tr><td rowspan="2">3:35 – 4:15 pm</td><td rowspan="2">Roll-to-Roll Advanced Materials Lab Consortium<br>Oak Ridge National Lab, Others</td></tr>
<tr><td>3:55 – 4:15 pm</td><td>High-Silicon Steel Strip By Single-Step Shear Deformation Processing<br>Purdue University</td></tr>
<tr><td>4:15 – 4:35 pm</td><td>Polydopamine/PTFE Composite Coating for Large-Scale Journal Bearings in Next Generation Electric Machines<br>SurfTec, LLC</td><td>4:15 – 4:35 pm</td><td>Novel Membranes and Systems for Industrial and Municipal Water Purification and Reuse<br>GE/University of Colorado</td></tr>
<tr><td rowspan="2">4:35 – 4:55 pm</td><td rowspan="2">Advanced Manufacturing of High Performance Superconductor Wires for NGEM<br>University of Houston</td><td colspan="2">Workforce Development</td></tr>
<tr><td>4:35 – 4:55 pm</td><td>Lab Embedded Entrepreneurship Programs</td></tr>
<tr><td>4:55 – 5:00 pm</td><td>Introduction to Poster Session<br>AMO Staff</td><td>4:55 – 5:00 pm</td><td>Introduction to Poster Session<br>AMO Staff</td></tr>
<tr><td>5:15 – 7:30 pm</td><td colspan="3">POSTER SESSION AND NO-HOST RECEPTION</td></tr>
</table>

| # | Project Title | Performer |
|---|---|---|
| 1 | LEEP: Cyclotron Road | Ilan Gur (LBNL) |
| 2 | LEEP: Chain Reaction Innovations | John Carlisle (ANL) |
| 3 | LEEP: Innovation Crossroads | Tom Rogers (ORNL) |
| 4 | Technologist in Residence Partnership (ANL and UOP): Development of Next Generation Process and Catalyst Technology for the Production of Energy and Chemicals | Chris Marshall (ANL) |
| 5 | Graduate Study and Research Program Focused on the Experimentation, Design, Development, and Manufacturing of WBG-Based Power Electronics, Grid Equipment, and High-Efficiency Electrical Systems | Rolando Burgos (Virginia Polytechnic Institute and State University) |
| 6 | Design-Oriented Education and Hands-On Training with Wide Bandgap Power Electronics for the Next-Generation Power Engineering Workforce | Leon Tolbert (University of Tennessee-Knoxville) |
| 7 | The Implications of Advanced Manufacturing in a Connected Economy for a Smart, Sustainable, and Productive Economy | Arman Shehabi (LBNL)<br>Sujit Das (ORNL) |
| 8 | Industrial Water Use Characterization and Technology Opportunities for Efficient and Resilient Water Use | Prakash Rao (LBNL) |
| 9 | Sustainable Manufacturing Opportunities, Trends, and Technoeconomic Analysis | Alberta Carpenter (NREL) |

| | | |
|---|---|---|
| 10 | Manufacturing Supply Chain Analysis: Criticality, Growth, Energy, Security, and Resiliency Implications | Diane Graziano (ANL) |
| 11 | Geospatial Combine Heat and Power Opportunity Mapping and Smart Power Electronics Potential for Smart Grid Integration | Sachin Nimbalkar (ORNL)<br>Samantha Reese (NREL) |
| 12 | SMASH: Accelerated Discoveries of Amorphous Alloys by Combining AI with High Throughput Experiments | Apurva Mehta (SLAC) |
| 13 | CaloriCool - Caloric Materials Consortium | Vitalij Pecharsky (Ames Laboratory) |
| 14 | Cross-cutting Technologies R&D to Support Distributed Generation and CHP | Doug Longman (ANL) |
| 15 | Combined Heat and Power R&D | John Storey (ORNL) |
| 16 | Wear-Resistant Surface Technologies for Low-Leakage NG Compressors | Osman Eryilmaz (ANL) |
| 17 | Vertical Pillar GaN Based Transistors | Qinghui Shao (LLNL) |
| 18 | HPC4Mfg (LLNL and ZoomEssence): High Performance Computing Analysis for Energy Reduction of Industrial Spray Drying Technology | Ik Jang (LLNL) |
| 19 | HPC4Mfg (LBNL and PPG Industries): Modeling Paint Behavior During Rotary Bell Atomization | Robert Saye (LBNL) |
| 20 | HPC4Mfg (ORNL and Rolls Royce): Level-set Modeling Simulations of Chemical Vapor Infiltration for Ceramic Matrix Composites Manufacturing | Ramanan Sankaran (ORNL) |
| 21 | HPC4Mfg (ANL and Ford): Effect of Manufacturing Tolerances on Engine Stability | Sibendu Som (ANL) |
| 22 | SBIR: Fabrication of High-quality NaA Zeolite Membranes via a Novel Plate & Frame Configuration for Molecular-scale Mixture Separations | Haibing Wang (nGimat LLC) |
| 23 | SBIR: Transition Metal Blocking Microporous Polymer Separators for Energy-Dense and Long-Lived Li-ion Batteries | Peter Frischmann (Sepion Technologies) |
| 24 | SBIR: In-Line Quality and Process Control in Solar and Fuel Cell Manufacturing | Sergei Ostapenko (Ultrasonic Technologies) |
| 25 | Roll-to-Roll: Advanced Materials Manufacturing Laboratory Consortium CRADA Projects | Claus Daniel (ORNL) |
| 26 | Roll-to-Roll: Correlation of Dispersion Rheology and Structured Electrode Performance for Improved Lithium-Ion Cell Performance | David Wood (ORNL) |
| 27 | Roll-to-Roll: PEM Fuel Cell Gas-diffusion Electrodes (GDE) with Ionomer-rich Surface Layer | Mike Ulsh (NREL) |
| 28 | Roll-to-Roll: Data Mining for Predictive Synthesis of New Materials | Olga Kononova (LBNL) |
| 29 | Roll-to-Roll: Water Manufacture Process – Material for Water Technology | Yupo Lin (ANL) |
| 30 | Roll-to-Roll: Functional Materials: Understanding Materials Synthesis | Venkat Srinivasan (ANL) |
| 31 | SBIR: Photothermal Solar Cell | Youssef Habib (Aquaneers) |
| 32 | SBIR: Ionic Membrane Based Desalination System | Bamdad Bahar (Xergy) |
| 33 | SBIR: Solar Thermal Assisted Vacuum Freezing Desalination of Seawater at the Triple Point | Fangyu Cao (Advanced Cooling Technologies) |
| 34 | SBIR: Bio-inspired Macromolecules Containing Atomically Precise Catalytic Active Sites | Ted Amudsen (Mainstream Technology)<br>Chris Schafmeister (Temple University) |
| 35 | SBIR: Atomically Precise Membranes for the Separation of Hydrocarbons | Ted Amudsen (Mainstream Technology)<br>Chris Schafmeister (Temple University) |
| 36 | SBIR: Biologically Inspired Ammonia Production with Immobilized Nitrogenase | John Watkins (Fulcrum BioScience) |
| 37 | Blue Sky Manufacturing Competition (not reviewed) | Zhijian Pei |

| Day 2 (July 18) | | | |
|---|---|---|---|
| **TRACK A** | | **TRACK B** | |
| 8:00 – 9:00 am | **REGISTRATION FOR ATTENDEES** | | |
| **Motor-Driven Systems: Enabling Technologies (Continued)** | | **Roll-to-Roll Processing (Continued)** | |
| 9:00 – 9:20 am | Si-Al-Cr-Mn Alloy for High Specific Resistivity<br>*AK Steel Corporation* | 9:00 – 9:20 am | Development of Roll-to-Roll Simultaneous Multilayer Deposition Methods for Solid-state Electrochemical Devices using Highly Particulate Loaded Aqueous Inks<br>*Saint-Gobain* |
| 9:20 – 9:40 am | Resistively Graded Insulation System for Next-Generation Converter-Fed Motors<br>*General Electric* | **Waste Heat Recovery and Direct Thermal Energy Conversion Materials** | |
| | | 9:20 – 9:40 am | Roll-to-Roll Manufactured Hybrid Metal-Polymer Heat Exchangers with Anti-Fouling and Self-Monitoring for Waste Heat Recovery<br>*University of Illinois* |
| **Advanced Materials Manufacturing** | | 9:40 – 10:00 am | Turbocompression Cooling System for Ultra Low Temperature Waste Heat Recovery<br>*Colorado State University* |
| 9:40 – 10:00 am | High Performance Computing for Manufacturing<br>*LLNL* | | |
| 10:00 – 10:20 am | A Novel Flash Ironmaking Process<br>*American Iron and Steel Institute* | 10:00 – 10:20 am | High Efficiency Waste Heat Harvesting Using Novel Thermal Oscillators<br>*Yale University* |
| 10:25 – 10:40 am | **BREAK** | | |
| 10:40 – 11:00 am | Flash Processed Steel for Automotive Applications (SBIR Phase III)<br>*SFP Works* | **Process Intensification** | |
| | | 10:40 – 11:00 am | A Transient Kinetic Approach to Catalytic Materials for Energy-Efficient Routes to Ammonia, Ethylene and Related Chemicals<br>*Idaho National Laboratory* |
| 11:00 – 11:20 am | Fabrication of Advanced Nanocarbon-Metal Composites for Improved Energy Efficiency<br>*University of Maryland* | 11:00 – 11:20 am | New Design Methods and Algorithms for Energy Efficient Distillation Trains<br>*Purdue University* |
| 11:20 – 11:40 am | High Performance Electrical and Thermal Conductors<br>*Argonne National Laboratory* | 11:20 – 11:40 am | Integrated Hydrogen Combustion with Energy-Efficient Ethylene Production<br>*EcoCatalytic Inc.* |
| 11:40 am – 12:00 pm | Melt Processing of Covetic Materials<br>*National Energy Technology Laboratory* | 11:40 am – 12:00 pm | Low-Pressure Electrolytic Ammonia Production<br>*Energy & Environmental Research Center* |
| 12:00 – 1:15 pm | **LUNCH**<br>(Private Lunch for Reviewiers) | 12:00 – 1:15 pm | **LUNCH**<br>(Private Lunch for Reviewiers) |
| 1:15 – 1:35 pm | Improved Catalyst Selectivity and Longevity Using Atomic Layer Deposition<br>*Argonne National Laboratory* | 1:15 – 1:55 pm | Rapid Advancement in Process Intensification Deployment (RAPID) Institute<br>*AIChE* |
| 1:35 – 1:55 pm | Rational Design Platform for Transition Metal Catalyzed Electrochemical Synthesis<br>*Lawrence Livermore National Laboratory* | | |

## Day 2 (July 18) Continued

| TRACK A | | TRACK B | |
|---|---|---|---|
| 1:55 – 2:15 pm | The Radical Atom: Mechanosynthetic 3D Printing of an Atomically Precise SPM Tip<br>*UCLA* | **Workforce Development** | |
| | | 1:55 – 2:15 pm | New Traineeship: Advanced Manufacturing for Energy Systems<br>*University of Connecticut* |
| 2:15 – 2:35 pm | DNA Strand Displacement Driven Molecular Additive Manufacturing<br>*Dana-Farber Cancver Institute* | 2:15 – 2:35 pm | New Traineeship: Enhanced Preparation for Intelligent Cybermanufacturing Systems<br>*Georgia Tech* |
| 2:35 – 2:55 pm | **BREAK** | 2:35 – 2:55 pm | **BREAK** |
| 2:55 – 3:15 pm | Developing Nanometer Scale, Atomically Precise Metallo-Catalysts With Molecular Lego<br>*Temple University* | **Technology Partnerships** | |
| | | 2:55 – 3:20 pm | **Jay Wrobel**<br>Tools and Training |
| 3:15 – 3:35 pm | Atomically Precise Manufacturing for 2D-Designed Materials<br>*Zyvex Labs, LLC* | | |
| 3:35 – 3:55 pm | A Platform Technology for High-throughput Atomically Precise Manufacturing: Mechatronics at the Atomic Scale<br>*University of Texas at Dallas* | 3:20 – 3:45 pm | **John Smegal**<br>Industrial Assessment Centers |
| 3:55 – 4:15 pm | Solving Materials and Structures using Heuristics and Machine Learning<br>*SLAC* | 3:45 – 4:15 pm | **Eli Levine**<br>Better Plants |
| 4:15 – 4:35 pm | Carbon-Free Iron for a Sustainable Future<br>*Boston Electrometallurgical* | **Smart Manufacturing** | |
| | | 4:15 – 4:55 pm | Clean Energy Smart Manufacturing Innovation Institute<br>*CESMII* |
| 4:35 – 4:55 pm | Lifetime Energy Savings Via Advanced Manufacturing of Low Density Steels For Transportation Applications<br>*AK Steel* | | |
| 4:55 pm | **ADJOURN** | | |
| 5:00 – 8:00 pm | ***Private Dinner and Discussion for Reviewers*** | | |

| Day 3 (July 19) | | | |
|---|---|---|---|
| TRACK A | | TRACK B | |
| 8:00 – 9:00 am | **REGISTRATION FOR ATTENDEES** | | |
| **Wide Bandgap Semiconductors** | | **Smart Manufacturing (Continued)** | |
| 9:00 – 9:40 am | Power America<br>*North Carolina State University* | 9:00 – 9:20 am | An Open-Source Framework for the Computational Analysis and Design of Autothermal Chemical Processes<br>*Iowa State University* |
| | | **Technology Partnerships (Continued)** | |
| | | 9:20 – 9:55 am | **Jay Wrobel and Pete Langlois**<br>ISO 50001 Portfolio |
| 9:40 – 10:00 am | Medium Voltage Integrated Drive and Motor<br>*CalNetix Technologies* | | |
| 10:00 – 10:20 am | SiC enabled High-Frequency Medium Voltage Drive for High-Speed Motors<br>*General Electric* | 9:55 – 10:20 am | **Tarla Toomer**<br>CHP Deployment |
| 10:20 – 10:40 am | **BREAK** | 10:20 – 10:40 am | **BREAK** |
| 10:40 – 11:00 am | Integrated 10kV SiC VSD and High-Speed MW Motor for Gas Compression Systems<br>*Eaton Corporation* | **Process Heating** | |
| | | 10:40 – 11:00 am | Coatings and Process Development Reduced Energy Automotive OEM Manufacturing<br>*PPG Industries, Inc.* |
| 11:00 – 11:20 am | Fully Integrated High Speed Megawatt Class Motor and High Frequency Variable Speed Drive System<br>*Clemson University* | 11:00 – 11:20 am | A Direct Process for Wire Production from Sulfide Concentrates<br>*MIT* |
| 11:20 – 11:40 am | Integrated Electric Drive with HV2 Modular Electric Machine and SiC Based Power Converters<br>*The Ohio State University* | 11:20 – 11:40 am | Low-temperature Electrochemical Activation of Ethane for Co-production of Chemicals/Fuels and Hydrogen<br>*Idaho National Laboratory* |
| 11:40 am | **PEER REVIEW MEETING ENDS** | | |
| 12:00 – 5:00 pm | ***PRIVATE MEETING OF REVIEW PANEL***<br>(including lunch and time with AMO management to address outstanding questions) | | |

# Appendix B: Evaluation Criteria for Program Overall Activity

## Relevance and Approach

### Mission

- How well does the AMO Program fit within the EERE mission and the overall DOE mission?
- Is the justification for a federal program clear and compelling?

### Approach

- Assess how well the overall AMO Program approach, including goals and programs, addresses the AMO mission.
- Do activities address high impact areas and address appropriate markets and technical barriers?

### Resources

- Are there adequate resources in terms of dollars for the current mission?
- Is the allocation of resources reasonable?

### Overall Assessment of Relevance

- What is your overall assessment of relevance and approach?
- What recommendations do you have on relevance and approach?

## Management

### Execution

- Are the activities likely to result in high quality products and outcomes?  How can their impact be improved?
- How can AMO improve the way its new technologies are received and used by target audiences/stakeholders?

### Resource Leveraging

- How well is the program coordinating with and learning from other EERE, DOE, and federal activities?
- What other resources could be used or leveraged to meet AMO goals?

### Overall Assessment of Management

- What is the panel's overall assessment of the organization and management of the AMO Program?
- What recommendations does the panel have on program management?

## Overall Program Assessment

- What are the best aspects of the AMO Program? What area needs the most improvement?
- What is the panel's overall assessment of the program?
- What recommendations does the panel have for the program?

# Appendix C: Evaluation Criteria for Individual Activities

## R&D Projects

### 1. Alignment and fit to the Advanced Manufacturing Office's Mission and Goals

Does the project align well to the overall mission and goals of AMO and does it address relevant technical targets as outlined in the MYPP? Is what they are trying to do challenging and appropriate for the AMO Program.

### 2. Clarity of presentation on technical merit and innovation

Does the project have a high level of scientific and technical merit, a high degree of innovation, and will it be compatible with current or future U.S. manufacturing operations?

### 3. Project accomplishments and progress towards goals

Are the accomplishments to date noteworthy (on-going projects only)? Is the project structured so that there is high likelihood of success and is there evidence of progress towards achieving its stated goals?

### 4. Technology transition plan

Is there evidence of a sound approach for transitioning the technology towards the market?

For each criteria, please provide comments about the project's strengths and weaknesses.

Please offer any additional comments or recommendations you have for the project.

## R&D Consortia

### 1. Alignment and fit to the Advanced Manufacturing Office's Mission and Goals

Does the Hub/Facility/Institute align well to the overall mission and goals of AMO and does it address relevant technical targets as outlined in the MYPP? Is what they are trying to do challenging and appropriate for the AMO Program.

### 2. Clarity of presentation on technical merit and innovation

Does the Hub/Facility/Institute have a high level of scientific and technical merit, a high degree of innovation, and will it be compatible with current or future U.S. manufacturing operations?

### 3. Consortium accomplishments and progress towards goals

Are the accomplishments to date noteworthy? Is there evidence of progress towards achieving the stated goals, including specific performance indicators for the Hub/Facility/Institute?

### 4. Technology transition plan

Is there evidence of a sound approach for transitioning technology towards the market and addressing market barriers?

For each criteria, please provide comments about the activity's strengths and weaknesses.

Please offer any additional comments or recommendations you have for the Consortium

## Technical Partnerships Activities

### 1. Clarity of presentation on goals

Does the activity have a high level of merit, a high degree of relevance, and is it be compatible with current or future U.S. manufacturing operations?

### 2. Alignment and fit to the Advanced Manufacturing Office's Mission and Goals

Does the activity align well to the overall mission and goals of AMO and does it address relevant targets as outlined in the MYPP?

### 3. Activity organization

Is the activity structured so that it is well suited to address market challenges and barriers, and is there a high likelihood of success?

### 4. Activity progress

Is there evidence of progress towards achieving the stated goals, including performance indicators, for the activity?

For each criteria, please provide comments about the activity's strengths and weaknesses.

Please offer any additional comments or recommendations you have for the activity.

# Appendix D: AMO Management Response

Dear Members of the AMO 2018 Program Peer Review Panel,

All of us at the Advanced Manufacturing Office (AMO) sincerely appreciate the time and expertise you contributed to our 2018 Peer Review. This rigorous review process helps AMO maintain a productive and cost-effective R&D portfolio that stimulates meaningful technology innovation. The review gives our project performers and partners the opportunity to reflect on progress, evaluate other approaches, and receive constructive feedback to ensure projects are on track for success. The resulting innovations in manufacturing and energy are essential to support the continued economic prosperity of industries and communities across our Nation.

The Committee's valuable feedback on opportunities to improve project oversight and related internal processes will bolster the performance of our R&D portfolio. As Acting Director, I am committed to implementing critical improvements and would like to highlight three broad suggestions that emerged as I reviewed the report:

- **Increase evaluation activities for low-TRL research.** The recent emphasis on early-stage research across a broad range of technologies underscores the need for more rigorous evaluation—including detailed techno-economic assessment, better fundamental understanding of material interactions, and process engineering analysis for scale-up. As part of EERE's Active Project Management approach, AMO will increase technical evaluations both to enhance the outcomes of current projects and to improve future proposal and project selection processes.

- **Improve internal office collaboration.** While AMO activities will remain structured around the same core pillars, greater office-wide collaboration could optimize efforts to address the technical research priorities identified in our Multi-Year Program Plan. This issue resonated with our staff, and AMO held a multi-day off-site meeting on the topic in November 2018. Procedures and activities to elevate collaboration are now underway.

- **Continue to improve the peer review experience for Committee members.** The Committee provided a number of useful suggestions related to the peer review process, and AMO intends to incorporate these ideas as it plans for the 2019 Peer Review. In particular, more information will be distributed to members prior to the Review to help them prepare for their assigned roles.

Once more, let me express my deep gratitude to all members of the Committee for their diligence in reviewing AMO's portfolio and providing useful insights. The results will assist AMO as it continues to work with academic, industry, lab, and other stakeholders to solve high-impact R&D challenges in manufacturing. Thanks also go to all of our partners for participating in the successful 2018 Peer Review.

Sincerely,

Valri Lightner
Acting Director, Advanced Manufacturing Office
Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy

# Appendix E: Review Panel Member Biographies

## Frank Pfefferkorn (Chair)

Frank Pfefferkorn is currently an Associate Professor of Mechanical Engineering at the University of Wisconsin-Madison, returning to Madison after serving for a year as Assistant Director for Research Partnerships at the Advanced Manufacturing National Program Office. His teaching and research have focused on manufacturing processes and heat transfer as it applies to manufacturing processes. His work goals are to: (1) educate/develop manufacturing and heat transfer engineers/workforce, and (2) help move laser remelting, friction stir welding and processing, sensor-enabled cutting tools, metal additive-subtractive manufacturing, and smart manufacturing from arts to science-based technologies that will help U.S. manufacturers. He also serves as the Director of the Manufacturing Systems Engineering Program at the University of Wisconsin-Madison.

Frank is a member of the International Academy of Production Engineering (CIRP), American Society of Mechanical Engineers (ASME), and Society of Manufacturing Engineers (SME). He is also the Secretary of the CIRP Scientific Technical Committee "E" and Secretary of ASME's Manufacturing Engineering Division Executive Committee. Frank holds a B.S. in Mechanical Engineering from the University of Illinois at Urbana-Champaign, and M.S. and Ph.D. degrees in Mechanical Engineering from Purdue University (West Lafayette, IN).

## Michael McGrath

Michael McGrath is an independent consultant with extensive government and industry experience in technology management. As a VP at Analytic Services Inc. (ANSER), he led business operations in Systems and Operations Analysis. As chairman of the board of Advanced Technology International, he directed management of major research and development consortia. He previously served as the Deputy Assistant Secretary of the Navy for Research, Development, Test and Evaluation, where he was a strong proponent for improvements in technology transition, modeling and simulation, and test and evaluation. In prior positions, he served as: VP for Government Business at the Sarnoff Corporation (former RCA corporate lab); as Assistant Deputy Undersecretary for Dual Use and Commercial Programs in the Office of the Secretary of Defense (OSD), with responsibility for industrial base and commercial technology investment programs; as a Program Manager at the Defense Systems Research Projects Agency (DARPA), where he managed a portfolio of manufacturing technology programs; and as Director of the DoD Computer-aided Acquisition and Logistics Support program, automating the interface between DoD and industry for technical data interchange and access. His early government career included positions in Logistics Management at Naval Air Systems Command and in Acquisition Management in OSD. He has served on Defense Science Board and National Academies studies, and is an active member of the National Defense Industrial Association (NDIA), chair of the National Academies Defense Materials, Manufacturing and Infrastructure committee, member of the Board on Army Science and Technology, and a participant on several university and not-for-profit advisory boards. His research interests are in manufacturing, cybersecurity, digital technical data and data analytics. Dr. McGrath holds a BS in Space Science and Applied Physics and an MS in Aerospace Engineering from Catholic University, and a doctorate in Operations Research from George Washington University.

## Jim Lancaster

Jim Lancaster is Acting Director of the National Materials and Manufacturing Board (NMMB) at the National Academy of Engineering. Dr. Lancaster is also the Director of the Board on Physics and Astronomy (BPA) at the National Academy. Dr. Lancaster joined the BPA as a program officer in 2008 and was responsible staff officer for a number of studies, including An Assessment of the Science Proposed for the Deep Underground Science and Engineering Laboratory (DUSEL), Research at the Intersection of the Physical and Life Sciences, Frontiers in Crystalline Matter: From Discovery to Technology, and Selling the Nation's Helium Reserve. Prior to joining the BPA, Dr. Lancaster served on faculty at Rice University, where he taught introductory physics to science and engineering students, and as a staff researcher, where he participated in experimental investigations of the interactions of highly excited atoms with electromagnetic pulses and surfaces. During his time at Rice, Dr. Lancaster received both the Wilson Prize for outstanding doctoral thesis in physics and astronomy, and the APS teaching award for his work as instructor of undergraduates. He is the co-author of over 25 peer-reviewed articles and is a member of the American Physical Society.

In addition to M.A. and Ph.D. degrees in Physics from Rice University, Dr. Lancaster holds a B.A degree in Economics from Rice University and a J.D. degree from the University of Texas. Prior to entering the field of physics, Dr. Lancaster practiced law for over 12 years, specializing in the financial structuring and restructuring of businesses.

## Thomas Kurfess

Thomas Kurfess is a Professor of Mechanical Engineering and the HUSCO/Ramirez Distinguished Chair in Fluid Power and Motion Control at the Georgia Institute of Technology. Dr. Kurfess' research focuses on the design and development of advanced manufacturing systems targeting complex product production and optimization. Dr. Kurfess began his academic career at Carnegie Mellon University where he rose to the rank of Associate Professor. In 1994, he moved to the Georgia Institute of Technology where he rose to the rank of Professor. In 2005, he was named Professor and BMW Chair of Manufacturing in the Department of Mechanical Engineering at Clemson University's International Center for Automotive Research. In 2012, Dr. Kurfess returned to Georgia Tech.

During 2012-2013, Dr. Kurfess served as the Assistant Director for Advanced Manufacturing at the Office of Science and Technology Policy (OSTP) within the Executive Office of the President. Professor Kurfess has served as a special consultant of the United Nations to the Government of Malaysia in the area of applied mechatronics and manufacturing, and as a participating guest at the Lawrence Livermore National Laboratory in their Precision Engineering Program. He currently serves on the Board of Directors for the Society of Manufacturing Engineers, the National Center for Manufacturing Sciences, and the National Center for Defense Manufacturing and Machining, and on the Board of Trustees of the MT Connect Institute. He has received numerous awards including a National Science Foundation (NSF) Young Investigator Award, an NSF Presidential Faculty Fellowship Award, the ASME Pi Tau Sigma Award, SME Young Manufacturing Engineer of the Year Award, the ASME Blackall Machine Tool and Gage Award, the ASME Gustus L. Larson Award, an ASME Swanson Federal Award, and the SME Education Award. He is a Fellow of the AAAS, the SME and the ASME. He earned a B.S., M.S., and Ph.D. in Mechanical Engineering, as well as a M.S. in Electrical Engineering and Computer Science, from MIT.

## James (Jim) Lyons

James (Jim) Lyons entered the venture capital business in 2008 after a 30-year technology career at General Electric. Jim is currently the principal at the Farmington River Technologies consulting firm and also serves as chief technologist for the venture investment teams at the Capricorn Investment Group and Energy Innovation focused on the creation and growth of clean/renewable energy companies. Formerly, Jim was Chief Engineer for Electrical Technologies at GE Research serving as technology leader and mentor for a 250-member global team. He was a leading advocate for renewables within GE and corporate champion behind the formation of GE Wind Energy in 2002 - which quickly grew to $8B annual revenues.

In 2000, Jim was the technology leader during the creation of GE's Digital Energy business unit. While at GE, he served on the board of directors of Powerex, the Electric Drive Trade Association, and the US Offshore Wind Collaborative as well as becoming a principal company spokesperson for renewable energy. In 2006, Jim was co-chair of the American Wind Energy Conference, initiating the AWEA/DOE 20% wind energy roadmap. He has led many additional technology and business initiatives e.g. waste gasification, electric vehicles, advanced batteries, power electronics, solid-state lighting, solar PV, rural electrification, and nuclear fusion. He currently serves on a variety of technical board assignments including: Curent ERC, Servato, Encell, Sunpreme, Kinestral, and Norwegian Crystals. Jim is a reviewer for the DOE and the National Science Foundation. He holds 40 patents and has a B.S. in Electrical Engineering from Rensselaer Polytechnic Institute, an M.S. in Electrical Engineering from Virginia Polytechnic Institute and a Ph.D. from Cornell University.

## Steve Sciamanna

Steve Sciamanna currently teaches in the Product Development Masters Program in the Department of Chemical Engineering at UC-Berkeley. Previously he had an extensive career at Chevron; focusing on process engineering and product development. In his last position as a Consulting Engineer/Scientist he provided techno-economic assessments for projects such as bioenergy and Gas-to-Liquids. Previously he was the Program Manager/Leader of the technology development and deployment effort for a heavy oil upgrading process. Prior to that, he served as the R&D Manager for MolecularDiamond Technologies, a unit of Chevron Technology Ventures, leading the basic and applied R&D programs. Those efforts were focused on the product and application development of diamondoid-based materials.

Before that, Steve managed a Chevron analytical lab-service group; developed and commercialized internal and external technologies; assessed international upstream facilities for acquisition; managed and grew the process engineering group for Tengizchevroil in Tengiz, Kazakhstan; took a Russian-developed crude oil treating process from concept-to commercialization; supported many small and large capital projects; and conducted separations science and engineering R&D in the areas of minerals, environmental and gas processing. Steve received his B.S. and Ph.D. degrees in Chemical Engineering from UC-Berkeley and an M.S. degree from the Massachusetts Institute of Technology (MIT).

## Sharon Nolen

Sharon Nolen is Manager, Global Natural Resource Management at Eastman Chemical Company. Sharon holds a BS in Chemical Engineering from Tennessee Tech University and has completed the University of Tennessee's Executive Development Program. During her 29-year career at Eastman Chemical Company, she has held a variety of leadership positions in Process Engineering, Plant Engineering, Corporate Quality, Information Technology, and Utilities Division before assuming leadership of the Worldwide Energy Program in 2010. Her role has expanded to more broadly include water conservation and renewable energy. Under her leadership, Eastman has been recognized by EPA for seven consecutive years as an ENERGY STAR® Partner of the Year. Sharon is Eastman's representative for the Department of Energy's (DOE) Better Buildings, Better Plants Challenge Program. Sharon is a Professional Engineer and a Certified Energy Manager and was recognized with the 2018 Industrial Energy Technology Conference Energy Award.

## Francis Via

Francis Via is a senior consultant at Fairfield Resources, focusing on technology assessment and proactive IP licensing and marketing programs. Dr. Via had previously served as a Research Manager at GE Corporate R&D, where he managed a catalyst research team at the GE Corporate R&D Center to develop fuel cells, light-emitting diodes, process technology, medical imaging agents and applying combinatorial chemistry for catalysis. Prior to his time at GE, Dr. Via was Director of External Corporate R&D at Akzo Nobel, where his efforts focused on capturing emerging technology in catalysis, advanced materials, polymers, electronic chemicals, immuno-diagnostics and biochemistry by utilizing external cooperative research programs at universities and national laboratories and rapidly transferring the technologies to business unit R&D for commercialization. Earlier in his career, Dr. Via was a Manager at the Stauffer Chemical Company.

Dr. Via holds 26 patents, has 11 publications, and more than 25 invited presentations. He holds a B.S. degree from West Virginia University, a Ph.D. from Ohio State in Organic Chemistry, and attended management training at the Wharton School, Polytechnic U, and other programs.

## Bill Powers

Bill Powers is a management consultant and investor. He is a Retired Vice President of Research at Ford Motor Company, and his approximately 20 years at Ford included positions as Director of various divisions within the company. Prior positions also include Professor at University of Michigan; Research Engineer, University of Texas; and Mathematician and Aerospace Engineer, NASA Marshall Space Flight Center. He is a member of the National Academy of Engineering and a foreign member of the Royal Swedish Academy of Engineering Sciences.

His Fellowships include Institute of Electrical and Electronics Engineers, Society of Automotive Engineers (SAE), and American Society of Mechanical Engineers (ASME). He holds a Ph.D. in Engineering Mechanics from the University of Texas-Austin.

## Kelly Perl

Kelly Perl is the Industrial Team Leader in the Office of Energy Consumption and Efficiency Analysis at EIA. Kelly is responsible for the analysis of industrial sector energy consumption and the impact of technology on energy consumption in manufacturing and nonmanufacturing industries. Her team's work appears in EIA's Annual Energy Outlook, International Energy Outlook, and Today in Energy articles. Before joining EIA in August 2011, Kelly worked at the Federal Energy Regulatory Commission and in private industry as an electricity expert. She holds a PhD in Economics from Princeton University and an AB in Economics from the University of California at Berkeley.

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