U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

AMO Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) Information Webinar

December 12, 2019

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Advanced Manufacturing Office

www.manufacturing.energy.gov

This Webinar is Being Recorded

- *This WebEx call is being recorded and may be posted on DOE's website or used internally. If you do not wish to have your voice recorded, please do not speak during the call or disconnect now. If you do not wish to have your image recorded, please turn off your camera or participate only by phone. If you speak during the call or use a video connection, you are presumed to consent to recording and to the use of your voice or image.*
- Recording is done to capture questions accurately. We will post presentation slides online after the webinar; the webinar recording will not be posted.

Welcome to AMO SBIR

- **Especially First Timers! (Phase 0)**
  – Phase I winners
    - double VC funding chance
    - increase firm/individual income, output, patents
- **Topic vs. FOA vs. one-stop-shop**
  – EERE Topic webinar –Nov. 19
  – All DOE FOA webinar – Dec. 19

Today's Webinar Agenda (10 min. each)

	Time
Overview	2:00 p.m.
6a: Atomic Precision for Energy Efficient and Clean Energy-Related **Microelectronics**	2:05 p.m.
6b: Sensors for Harsh and Corrosive Environments	2:15 p.m.
16b: Thermal Energy Storage in Industry and Relevant Materials Manufacturing	2:25 p.m.
6d: Water Desalination: Cost-effective Energy Recovery for Modular Desalination Systems	2:35 p.m.
Interim Q&A+	2:45 p.m.
15a: Novel Utilization Strategies for **Ocean Plastic Waste**	2:45+ p.m.
6c: Critical Materials Supply Chain Enabling Research	2:55+ p.m.
17a: Compact Power Conditioning Systems for **High-Torque, Low-Speed Machines**	3:05+ p.m.
Additional Q&A **+ starts up to 10 minutes later if there are interim questions**	3:15+ p.m.

General for Topic 6-Advanced Manufacturing (+15,16,17)

- AMO mission: (industry, R&D, energy productivity, competitiveness)
- Manufacturability,
  - Technical merit;
  - Excellent team/facilities; and
  - High impact in mission areas.

FOA/Reviewer criteria (%)

All proposals must:

- Propose a tightly structured program with appropriate technical **milestones**;
- Provide evidence of relevant R&D **experience and capability** of applicant;
- Provide evidence that the proposed technology can be **scaled;**
- Project **price and/or performance improvements** tied to a recent baseline;
- Explicitly and thoroughly **differentiate the technology from commercially available**;
- Include a preliminary **cost analysis**; and
- **Justify all performance claims** with appropriate models/simulations and/or relevant experimental data.

Upcoming Phase I Release 2 FOA (Dec. 16)

https://science.osti.gov/sbir/FundingOpportunities

- Eligibility questions
- Deadlines/exceptions
- Evaluation (including reviewer criteria)
- Registrations (e.g., DUNS, SAM, grants.gov, PAMS)
- DOE-SBIR/STTR help:

  301-903-5707

  sbir-sttr@science.doe.gov

6a: Atomic Precision for **Microelectronics**

- **Why Microelectronics?**
  - End of Moore's law→efficiency improvements not longer guaranteed.
  - Ubiquity of Microelectronics. (IIOT)
- **Why Now?**
  - Inflection point—high leverage
  - Other government agencies (DARPA/NSF/DOE/SC)
- **Why AMO?**
  - AP since 2015, AP micro-related since 2018
  - AMO stakeholders need to be part of what's next
  - Possibility for new combinations due to efficiency/mfg

6a A.P. for Microelectronics… continued

Proposed technologies must **take advantage of atomic precision** to make chips and related manufacturing processes:

- **more energy efficient** than traditional microelectronics and/or
- **better performing** in clean energy applications.

Atomic precision (AP) for microelectronics is

- less absolute than prior AMO atomically precise topics

≡ ***almost*** no unintentional defects, missing atoms, extra atoms, or incorrect (impurity) atoms.

- intended to allow for cutting edge deposition-based technologies and include some novel 2D materials

≡ Atomic spacing in 1D and <50 nm in other dimension, i.e. maximizes lateral geometry precision within an atomic layers.

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov

6a A.P. for Microelectronics… continued

Technology approaches:

- Hydrogen Depassivation STM Lithography;
- Atomic layer deposition (ALD);
- Atomic layer etching (ALE);
- AP fabrication of carbon nanotube-based (CNT) transistors ;
- Directed self-assembly lithography; or
- Other technologies and techniques to make the above approaches more manufacturable.

Applications:

- High performance imaging and characterization tools
- Precise coatings for fuel cells, solar cells, batteries, catalytic surfaces, & membranes
- Low power transistors and other electronics that use quantum effects;
- Sensors for energy efficiency applications (electronic, photonic, and plasmonic);
- Flexible devices for light detection, emission, and photovoltaics; or
- Error detection and correction methods for all applications

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov

6b: Sensors for HCE

- Harsh and corrosive environments (HCEs) encountered in industry include oil, gas, and geothermal well drilling and production, as well as CO_2 gas sequestration applications – conditions with pressures reaching 20,000 pounds per square inch (psi) and temperatures up to 1200 °C in corrosive environments.
- Candidate sensor technologies would monitor pressure, temperature, composition, flow rates, and other variables in these environments.
- Restricted to terrestrial and undersea industrial applications; aerospace sensor R&D is specifically excluded.

Questions – Contact: Brian Valentine, brian.valentine@ee.doe.gov, or
Al Hefner, allen.hefner@ee.doe.gov

6b: Sensors for HCE (cont'd)

Two areas of interest are:

- **Innovations in materials and configurations** of sensors applied in harsh and corrosive environments. Must exceed commercial specs for:
  - expected longevity,
  - response to variable to be measured, and
  - availability.
- **Wide area networks of sensors** applied in harsh and corrosive environments in:
  - oil and geothermal wells,
  - undersea applications, and
  - other distributed applications.

  The proposed means to address the limitations of acquiring data over a distributed network of sensors in harsh environments must be addressed.

Questions – Contact: Brian Valentine, brian.valentine@ee.doe.gov, or Al Hefner, allen.hefner@ee.doe.gov

16b: Thermal Energy Storage (Industry, Materials)

Topic 16 is Joint between Building Technologies Office (a) and AMO (b)

- **16b:** This subtopic seeks to accelerate the development of non-building (including industrial and solar thermal) applications of thermal energy storage and materials that overcome limitations of current materials.
- Except for industrial building heating and cooling applications covered in 16a, thermal energy of interest to industry is generally at a much higher temperature (see Table 2) both in terms of the minimum temperature of thermal energy
  1) needed as inputs to industrial processes, and
  2) available as "waste (or renewable) heat" to be stored.

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov,

16b: Thermal Energy Storage (Industry, Materials, cont'd)

Process Heating Operation	Description	Temperature Range (°C)	U.S. Energy Use (TBtu)
Fluid heating, boiling, and distillation	Distillation, reforming, cracking, hydrotreating; chemicals production, food preparation	65-540	3,015
Drying	Water and organic compound removal	90-370	1,178
Metal smelting and melting	Ore smelting, steelmaking, and other metals production	425-1650	968
Calcining	Lime calcining	815-1095	395
Metal heat treating and reheating	Hardening, annealing, tempering	90-1370	203
Non-metal melting	Glass, ceramics, inorganics manufacturing	815-1650	199
Curing and forming	Polymer production, molding, extrusion	150-1370	109
Other	Preheating; catalysis, thermal oxidation, incineration, softening, and warming	90-1650	1,049

Table 2: U.S. Industrial Process Heat. (Source: Thermal Energy Futures, Kurup et al. 2019)

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov

16b: Thermal Energy Storage (Industry, Materials, cont'd)

Areas of Interest for this subtopic include:

- **Industrial Thermal Energy Storage Systems:** This area of interest focuses on industrial process heat, 95% of which derives from direct combustion or steam produced by fuel combustion and 34% of this heat is wasted. Activities should focus on storage systems that increase the utilization of waste and renewable (e.g., solar, geothermal) heat by providing cost effective thermal storage options.
- **Materials manufacturing** research for cost-effective, robust, environmentally friendly thermal storage materials for industrial processes: All types of storage are of interest (sensible, latent and thermochemical). Types of Materials of interest include PCM (encapsulated and not) Inorganic, molten salt, Ni-based alloys, stainless steels. R&D should focus on improving the performance of materials with the highest potential to possess characteristics outlined in Table 3.

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov,

16b: Thermal Energy Storage (Industry, Materials, cont'd)

In addition to metrics in Table 3, proposed approaches should maximize **thermal conductivity** and **durability** (e.g., with aging and thermal cycling), and **scale to industrially relevant volumes and masses**.

Metric Description	Metric	Clarifying Details
Phase Change Temperature	PCMs: >>30°C TCMs: 60-1700°C	Operating temperatures need to be appropriate for industrial applications highlighted in Table 2 or for product manufacturing.
Large-scale availability and low price	<$25/kWh $_{thermal}$	Higher Temperature materials are generally more costly
Volumetric/Mass energy capacity	>100 kWh/m^3/ 120 kWh/t	

Table 3: Metrics for Next Generation Thermal Storage Materials for Non-Buildings Applications.

Questions – Contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov

6d: Water Desalination – Cost-effective Energy Recovery for Modular Desalination Systems

- In October 2018, The Water Security Grand Challenge (WSGC) was announced to advance transformational technology and innovation to meet the global need for safe, secure, and affordable water.
- This subtopic is focused on the WSGC's goal 5 – small, modular desalination systems that have the potential to serve areas where energy and/or clean water is scarce, expensive, or challenging to obtain, such as islands, rural areas, and communities affected by a disaster.
- Affordable energy recovery devices (ERDs) need to be developed to reduce power consumption in small, modular desalination systems.
- Proposals should address how the ERD innovation will improve the lifecycle energy efficiency and production costs per m^3 of water for small, modular seawater or brackish water desalination systems, particularly those using renewable energy.

Questions –Contact: Melissa Klembara, melissa.klembara@ee.doe.gov
(Kenneth Kort substituting for Melissa on the webinar)

Q&A Break

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https://science.osti.gov/sbir/FundingOpportunities

Why it's Worth it–

- Even Just a EERE Phase I has benefits to you
  - double VC funding chance
  - increase firm/individual income, output, patents
- Phase II can be more than you think
  - Phase IIA or IIB
  - Phase IIC (new, requires external cost-share)

15a: Novel Utilization Strategies for Ocean Plastic Waste (and other waterways)

Joint topic between AMO and Bioenergy Technologies Office

- This topic seeks technologies for converting waste plastics into a useful product (including mechanical, chemical, biochemical, or other conversion methods).
- It is expected that applicants may have programs that investigate multiple areas for addressing ocean plastic waste, including plastic collection and end-product testing.
- Applicants must discuss how their technology will address issues of mixed plastics and contamination unique to plastics recovered from waterways.
- However, awardees from this solicitation will only be funded for development of a conversion technology.

Questions –Contact: Melissa Klembara, Melissa.Klembara@ee.doe.gov (Kathryn Peretti substituting for Melissa on webinar) or Jay Fitzgerald, Jay.Fitzgerald@ee.doe.gov

6c: Critical Materials Supply Chain Enabling Research

- In response to White House Executive Order 13817, *A Federal Strategy to Ensure Secure and Reliable Supplies of Critical Minerals*, the Secretary of Interior published a list of critical minerals in 2018.
- The Department of Energy (DOE) assesses material criticality based on importance to energy and the potential for supply risk for a range of **energy technologies**.
- This SBIR subtopic provides the opportunity to strengthen the domestic critical materials supply chain. Proposals should not be duplicative of existing efforts at the Critical Materials Institute. Proposals are encouraged to address, but are not limited to, the following areas of interest:
  - i. Reduction of Critical Materials in Energy Technologies
  - ii. Energy Efficient Manufacturing of Critical Materials

Questions – Contact: Helena Khazdozian, Helena.Khazdozian@ee.doe.gov

6c: Critical Materials Supply Chain Enabling Research (cont'd)

i. **Reduction of Critical Materials in Energy Technologies:**

Application	Wind	Vehicles			Lighting	Manufacturing & Mining	
Technology	Magnets	Magnets	Catalytic Converters	Light-weighting	LEDS	Tooling	Bearings
Bismuth (Bi)							■
Cerium (Ce)			■				
Cobalt (Co)	■	■				■	
Dysprosium (Dy)	■	■					
Gallium (Ga)					■		
Magnesium (Mg)				■			
Neodymium (Nd)	■	■					
Praseodymium (Pr)	■	■					
Samarium (Sm)	■	■					
Tungsten (W)						■	■

- Proposals that either target reduction of critical materials in batteries or propose a system to completely substitute for critical material-dependent technology will be considered non-responsive.

Questions – Contact: Helena Khazdozian, Helena.Khazdozian@ee.doe.gov

6c: Critical Materials Supply Chain Enabling Research (cont'd)

ii. **Energy Efficient Manufacturing of Critical Materials:**

- Manufacturing of gap magnets (energy product ranging from 10 to 20 MGOe)
- Manufacturing of magnesium-based alloys for vehicle lightweighting
- Processes to recycle or recover critical materials from end-of-life products
- Proposals must include analysis to demonstrate that the improvements in energy efficiency of processing and manufacturing of critical materials represent a 10% improvement in cost-competitiveness relative to a defined baseline.
- Cost-competitiveness analyses must consider a complete life-cycle including environmental costs.
- Improvement in energy efficiency may be achieved by automation of processes, additive manufacturing, reduction of processing temperatures, or other proposed innovations.

Questions – Contact: Helena Khazdozian, Helena.Khazdozian@ee.doe.gov

17a: Compact Power Conditioning Systems for High-Torque, Low-Speed Machines

Joint topic between AMO and Wind and Water Power Technologies Office

- Focused on manufacturing **power conditioning systems** (PCS) to meet the needs for generator grid integration requirements and need to have compact size and weight to meet requirements for the turbine location and assembly.
- Advanced high-voltage high-frequency silicon-carbide power semiconductors will enable these needs to be met by providing:
  - Medium-voltage drive (3.3 – 10 kV) to reduce current requirements;
  - High-frequency switching to mitigate high fault currents (that would result from the low impedance of these machines); and
  - Extremely low harmonics needed to prevent eddy current heating near the cryogenic windings of superconducting machines.

Questions – Contact: Rajesh Dham, rajesh.dham@ee.doe.gov, Michael Derby, michael.derby@ee.doe.gov, or Al Hefner allen.hefner@ee.doe.gov

17a: Compact Power Conditioning Systems for High-Torque, Low-Speed Machines (cont'd)

- Applicants must define:
  - Phase I – advanced PCS approaches including topology, technology, and controls to address challenges of advanced very high-power wind turbines and MHK turbines
  - Phase II – experimental validation of advanced approaches

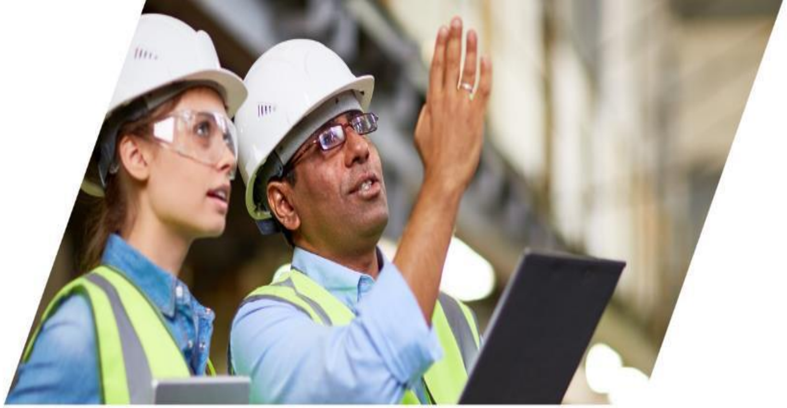
Questions – Contact: Rajesh Dham, rajesh.dham@ee.doe.gov, Michael Derby, michael.derby@ee.doe.gov, or Al Hefner allen.hefner@ee.doe.gov

Webinar Wrap-Up

- Webinar presentation slides will be posted and emailed to all webinar participants
- Q&A responses will be posted and emailed to all webinar participants
- If you want to ensure your question gets answered, email the contact for your topic
- Mandatory letter of intent deadline: January 6, 2020

Overarching Questions:

- Technical questions, contact: Tina Kaarsberg, tina.kaarsberg@ee.doe.gov
- Administrative questions, contact: SBIR-STTR@science.doe.gov or 301-903-5707



Questions?

For additional information:

energy.gov/eere/amo/advanced-manufacturing-office

energy.gov/eere/amo/events/amo-community-small-business-innovation-research-sbir-and-small-business-technology