DEPARTMENT OF ENERGY (DOE)
OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY (EERE)

CLEAN ENERGY MANUFACTURING INNOVATION INSTITUTE FOR COMPOSITE MATERIALS AND STRUCTURES

Funding Opportunity Announcement (FOA) Number: DE-FOA-0000977
FOA Type: Initial
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FOA Issue Date:	02/25/2014
Informational Webinar:	03/06/2014 3:00 PM ET
Submission Deadline for Concept Papers:	04/22/2014 5:00 PM ET
Submission Deadline for Full Applications:	06/19/2014 5:00 PM ET
Submission Deadline for Replies to Reviewer Comments:	07/24/2014 5:00 PM ET
Expected Date for EERE Selection Notifications:	September 2014
Expected Timeframe for Award Negotiations:	90 days

- Applicants must submit a Concept Paper by 5:00 PM ET on the due date listed above to be eligible to submit a Full Application.

- To apply to this FOA, Applicants must register with and submit application materials through EERE Exchange at https://eere-Exchange.energy.gov, EERE's online application portal. Frequently asked questions for this FOA and the EERE Application process can be found at https://eere-exchange.energy.gov/FAQ.aspx.

- Applicants must designate primary and backup points-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the Applicant/Selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the Selection.

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EXECUTIVE SUMMARY

Means of Submission	Concept Papers, Full Applications, and Replies to Reviewer Comments must be submitted through EERE Exchange at https://eere-Exchange.energy.gov, EERE's online application portal. EERE will not review or consider applications submitted through other means. The Users' Guide for Applying to the Department of Energy EERE Funding Opportunity Announcements is found at https://eere-Exchange.energy.gov/Manuals.aspx.
Total Amount to be Awarded	Up to $70,000,000 with approximately $14,000,000 available for the first budget period
Average Award Amount	EERE anticipates making one award up to $70,000,000
Types of Funding Agreements	Cooperative Agreements, Technology Investment Agreements, Work Authorizations, and Interagency Agreements
Period of Performance	Up to 60 months, divided into budget periods; budget periods will be for a 12 month (approximate) term.
Eligible Applicants	Individuals, Domestic Entities, Foreign Entities, Incorporated Consortia, Unincorporated Consortia, subject to the definitions in Section III.A.
Cost Share Requirement	50% of Total Project Cost (required minimum)
Submission of Multiple Concept Papers and Full Applications	Applicants may only submit one Concept Paper and one Full Application for consideration under this FOA as the Prime Applicant.
Application Forms	Required forms and templates for Full Applications are available on EERE Exchange at https://eere-Exchange.energy.gov.
FOA Summary	Through this Funding Opportunity Announcement (FOA), the Advanced Manufacturing Office (AMO) of EERE seeks to establish a Clean Energy Manufacturing Innovation Institute for Composites Materials and Structures that will support U.S. prosperity and security; and contribute to the creation of a national network of manufacturing innovation institutes. The vision for the Institute is to revitalize American manufacturing and support domestic manufacturing competitiveness. The technical topic area for this Institute is low cost, energy efficient manufacturing of fiber reinforced polymer composites. The Institute will target continuous or discontinuous, primarily carbon and glass fiber systems, with thermoset or thermoplastic resin materials. These types of composites are foundational technologies that are broadly applicable and pervasive in multiple industries and markets with potentially transformational technical and economic impact.

I. FUNDING OPPORTUNITY DESCRIPTION

A. INTRODUCTION

The Office of Energy Efficiency and Renewable Energy (EERE), within the Department of Energy (DOE), invests in high-risk, high-value research, development and deployment in energy efficiency and renewable energy technologies. EERE, through the Advanced Manufacturing Office, seeks to establish a Clean Energy Manufacturing Innovation Institute for Composite Materials and Structures, to support U.S. prosperity and security; to further the mission of R&D in energy efficient and renewable technologies; and contribute to the creation of a national network of manufacturing institutes. The vision for these Institutes is to help revitalize American manufacturing and support domestic manufacturing competitiveness.

EERE's Advanced Manufacturing Office (AMO) partners with private and public stakeholders to support development and deployment of innovative technologies that can improve U.S. competitiveness, save energy, and ensure global leadership in advanced manufacturing and clean energy technologies. AMO supports cost-shared research, development and demonstration of innovative, next generation manufacturing processes and production technologies that will improve energy efficiency as well as reduce emissions, industrial waste and the life-cycle energy consumption of manufactured products.

The focus of the Institute resulting from this Funding Opportunity Announcement (FOA) will be low-cost, energy efficient manufacturing and recycling of fiber reinforced polymer composites. The Institute will target continuous or discontinuous, primarily carbon and glass fiber composite, with thermoset or thermoplastic resin materials due to their superior strength and stiffness to weight ratios relative to other materials, and subsequent applicability to clean energy and industrial applications with potential impact to national energy goals. These types of composites are foundational technologies that are broadly applicable and pervasive in multiple industries and markets with potentially transformational technical and economic impact.

B. BACKGROUND

Manufacturing converts a wide range of raw materials, components, and parts into finished goods that meet market expectations. The manufacturing sector provides about 12% of U.S. Gross Domestic Product (GDP), employs nearly 12 million Americans today and will be critical to future U.S. global economic competitiveness and job growth. Technology-based productivity improvements have consistently driven job growth over time across the economy.[1] The manufacturing sector develops and produces many of the technologies that advance the competitiveness and growth of the entire economy, including the service sector; every dollar

[1] National Science and Technology Council. "A National Strategic Plan for Advanced Manufacturing." Web. February 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/iam_advancedmanufacturing_strategicplan_2012.pdf

spent in manufacturing generates 1.35 dollars in additional economic activity.[2] Harnessing this opportunity, advanced manufacturing can be summarized as that segment of the manufacturing sector where technology provides a competitive advantage.

In recognition of the vital role an advanced manufacturing sector has in the U.S. economy and national security, and to support the growing resurgence of U.S. manufacturing after years of decline, in 2012 President Obama proposed a National Network for Manufacturing Innovation (NNMI).[3] The creation of a network of regional institutes for manufacturing innovation will enable the transition of products and technologies from research to the marketplace.

Previously, DOE, in coordination with the inter-agency Advanced Manufacturing National Program Office (AMNPO), released a FOA in May 2013 to establish a Clean Energy Manufacturing Innovation (CEMI) Institute focused on manufacturing next generation power electronic devices.

Power electronic devices based on wide bandgap semiconductor materials have significant potential to increase energy productivity and U.S. manufacturing competitiveness.[4] This funding opportunity is a follow on to the initial Clean Energy Manufacturing Innovation Institute and will be focused on Composite Materials and Structures.

At the technical core of each Institute is shared research, development and demonstration (RD&D) infrastructure that contains equipment and resources accessible to external parties for technology development that would otherwise be cost prohibitive, particularly for small and medium-sized enterprises (SMEs). AMO supports the development of innovative next generation manufacturing processes and production technologies through the creation of collaborative communities with shared RD&D infrastructure. Work conducted at these shared facilities reduces technical risks and enables business case development to justify subsequent private investment. Public-private shared RD&D infrastructure devoted to advanced manufacturing has been a key recommendation of both industry and academia.[5]

The Department of Energy works to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions.[6] Transforming and securing the nation's energy systems and maintaining U.S. leadership in clean energy and high value technologies requires domestic manufacturing of

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[2] President's Council of Advisors on Science and Technology. "Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing." Web. July 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_amp_steering_committee_report_final_july_17_2012.pdf

[3] The White House. Office of the Press Secretary. "President Obama to Announce New Efforts to Support Manufacturing Innovation, Encourage Insourcing." March 9, 2012.http://www.whitehouse.gov/the-press-office/2012/07/17/fact-sheet-white-house-advanced-manufacturing-initiatives-drive-innovati

[4] U.S. Department of Energy. Advanced Manufacturing Website. Web. http://www1.eere.energy.gov/manufacturing newsandevents/news_detail.html?news_id=19300

[5] President's Council of Advisors on Science and Technology. "Report to the President on Capturing Domestic Competitive Advantage in Advanced Manufacturing." Web. July 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast_amp_steering_committee_report_final_july_17_2012.pdf

[6] U,S, Department of Energy. 2011 Strategic Plan. http://energy.gov/sites/prod/files/2011_DOE_Strategic_Plan_.pdf

technologies that produce, move, and use clean energy at a meaningful scale. A robust and competitive domestic manufacturing base is critical for national energy security both because it can reduce our dependence on oil and ensures domestic supplies of key products.

Investment in innovative advanced manufacturing technologies helps maintain the competitiveness of U.S. producers to ensure growth in manufacturing investment and employment. In 2012, a record $269 billion was invested globally in clean energy technologies,[7] and potentially trillions of dollars will be invested in the coming decades. A core thrust for the EERE is to maintain U.S. global competitiveness in clean energy, and manufacturing is an important part of the path forward. EERE launched its Clean Energy Manufacturing Initiative to increase U.S. manufacturing competitiveness in the production of clean energy products and domestic manufacturing competitiveness across the board by increasing energy productivity.[8] The implementation of significant cross-cutting manufacturing research and development, shared facilities and technical assistance of the CEMI initiative is through the EERE Advanced Manufacturing Office.

Energy, Manufacturing and Innovation

Energy efficient production methods, clean energy technologies, low-cost production techniques, and energy efficient products manufactured domestically are critical to U.S. competitiveness. "Energy costs are a major contributor to manufacturing costs and technology innovations that steeply reduce energy consumption in industrial and manufacturing processes can give American manufacturers competitive advantages in the global marketplace."[9] As an example, energy represents 60 percent of operating costs in the chemicals industry and even higher percentages for the petrochemical subsector.[10]

U.S. industry consumes approximately 30 quadrillion Btu (quads) of energy per year,[11] almost one third of all energy used in the United States. Process improvements and innovation can lead to reductions in energy use in the industrial and manufacturing sectors and also impact energy consumption on a life-cycle basis for manufactured goods in other sectors such as transportation and electricity.

[7] Bloomberg New Energy Finance. "Finance data from the Market Sizing tool for Insight clients of Bloomberg New Energy Finance, accessed 3/5/13." https://www.bnef.com/MarketSizing/Finance

[8] U.S. Department of Energy. DOE/EE-0892. "Clean Energy Manufacturing Initiative." June 2013. http://www1.eere.energy.gov/energymanufacturing/pdfs/clean_energy_manufacturing_initiative_fact_sheet.pdf

[9] U.S. House of Representatives. Committee on Appropriations. Energy and Water Development Appropriations Bill, 2013 (to Accompany H.R. 5325) Together with Additional Views. 112th Congress. 2d Session. Report 112-462. Washington: GPO, 2012. GPO. U.S.Government Printing Office. Web. 2 May 2012. (85). http://www.gpo.gov

[10] Energy Information Administration (2011). "International Energy Outlook 2011." p.109. Released 19 September 2011. http://www.eia.gov/forecasts/ieo/industrial.cfm

[11] Energy Information Administration (2012). "Annual Energy Outlook 2012." Table C2. Web. DOE/EIA-0383 http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf

Life-cycle energy consumption is the total amount of energy needed to acquire and process raw materials, manufacture, use and dispose (end-of-life) of products.[12] Advanced manufacturing technologies can impact energy intensity in the production, use phase and end-of-life stage for a product, with the net effect of an overall life-cycle reduction in energy consumption. Examples of the impact of advanced manufacturing across different product life-cycle phases are given below:

- Production phase - the use of membranes for separations in chemical refining instead of distillation, which can reduce the amount of energy required to make intermediate or fine chemicals.
- Use phase - production of lower cost, high quality Light-emitting Diodes (LEDs) to enable the widespread use of energy efficient lighting (In 2011 LEDs were estimated to use 77% less primary energy than incandescent bulbs on a levelized lifetime basis of MJ/20 million lumen-hours).[13]
- End-of-life phase – design for recyclability to enable higher levels of aluminum recycling at lower energy intensity than production from raw minerals.

National Network for Manufacturing Innovation

The inter-agency Advanced Manufacturing National Program Office (AMNPO) has led the formation of the pilot National Network for Manufacturing Innovation (NNMI) concept by gathering input from hundreds of private sector, academics, state government and other stakeholders through a series of public workshops and a formal Request for Information. As a parallel activity, the Administration called for the launch of a competitively selected proof of concept pilot institute. Following merit review of resulting applications, America Makes, the interagency supported National Additive Manufacturing Innovation Institute was announced in Youngstown, OH.[14] The combined stakeholder feedback and experience gained from the launch of America Makes was critical in defining and testing the Institute concept. The result of these efforts is formalized in the National Science and Technology Council report published January 2013, "National Network for Manufacturing Innovation: A Preliminary Design." The report summarizes the NNMI and Institute concepts as follows:

> *"The Federal investment in the National Network for Manufacturing Innovation (NNMI) serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will consist of linked Institutes for*

[12] Navigant Consulting (2012). "Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products." Prepared for the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Buildings Technology Program. Web. p.9. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf.

[13] Navigant Consulting (2012). "Life-Cycle Assessment of Energy and Environmental Impacts of LED Lighting Products." Prepared for the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. Buildings Technology Program. Web. p.36.http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.pdf.

[14]The White House. Office of the Press Secretary. "We Can't Wait: Obama Administration Announces New Public-Private Partnership to Support ." August 16, 2012 http://www.whitehouse.gov/the-press-office/2012/08/16/we-can-t-wait-obama-administration-announces-new-public-private-partners

Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.

As sustainable manufacturing innovation hubs, IMIs will create, showcase, and deploy new capabilities, new products, and new processes that can impact commercial production. They will build workforce skills at all levels and enhance manufacturing capabilities in companies large and small. Institutes will draw together the best talents and capabilities from all the partners to build the proving grounds where innovations flourish and to help advance American domestic manufacturing." [15]

In the 2013 State of the Union Address, the President announced immediate action by the Department of Energy and the Department of Defense to launch three more Institutes.[16] The competitive award process for these three Institutes began in May 2013, with the DOE leading the Clean Energy Manufacturing Innovation Institute focused on next generation power electronics, and DOD leading two Institutes with one focused on Digital Design and Manufacturing Innovation and a second on Lightweight and Modern Metals Manufacturing.[17] Through the creation of Institutes, DOE, AMNPO and its partner agencies seek to ensure U.S. prosperity and security to support innovative, advanced manufacturing technologies that will enhance domestic advanced manufacturing competitiveness and create jobs for American workers.

Institute Overview

This section summarizes the overall vision for Institutes and the NNMI as articulated in the NSTC "National Network for Manufacturing Innovation: Preliminary Design" report and provides a high level framework for an Institute, including the Institute which is the goal of this FOA.

Institute leadership must be capable of managing an industry-wide technology development activity, workforce development and infrastructure agenda that strongly leverages industry consortia, regional clusters, and other resources in science, technology, and economic development. Institutes will have a strong management team and strong organizational director. The Preliminary Design report describes an independent non-profit organization to manage each Institute. Governance of the Institute will be clearly defined and the Institute will have a well-defined operational plan that will enable the Institute to maintain relevance to stakeholders over time. Institutes will be expected to be financially sustainable within five to seven years of launch, through revenue-generating activities including member fees, intellectual property licenses, contract research, and fee-for-service activities, as examples.

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[15] National Science and Technology Council (2013).. "National Network for Manufacturing Innovation: A Preliminary Design."." January 2013. http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_nnmi_prelim_design_final.pdf

[16] White House. Press Release. 02-13-2013. Web. http://www.whitehouse.gov/the-press-office/2013/02/13/fact-sheet-president-s-plan-make-america-magnet-jobs-investing-manufactu

[17] U.S. Department of Energy. Advanced Manufacturing Website. Web. http://www1.eere.energy.gov/manufacturing newsandevents/news_detail.html?news_id=19300

Participants in the Institute may engage and conduct work at an Institute using a variety of contracting and collaboration instruments. The Institutes should be of an adequate size and scale to provide long-term significant economic impact in the region and nationally.

Through shared RD&D infrastructure and capabilities at its core, an Institute will enable demonstration of advanced manufacturing technologies at a scale significant enough to establish technical feasibility and enable business case development to attract further private investment. Each Institute will be organized to foster an open exchange of pre-competitive manufacturing best-practices and know-how -- including design and processing tools, qualification and certification approaches, and fabrication costing methods -- while protecting company proprietary intellectual property. Each Institute will include business models to allow manufacturers of all sizes access to and use of the shared RD&D infrastructure, as well as guide and train participants. The Institute will also provide the opportunity for equipment suppliers and partners to improve their own technologies by learning from other users. An Institute will engage the manufacturing community at all levels of the supply chain, from large companies, potential end users, to researchers and small and medium-sized enterprises (SMEs) involved in critical development work and who will support the transition to commercial applications, to ensure the Institute is focused on industry relevant problems and increase likelihood of success.

The Institute will support applied research, development and demonstration projects that enable new processes, equipment, design tools, and capabilities for innovative production or materials technologies; accelerate certification and qualification of processes and products; maintain data and models; assist in the development of testing protocols and standards; and demonstrate the transition of innovations to the commercial market as appropriate for the technology focus area.

The Institutes will engage with the broader community by hosting interns and developmental assignments for individuals from industry, academia, and government to accelerate pre-competitive development of advanced manufacturing technologies, as well as support technical educational and workforce development of the manufacturing community around the Institute. Each Institute will interact and engage with other national, regional and local resources and facilities and participate in a National Network for Manufacturing Innovation.

Shared RD&D Infrastructure

A critical element of the Institute model is the establishment and operation of shared RD&D infrastructure. Each Institute supports collaboration between process and product developers to foster innovation. A model for the shared RD&D infrastructure of the Institute is shown in Figure 1, with examples of the capabilities that may be included. Not every Institute will require each type of capability represented in the diagram and the list is not exhaustive. While it may not be realistic or cost-effective for an Institute to house the complete set of capabilities needed within the physical walls of the Institute, a core set of capabilities that provides a clear center of gravity for the Institute is expected. An Institute will leverage existing infrastructure and establish partnerships with laboratories, test facilities and other research centers to supplement the capabilities within the Institute as needed and well justified.

As illustrated by Figure 1, the output from either the horizontal (new end products or processes) or vertical path (new enabling technologies or production capabilities) is an impact to manufacturing supply chains and end-markets by an Institute. The horizontal path through the diagram describes the potential path for a product-focused participant where the outcome is development of a business case for private sector investment and demonstration of technical feasibility of production at meaningful scale for that technology or market application. The Institute provides users affordable access to a set of alternate physical and virtual tools to manufacture, optimize, and evaluate production of new materials, devices, or components. These tools enable developers and innovators to rapidly test new technologies, optimize processes, reduce technical risk or uncertainties to encourage investment, understand cost of production at scale, and implement technical innovations.

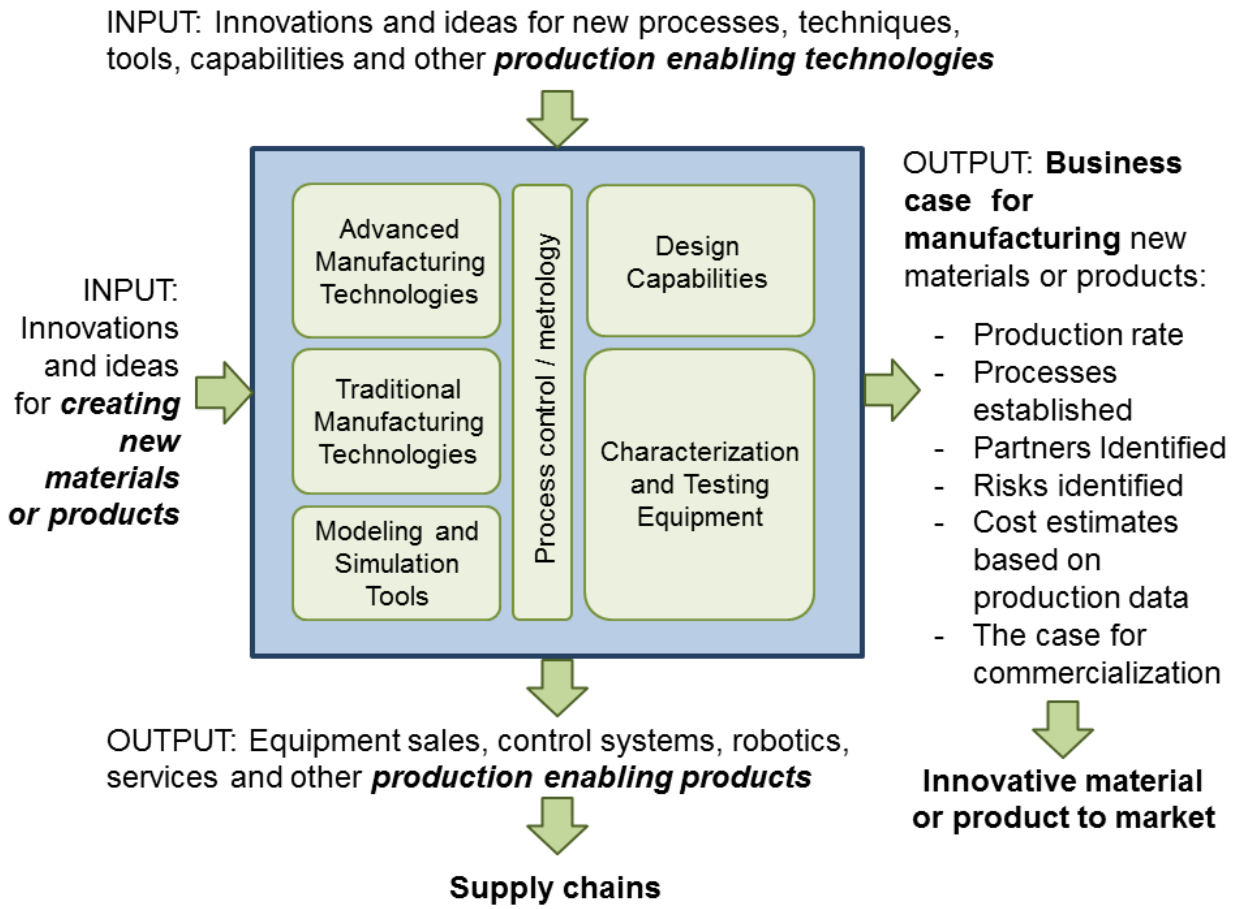

Figure 1. Diagram of the shared RD&D infrastructure of an Institute (as an example)

The vertical path through the diagram outlines how process-focused participants might benefit from the Institute. Equipment and tool suppliers may provide test or production units for use within the Institute providing exposure to new users, enabling application for new products, innovations in equipment design or operation. Process innovations might include modified control systems, automation or use of robotics, new designs and other benefits. The

development of these process related innovations and ideas to production-relevant scales enables rapid deployment of production enabling technologies into manufacturing supply chains.

With shared RD&D infrastructure, a focused and capable leadership team, an engaged industry and research partnership, a supportive local and regional economic community and a compelling advanced manufacturing vision, an Institute will be structured to effectively and sustainably support the challenge of moving an emerging clean energy manufacturing concept from proof of principle laboratory results to private sector market opportunity. In doing so, each Institute, and a resulting network of Institutes, should significantly enhance the competitiveness of domestic manufacturing in areas relevant to clean energy manufacturing.

C. TECHNICAL TOPIC AREA AND FOA GOALS

Introduction

Improvements in the manufacturing and fabrication of complex composite components are a critical way to support the Nation's energy goals and domestic prosperity. Lightweight, high strength and stiffness composite materials have been identified as a key cross-cutting technology for reinventing energy efficient transportation, enabling efficient power generation, providing new mechanisms for storing and transporting reduced carbon fuels, and increasing renewable power production.[18] Fiber reinforced polymer composites can be used in vehicles, industrial equipment, wind turbines, compressed gas storage, buildings and infrastructure, and many other applications.

One industry analysis predicts the global carbon fiber polymer composite market alone to grow to $25.2 billion by 2020[19] and glass fiber reinforcements to reach $16.4 billion by 2016.[20] Improvements and innovation in manufacturing and assembly techniques for fiber reinforced polymer composite materials and structures are needed to meet cost and performance targets to enable even wider adoption across multiple industries.[21] Addressing technical challenges may enable U.S. manufacturers to capture a larger market share of the higher value add of composites in the supply chain and could support domestic manufacturing competitiveness.

The focus of this FOA is Fiber Reinforced Polymer Composites due to their superior strength and stiffness to weight ratios relative to other materials, as shown in Figure 2, and subsequent applicability to clean energy and industrial applications with energy impact.

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[18] The Minerals, Metals and Materials Society (2012). *Materials: Foundation for the Clean Energy Age.* Retrieved from http://energy.tms.org/docs/pdfs/Materials_Foundation_for_Clean_Energy_Age_Press_Final.pdf

[19] Industry Experts. Website. *Carbon Fibers and Carbon Fiber Reinforced Plastics (CFRP) – A Global Market Overview.* http://industry-experts.com/verticals/chemicalsandplastics/carbon-fibers-and-carbon-fiber-reinforced-plastics-a-global-market-overview.html

[20] Industry Experts. Website. *Glass Fiber Reinforcements – A Global Market Overview.* http://industry-experts.com/verticals/chemicalsandplastics/glass-fiber-reinforcements-a-global-market-overview.html

[21] The Minerals, Metals and Materials Society (2011). *Linking Transformational Materials and Processing for an Energy Efficient and Low-Carbon Economy: Creating the Vision and Accelerating Realization, Innovation Impact Report*. Retrieved from http://energy.tms.org/docs/pdfs/Phase_III_Report.pdf

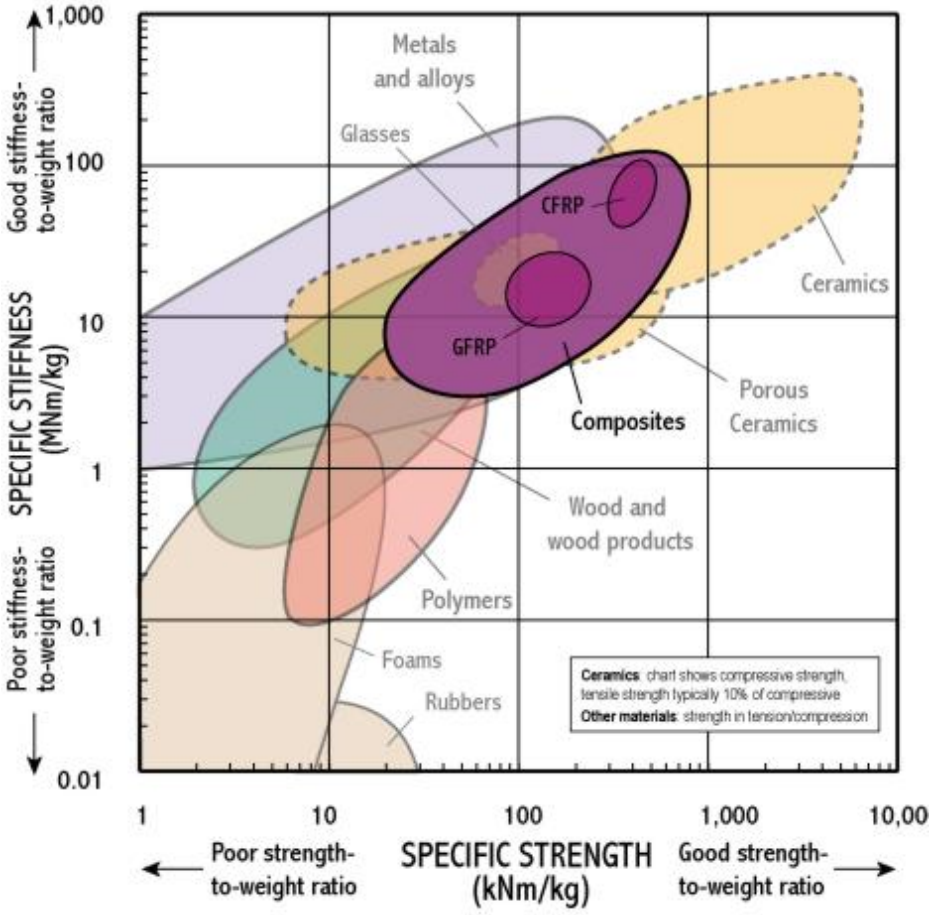

Figure 2. Specific stiffness and specific strength for various materials, the figure highlights Carbon Fiber Reinforced Polymer (CFRP) Composites and Glass Fiber Reinforced Polymer (GFRP) Composites.[22]

Carbon fiber reinforced polymer composites offer the highest structural properties to density ratios (specific strength is axial tensile strength divided by density and specific stiffness is axial modulus divided by density), excellent corrosion resistance and other desirable properties, but are costly relative to other materials on a weight basis. Glass fiber reinforced polymer composites have improved specific mechanical properties over metals and cost less than carbon fiber composites but have lower strength to weight ratio and are not as stiff as carbon fiber composites. Table 1 provides further data for GFRP, CFRP and common metals including estimated embodied energy and production costs.

[22] University of Cambridge, Department of Engineering Website. http://www-materials.eng.cam.ac.uk/mpsite/interactive_charts/spec-spec/basic.html

	GFRP	CFRP	Steel	Aluminum	Magnesium	Titanium
Specific Strength (kNm/kg)[23,24]	150	400	38	130	158	120
Embodied Energy (MJ/kg)[25,26]	33	236	45	227	416	474
Domestic Production Cost ($/kg)[27,28]	2.5	27	0.47	2	3.31	9
Density (kg/m^3)[29,30]	1800	1590	7870	2700	1800	4500

Table 1. Representative values (as an average when a range of data was sourced) for specific strength (tensile strength/density), embodied energy, production cost and density for GFRP, CFRP, steel, aluminum, magnesium and titanium.

The use of composite materials and structures can lead to significant life-cycle energy benefits by reducing oil consumption in transportation, increasing wind energy production and improving energy storage.[31]

Fiber reinforced polymer composite materials have traditionally been used in defense, aerospace and other high value, low volume applications where higher costs and longer production cycle times can be tolerated because of the high performance design requirements

[23] University of Cambridge, Department of Engineering Website. http://www-materials.eng.cam.ac.uk/mpsite/interactive_charts/spec-spec/basic.html Note: Composite material performance will vary based on the type of matrix material, fiber and fiber volume fraction and laminate construction. Values in this chart are more closely representative of quasi-isotropic composites, unidirectional composites may have even higher properties.

[24] U.S. Department of Energy ARPA-E (2013). *Modern Electro/Thermochemical Advances in Light-metal Systems (METALS), Funding Opportunity No. DE-FOA-0000882*, https://arpa-e-foa.energy.gov/Default.aspx?Archive=1%20-%20FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077#FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077

[25] Song. Y.S., *et.al*. "Life Cycle Energy Analysis of Fiber-Reinforced Composites." *Composites: Part A* 40 (2009) 1257-1265. Note: Averages of data from table 1 and 2.

[26] Rankin, W.J. (2011). *Minerals, Metals and Sustainability: Meeting Future Energy Needs.* Table 9.5.

[27] Note: Average value from data in Table 2 in this document.

[28] U.S. Department of Energy ARPA-E (2013). *Modern Electro/Thermochemical Advances in Light-metal Systems (METALS), Funding Opportunity No. DE-FOA-0000882*, https://arpa-e-foa.energy.gov/Default.aspx?Archive=1%20-%20FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077#FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077

[29] U.S. Department of Energy ARPA-E (2013). *Modern Electro/Thermochemical Advances in Light-metal Systems (METALS), Funding Opportunity No. DE-FOA-0000882*, https://arpa-e-foa.energy.gov/Default.aspx?Archive=1%20-%20FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077#FoaId7494c8b3-e88e-48f2-b4c8-e4c093bbe077

[30] University of Cambridge, Department of Engineering Website. http://www-materials.eng.cam.ac.uk/mpsite/interactive_charts/strength-density/basic.html.

[31] The Minerals, Metals and Materials Society (2012). *Materials: Foundation for the Clean Energy Age.* Retrieved from http://energy.tms.org/docs/pdfs/Materials_Foundation_for_Clean_Energy_Age_Press_Final.pdf

and resulting high value add of composites in the end-use products.[32] Improvements to materials and manufacturing techniques have led to increased use of fiber reinforced polymer composites in other high value add industries, such as sports equipment, but they have not yet surpassed the tipping point to meet production volumes and cost targets to support widespread adoption in clean energy and industrial applications, where the application of composite materials might have significant impact in energy sectors. The energy intensity of carbon fiber composites and the lack of recyclability for fiber reinforced polymer composites are further limitations to the use of these materials.

A concentrated focus on innovative composite manufacturing approaches to meet cost and production targets that lower the energy consumption, greenhouse gas emissions and address end-of-life issues will accelerate the realization of life cycle energy efficiency Target fiber reinforced polymer composite applications for this FOA are highlighted here.

Target Applications

Vehicles

Lightweighting is an important end-use energy efficiency strategy in transportation, for example a 10% reduction in vehicle weight can improve fuel efficiency by 6%–8% for conventional internal combustion engines, or increase the range of a battery-electric vehicle by up to 10%.[33] A 10% reduction in the weight of all vehicles in the U.S. car and light-duty truck fleet could result in a 1,060 TBTU annual reduction in energy and a 72 MMT reduction in CO_2 emissions.[34] The DOE Vehicles Technology Office (VTO) estimates savings of more than 5 billion gallons of fuel annually by 2030, if one quarter of the U.S. light duty fleet utilizes lightweight components and high-efficiency engines enabled by advanced materials.[35]

In 2012, the Corporate Average Fuel Economy (CAFE) standard for cars and light-duty trucks set forth by the U.S. Environmental Protection Agency will increase fuel economy to the equivalent of 54.5mpg by model year 2025.[36] Lightweighting has been identified as a potential new technology approach with significant potential to achieve this standard. The U.S. Drive Materials Technical Team identified carbon fiber composites as the most impactful material to reducing vehicle mass in their 2013 Roadmap.[37] Composites can offer a range of mass reductions over steel ranging from 25–30% (glass fiber systems) up to 60–70% (carbon fiber

[32] National Research Council (2005). *High-Performance Structural Fibers for Advanced Polymer Matrix Composites*. Washington, DC: The National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=11268

[33] U.S. Department of Energy (2011), *Quadrennial Technology Review.* p.39. Retrieved from http://energy.gov/sites/prod/files/QTR_report.pdf

[34] The Minerals, Metals and Materials Society (2011). *Linking Transformational Materials and Processing for an Energy Efficient and Low-Carbon Economy: Creating the Vision and Accelerating Realization, Innovation Impact Report*. p.92. Retrieved from http://energy.tms.org/docs/pdfs/Phase_III_Report.pdf

[35] http://www1.eere.energy.gov/vehiclesandfuels/technologies/materials/index.html

[36] National Highway Traffic Safety Administration. Press Release. August 28, 2012. http://www.nhtsa.gov/About+NHTSA/Press+Releases/2012/Obama+Administration+Finalizes+Historic+54.5+mpg+Fuel+Efficiency+Standards

[37] US DRIVE (2013). *Materials Technical Team Roadmap*. Figure 1. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/mtt_roadmap_august2013.pdf

systems).[38] Glass fiber composites can be found in closures or semi-structural components, such as: rear hatches, roofs, doors and brackets, which make up 8-10% of the typical light duty weight. Glass fiber composites can be used where the ability to consolidate parts, corrosion resistance and damping properties are beneficial.[39] Technology gaps to the further use of glass fiber composites for components and structures include limitations to mechanical properties and durability, insufficient data and long process cycle times.[40]

Carbon fiber composites have had limited adoption in the commercial automotive sector over the past forty years in primarily semi-structural (i.e. hood, roof) [41] and non-structural (i.e. seat fabric) for low volume production runs. However, they offer the most significant impact to vehicle Lightweighting and use in vehicle structural applications. The typical body structure for a light duty vehicle accounts for 23-28% of the weight.[42] The DOE Vehicle Technologies Program sets a goal of a 50% weight reduction in passenger-vehicle body and chassis systems.[43] While one foreign manufacturer recently released a low volume electric vehicle with a primarily carbon fiber body,[44] as indicated by VTO workshop participants, the structural and safety requirements for body structures requires additional failure mode information, materials with equal or better performance at equivalent cost, better design tools and dependable joining technology for composites, all at adequate manufacturing speeds and consistency for more common vehicle models.[45] The U.S. Drive Materials Technology Team also identified high volume manufacturing, recycling, predictive modeling and other enabling technologies as some of the most critical challenges to the further adoption of carbon fiber composites.[46]

The American Chemistry Council further identifies in the Plastics in Automotive Markets Technology Roadmap, "The industry's manufacturing infrastructure must become fully effective while working with plastics and combining multiple materials into a functional whole.

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[38] U.S. Drive (2013). Materials Technical Team Roadmap. p.4 Accessed October 31, 2013. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/mtt_roadmap_august2013.pdf

[39] Massachusetts Institute of Technology. Laboratory for Energy and the Environment (2008). *On the Road in 2035.* Table 14.

[40] U.S. Department of Energy, Vehicles Technology Office (2012). *Lightduty Vehicles Workshop Report*. p.33. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf.

[41] Massachusetts Institute of Technology. Laboratory for Energy and the Environment (2008). *On the Road in 2035.* p.48

[42] U.S. Department of Energy, Vehicles Technology Office (2012). *Lightduty Vehicles Workshop Report*. p.9. Retrieved from http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf.

[43] US Department of Energy, Vehicle Technologies Office (2010), Materials Technologies: Goals, Strategies, and Top Accomplishments.

[44] Composites World. Accessed October 3, 2013. http://www.compositesworld.com/news/bmw-formally-launches-i3-manufacture-and-assembly

[45] U.S. Department of Energy, Vehicles Technology Office (2012). *Lightduty Vehicles Workshop Report*. p.9. Retrieved from http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf.

[46] US DRIVE (2013). *Materials Technical Team Roadmap*. Figure 1. Retrieved from http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/mtt_roadmap_august2013.pdf

Simultaneously, the industry's developmental infrastructure must become fully adept at designing with plastics and innovating new applications for plastics and polymer composites, especially in light of evolving safety performance criteria and energy efficiency goals."[47]

The benefits of Lightweighting extends to military vehicles as well for improved fuel economy, increased performance, the ability to better support operationally and improved survivability, according to the 2012 National Research Council report on the *Application of Lightweighting Technology to Military Vehicles, Vessels and Aircraft*.[48] The report also recognizes that "robust manufacturing processes for fabricating complex structural components from continuous-fiber-reinforced composites have not yet achieved the rate and consistency of steel stamping."[49]

Wind Turbines

Supplying 20% of U.S. electricity from wind could reduce carbon dioxide emissions from electricity generation by 825 million metric tons by 2030.[50] In wind energy, high strength and stiffness, fatigue-resistant lightweight materials like carbon fiber composites can support development of lighter, longer blades and increased power generation.[51] In addition, "using lighter blades reduces the load-carrying requirements for the entire supporting structure and saves total costs far beyond the material savings of the blades alone."[52] Not only could there be cost savings for land-based wind applications by reducing the structure of the turbine tower, but significant savings in reducing the support structure for offshore wind applications.

While high performance carbon fiber has been used for highly loaded areas (i.e. spar caps) by some manufacturers, glass fiber composites with lower specific properties are the dominant materials for the overall blade due to lower cost. Capital cost of turbine structures and blade is a significant contributor to the levelized cost of electricity (LCOE) for wind generation. As a result, any enhancement in structural properties of materials must be balanced against the increased cost, to ensure the overall system costs do not increase disproportionately with the increased power capacity and energy production. For longer blades, the use of carbon fiber is favorable due to the possible weight reduction of the blade (one study estimates a 28% reduction for a 100m carbon fiber spar cap blade design compared to the glass fiber equivalent[53]) and overall system weight, design and manufacturing impact this could have on

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[47] American Chemistry Council (2009). *Plastics in Automotive Markets Technology Roadmap*. Retrieved from http://www.plastics-car.com/roadmap_fullversion

[48] National Research Council (2012). *Application of Lightweighting Technology to Military Aircraft, Vessels and Vehicles*. p.122. The National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=13277

[49] National Research Council (2012). *Application of Lightweighting Technology to Military Aircraft, Vessels and Vehicles*. p.2. The National Academies Press. Retrieved from http://www.nap.edu/catalog.php?record_id=13277

[50] U.S. Department of Energy (2008). *20% Wind Energy by 2030.*p13. Retrieved from http://www1.eere.energy.gov/wind/pdfs/41869.pdf

[51] The Minerals, Metals and Materials Society (2012). *Materials: Foundation for the Clean Energy Age.* p.24. Retrieved from http://energy.tms.org/docs/pdfs/Materials_Foundation_for_Clean_Energy_Age_Press_Final.pdf

[52] U.S. Department of Energy (2008). *20% Wind Energy by 2030.* p.32. Retrieved from http://www1.eere.energy.gov/wind/pdfs/41869.pdf

[53] Griffith, T. et.al. (2012). *Challenges and Opportunities in Large Offshore Rotor Development: Sandia 100-meter Blade Research.* AWEA Windpower 2012 Conference and Exhibition, Scientific Track Paper, June 3-6,2012. Table 8.

large scale wind. However, use of carbon fiber is limited due to cost. Cost models by Sandia National Laboratory indicate that for a 100m-long blade design, carbon fiber costs would need to drop 34% to be competitive with an equivalent 100m-long all glass design.[54]

Further advances in manufacturing techniques, improved quality control, innovations for glass-carbon fiber hybrid composites and reduced costs for carbon fiber composite materials and manufacturing will support production of larger turbines and enable continued growth of wind. One industry analyst predicts wind could be the largest consumer of carbon fiber composites by 2018.[55] The U.S. has a strong position in manufacturing of wind energy equipment[56] and innovative manufacturing techniques could further strengthen U.S. competitiveness in this market segment.

Compressed Gas Storage

According to the Fuel Cells Technologies Office (FCTO), analysis has shown that Fuel Cell Electric Vehicles using hydrogen can reduce oil consumption in the light-duty vehicle fleet by more than 95% when compared with today's gasoline internal combustion engine vehicles, by more than 85% when compared with advanced hybrid electric vehicles using gasoline or ethanol, and by more than 80% when compared with advanced plug-in hybrid electric vehicles.[57] Full commercialization of fuel cell systems using hydrogen will require advances in hydrogen storage technologies. Lightweight, compact and cost competitive hydrogen storage will help make fuel cell systems competitive for mobile and stationary applications. Early markets for fuel cells include portable, stationary, back-up and material handling equipment (i.e. fork trucks) applications.

Many storage technologies for hydrogen are similar to those needed for natural gas applications. As compressed gas storage for hydrogen and natural gas demand grows, lower cost materials and manufacturing methods for storage tanks will be required. High pressure storage tanks are typically made with high strength (>700ksi tensile strength) carbon fiber filament in a polymer matrix wound over a metallic or polymeric liner. Carbon fiber composites can account for over 60% of the cost of these systems.[58] FCTO has set ultimate cost targets of \$8/kWhr (\$267/kg H_2 stored). For Type IV storage tanks with 5.6kg of hydrogen storage at 700bar to meet these cost targets carbon fiber composite costs will need to drop to \$10-

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Retrieved from http://energy.sandia.gov/wp/wp-content/gallery/uploads/Griffith_WindPower-SAND2012-4229C.pdf

[54] Sandia National Laboratories (2013). SAND2013-2734. *Large Blade Manufacturing Cost Studies Using the Sandia Blade Manufacturing Cost Tool and Sandia 100-meter Blades*. p.27

[55] Red, C. (2012). "Global Market for Carbon Fiber Composites: Maintaining Competitiveness in the Evolving Materials Market." Presentation. Composites World 2012, La Jolla, CA, Dec 4-6.

[56] U.S. Department of Energy (2013). *2012 Wind Technologies Market Report*. p.14. Retrieved from http://www1.eere.energy.gov/wind/pdfs/2012_wind_technologies_market_report.pdf

[57] U.S. Department of Energy (2011). Hydrogen and Fuel Cells Program Plan. p.3. Retrieved from http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/program_plan2011.pdf

[58] U.S. Department of Energy (2013). Fuel Cells Technology Office Fact Record #13013: *Onboard Type IV Compressed Hydrogen Storage Systems – Current Performance and Cost.* Retrieved from http://www.hydrogen.energy.gov/pdfs/13010_onboard_storage_performance_cost.pdf

$15/kg.[59] The U.S. Drive Hydrogen Storage Technical team indicates that when manufactured in high volumes (500,000 units per year) the largest cost reductions to achieve their 2020 system target of $10/kWhr is expected to come from improvements in carbon fiber manufacturing and utilization of material use, as shown in Figure 3.

The FCTO continues to support R&D to lower carbon fiber costs including the use of alternative feedstock materials, advanced processing techniques for fiber conversion, as well as the use of fillers or additives as well as innovative tank design and manufacturing techniques. Manufacture and validation of these emerging carbon fiber materials in laminate form using high volume advanced processes will be a necessary step in adoption of new fiber technologies and achieving cost targets for compressed gas storage.

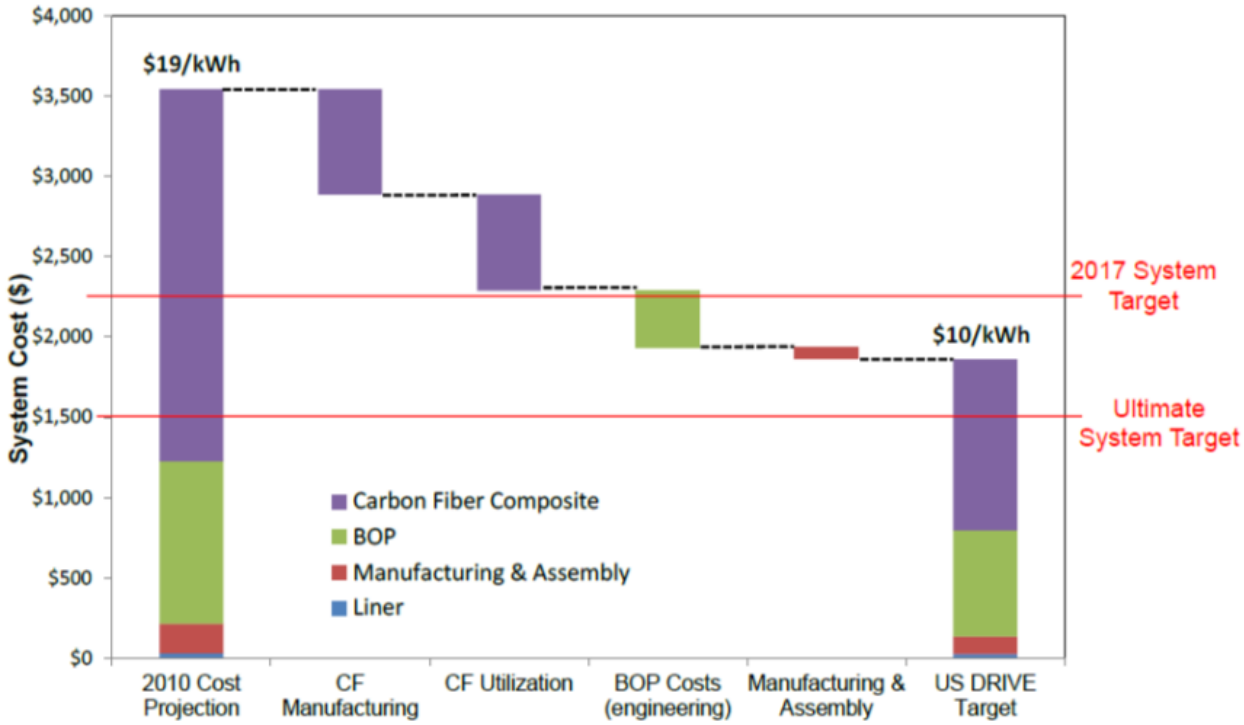

Figure 3. Potential Cost Reduction Strategy for Compressed Vessels to Meet the 2020 U.S. Drive Cost Target (BOP = Balance of Plant).[60]

Other Applications

Industrial equipment and components like heat exchangers, structural materials for buildings, fly-wheels for electricity grid stability, hydrokinetic power generation, support structures for solar systems, shipping containers and other systems can also benefit from lower cost, high strength and stiffness, corrosion resistant, and lightweight composite materials.

[59] Advanced Manufacturing Office estimate based on U.S. Department of Energy (2013). Fuel Cells Technology Office Fact Record #13013: *Onboard Type IV Compressed Hydrogen Storage Systems – Current Performance and Cost.* Retrieved from http://www.hydrogen.energy.gov/pdfs/13010_onboard_storage_performance_cost.pdf

[60] US Drive (2013). Hydrogen Storage Technical Team Roadmap. Figure 3. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/hstt_roadmap_june2013.pdf

Applicants may propose additional target application areas and economic and technical targets provided they can clearly demonstrate how effort in those areas will support the overall Institute objectives.

Composite Manufacturing

To gather information on technology development needs for fiber reinforced polymer composite manufacturing and obstacles to broader use of fiber reinforced polymer composites, AMO issued a Request for Information (RFI) in August, 2013.[61] Highlighted results from the RFI are presented here, and further details can be found in the draft RFI results document.[62]

The top five most important R&D areas identified by respondents (combined responses to questions 1 and 2)[63] with technology development needs in TRL/MRL 4-7 for fiber reinforced polymer composites are: high speed production (low cycle times), low cost production (noted by respondents as highly connected to production speed), energy efficient manufacturing, recycling/downcycling technologies, and innovative design concepts.

Respondents also identified a lack of knowledge and high capital costs (re-tooling/equipment costs) as the most significant obstacles they face to increase investement and/or adoption of this technology. Further details in these responses point to a lack of integration with end users, lack of confidence and knowledge at the design stage, and high capital cost for scale up.

In response to the RFI question regarding the most important training and workforce development needs (skills, certifications, etc.) to increase U.S. competitiveness in fiber reinforced composite manufacturing, one need identified by several respondents was for a certified manufacturing/technical workforce including both professional level, re-education of designers and engineers and community college/trade school programs for manufacutring with hands on training. The second need identified by multiple respondents was for an increased focus at universities at both the undergraduate and graduate levels for a range of knowledge areas relevant to composite manufacturing including: materials science courses focused on composites (rather than metals), design and simulation for composites, robotics, automation, industrial controls, textiles, interfacial and surface science, and nanomaterials.

High quality material properties data and validated part performance data combined with adequate predictive modeling and simulation tools, design capabilities and technical education could address a lack of knowledge also identified by RFI respondents as an obstacle to broader use of fiber reinforced composite materials and structures.

Feedback from stakeholders in the manufacturing community obtained through four regional "Designing for Impact" workshops hosted by the Advanced National Program Office (AMNPO)

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[61] U.S. Department of Energy (2013). Advanced Manufacturing Office. *Request for Information-Fiber Reinforced Polymer Composite Manufacturing.* https://eere-exchange.energy.gov/FileContent.aspx?FileID=2cdd73ca-ac48-442e-8a5d-92b74cb68299

[62] U.S. Department of Energy. Advanced Manufacturing Office. RFI DE-FOA-0000980 Results Summary Document. http://www1.eere.energy.gov/manufacturing/pdfs/composites_rfi_results_summary.pdf

[63] U.S. Department of Energy (2013). Advanced Manufacturing Office. *Request for Information-Fiber Reinforced Polymer Composite Manufacturing.* https://eere-exchange.energy.gov/FileContent.aspx?FileID=2cdd73ca-ac48-442e-8a5d-92b74cb68299

and responses to the formal Request for Information released by the AMNPO in 2012 identify composites as a technology area suitable for a manufacturing innovation institute in which they would invest as an industrial partner.[64]

AMO issued a second Request for Information in December 2013 and the information submitted as comments for public release by respondents can be found on the AMO website: http://www1.eere.energy.gov/manufacturing/resources/index.html.

Institute Technical Focus Areas

AMO has identified three main focus areas for RD&D within the Institute: manufacturing throughput without degrading performance, energy use for composite materials and structures fabrication and recyclability for both in-process scrap and end-of-use. Additional enabling technologies and approaches to support improvements to composite manufacturing are discussed below. Translation and expansion on the knowledge and best practices available from high value-add first markets like aerospace would accelerate transition of this technology into clean energy and energy impactful industrial applications. Conversely, it is anticipated that the improvements to composite manufacturing for clean energy and industrial applications will have benefit and impact beyond the areas identified in this paper.

Speed

Technical and non-technical limitations to manufacturing composites at high speed (throughput) contribute to the high cost of composite components which restricts their broader application. As an example, carbon fiber composite components are currently in use on higher end vehicles in smaller production runs (<50,000 units/yr). Wider adoption is limited by the inability of manufacturing processes to meet the <3 minute cycle time needed for incorporation into larger vehicle production runs (>100,000 units/yr). One current technology used today for low to mid production volume vehicle parts has a <20min cycle time,[65] although <2mins cycle time has been shown at lab scale.[66] Current glass fiber composite manufacturing is also not competitive with the production throughput rates of metal stamping and a target of <5 minute cycle times for glass fiber composites by 2025 has been identified for high-volume automotive applications.[67] Reduction cycle time by the introduction of high-end processes has been identified as a cost-driver to enable increased use of glass and carbon fiber composites for wind turbine applications.[68]

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[64] Advanced Manufacturing National Program Office. Website. http://www.manufacturing.gov/rfi_responses.html

[65] Composites World. Accessed October 3, 2013. http://www.compositesworld.com/news/plasan-sheds-light-on-its-automotive-composites-work-in-michigan

[66] Dow Automotive Systems. YouTube Video Published October 1, 2013. Live demonstration of Dow Automotive Systems VORAFORCE 5300 epoxy formulation for high-speed mass production of light-weight structural carbon-fiber automotive composites, via high-pressure resin transfer molding (RTM) process. Demonstration part: 540 x 290 x 2mm, 50vol% carbon fiber content. Total cycle time ~80 seconds. http://www.youtube.com/watch?v=lgtjkpySvhY

[67] U.S. Department of Energy, Vehicles Technology Office (2012). Lightduty Vehicles Workshop Report. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf P.32 Table 10.

[68] Watson, J. and Serrano, J. (2010). *Composite Materials for Wind Blades.* p.51 http://windsystemsmag.com/article/detail/149/composite-materials-for-wind-blades

Improvements in automation, with high repeatability and further advancements of continuous processes such as tape and fiber placement systems, high speed resin transfer systems, pultrusion, high speed molding systems and new innovative processes with faster lay-up times and cure cycles to meet manufacturing rates and quality requirements are needed and will be an important RD&D focus area of the Institute. Use of innovative curing technologies (e.g. microwave, ultraviolet, electron beam, etc.) and integrated manufacturing approaches are also potential areas of R&D for the Institute.

Energy

Carbon fiber used today from aerospace to automotive, is primarily made from Polyacrylonitrile (PAN) based precursors. The conversion of the precursor PAN fiber to carbon fiber is energy intensive. In addition energy is used to manufacture the final composite piece, where layers of fiber and resin material are typically heated and pressed into a final laminate part. One study estimates that carbon fiber composites are 3-5x more energy intensive than conventional steel on a weight basis.[69] With the anticipated growth of carbon fiber composites over the next 10 years,[70] it will be increasingly important to reduce the energy use in the manufacturing of carbon fiber composites for all applications. AMO estimates that a 60% reduction in embodied energy of carbon fiber composites (relative to today's commercial technology) would shorten the time to realize use phase energy savings from lightweighting (and related greenhouse gas emissions reductions) by approximately 7 to 10 years for applications in the automotive sector.[71]

To achieve the energy targets identified in this FOA, the Institute will likely investigate a mix of strategies. One approach could be to reduce the energy used in the composite manufacturing process directly. Development and demonstration of improved selective heating, optimized cure cycles and further advancement of out-of-the-autoclave techniques are potential ways to reduce the energy used in composite manufacturing. As an example, a previous R&D project sponsored by EERE demonstrated an induction heating technology that resulted in estimated manufacturing energy savings of 40-75% for representative wind, automotive and aerospace parts.[72] A second approach could be through the use of alternative raw materials that require less energy to produce. The Bioenergy Technology Office's *Renewable, Low-Cost Carbon Fiber for Lightweight Vehicles: Summary Report* discusses potential alternative materials and technical challenges to drop in bio-based and unconventional fiber materials that may have lower embodied energy (and potentially cost) relative to existing PAN based technologies.[73]

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[69] Suzuki and Takahashi (2005). *Prediction of Energy Intensity of Carbon Fiber Reinforced Plastics for Mass-Produced Passenger Cars.*

[70] Composites World. Website. http://www.compositesworld.com/articles/carbon-fiber-market-gathering-momentum

[71] AMO internal analysis.

[72] U.S. Department of Energy (2011). Industrial Technologies Office Report DOE/EE-0389. Retrieved from http://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/eip_report.pdf

[73] U.S. Department of Energy, Bioenergy Technology Office (2013). *Renewable, Low-Cost Carbon Fiber for Lightweight Vehicles: Summary Report.* Retrieved from http://www1.eere.energy.gov/bioenergy/pdfs/carbon_fiber_summary_report.pdf

Recycling

The ability to reuse fibers and a strong recycling and reuse market can have a significant positive impact on the life-cycle energy and greenhouse gas footprint for composites, as well as cost.[74] Many carbon fiber and glass fiber composites today use thermoset polymer matrix materials. These composites are difficult to recycle because the temperatures required to separate the matrix material from the fiber can damage the fibers and leave residue that makes the fibers more difficult to reprocess. The increased use of thermoplastic matrix materials offers the potential for improved recyclability but face technical challenges with respect to temperature stability, moisture sensitivity, mechanical stability and final surface quality, among other issues.

Few technologies are currently available to recycle carbon fiber composites, primarily pyrolysis, a wet chemical process and a microwave based technology that was demonstrated at pilot scale in the U.S.[75] Innovative technologies are needed to continue to improve the recyclability of composites at a cost and performance competitive with virgin material with energy-efficient processes.[76] Further improvements to recycling technologies, demonstration and qualification of high quality recycled fiber materials at lower cost, demonstration of thermoplastic materials have the potential to help expand this market further and reduce the life-cycle energy impact and cost of fiber reinforced composite materials.

Enabling Technologies and Approaches

To achieve the targets of the FOA and have widespread impact to adoption of composites in industry, additional enabling technology development and approaches may be incorporated into the Institute activities to support the main manufacturing focus.

Innovative Design Concepts

The number of parts and the design of a system directly affect cost and manufacturability. Innovative design concepts that consolidate smaller parts into a single part may result in lower manufacturing costs. Composite systems are often overdesigned, adding cost and weight, due to the variability in material properties and lack of information and validated design models. Examples of innovative design approaches that could impact cost, manufacturability and energy use might include, material optimization, structural redesign, multi-functionality of parts, (for example use of composite material for strength as well as electrical shielding of embedded electrical control circuits). Designing damage tolerant composite structures is a standard practice for aerospace applications. As design requirements and concepts are developed for lower value-add applications, the effects of damage will need to be addressed. Fire mitigation concepts may also need to be considered to achieve the goals of this FOA. Design tools that address reliability trade-offs without increasing composite part cost will be essential in cost-sensitive applications.

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[74] Suzuki and Takahashi (2005). *Prediction of Energy Intensity of Carbon Fiber Reinforced Plastics for Mass-Produced Passenger Cars.*

[75] http://www.reinforcedplastics.com/view/8116/launching-the-carbon-fibre-recycling-industry/

[76] Pickering, *et.al. Low Cost, High Value Reuse of Recovered Carbon Fibres.* p.433. SAMPE 2013 Proceedings: Education & Green Sky – Materials Technology for a Better World. Long Beach, CA, May 6-9, 2013. Society for the Advancement of Material and Process Engineering.

Modeling and Simulation Tools

Modeling and simulation tools for materials as well as the process can speed the development cycle for new manufacturing processes, innovative designs and assembly techniques. In addressing modeling and simulation development, the Institute should leverage past work and other ongoing efforts supported by DOE, other federal agencies and programs to the greatest practical extent. One example of significant progress in this area is the Composite Materials Handbook 17, a compilation of data, standards and design practices for composite materials and structures primarily for aircraft though expanding into automotive.[77] Another example is modeling and simulation work sponsored by the DOE VTO to develop predictive engineering tools for injection-molded long-carbon-fiber thermoplastic composites.[78] While progress has been made in the modeling of composites, additional development is still needed, as even for mature industries "existing gaps in modeling preclude the goal of being able to predict a composite system's properties based purely on knowledge of the individual constituents and the processing history."[79] Design automation tools that address reliability trade-offs without increasing the composite part cost will be essential in these cost-sensitive applications.

Effective Joining

The use of multi-material structures and optimized designs can result in reduced weight or improved system performance. Joining different and novel materials presents challenges that include thermal expansion mismatch, limited temperature and load ranges for joined structures, reduced strength, joint performance and reparability, directionality of composite materials, nondestructive evaluation of bonded joints, the need for surface preparation, and long times to complete joining. Technology development is needed for fast, reliable techniques for joining materials and structures.[80] Such new joining methods must also avoid degradation of the resulting composite structure for broad applications. Joining techniques should contribute to the reduction in life-cycle energy use and be compatible with processes and manufacturing rates on the factory floor.

Defect Detection

Identifying manufacturing defects in components and structures is an important issue for composite systems. The components (matrix, fiber) of a composite retain their original state when combined to form the new material, making it challenging to identify defects in the heterogeneous composite material. Since undetected manufacturing defects can significantly degrade part performance, advancements in non-destructive evaluation methods to understand as-manufactured part performance and in-situ sensors for process control to prevent defect formation is required. Technologies exist for non-destructive evaluation of composites but new thinking may be required to adapt to specific material sets and

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[77] Composite Materials Handbook 17 Website. Accessed October 3, 2013. http://www.cmh17.org/documents.aspx

[78] Pacific Northwest National Laboratory (2013). Report PNNL-22301. *Predictive Engineering Tools for Injection-Molded Long-Carbon-Fiber Thermoplastic Composites.* Retrieved from http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-22301.pdf

79 National Research Council (2012). *Application of Lightweighting Technology to Military Aircraft, Vessels and Vehicles.* p120. The National Academies Press.

[80] U.S. Department of Energy, Vehicles Technology Office (2012). Lightduty Vehicles Workshop Report. Retrieved from http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf p.11.

improvements. Defect detection and remediation at high manufacturing throughputs is a significant product quality and cost challenge in many technologies and improvements will need to be made to accommodate high speed production and larger size components, in particular for wind blades.

Funding Opportunity Announcement Goals

The goal of this FOA is to establish a Clean Energy Manufacturing Innovation Institute for Composite Materials and Structures that will support U.S. prosperity and security; and contribute to the creation of the National Network for Manufacturing Innovation. The vision for the Institute is to help revitalize American manufacturing and support domestic manufacturing competitiveness.

The overall objectives of the Institute over a ten year time frame are to:

i) double the energy productivity[81] of fiber reinforced polymer composite manufacturing;
ii) reduce life cycle energy use and associated greenhouse gas emissions for targeted application areas;
iii) increase domestic production capacity;
iv) increase jobs for American workers; and
v) support regional economic development.

The technical topic area for this Institute is low-cost, high-speed, energy efficient manufacturing and recycling of fiber reinforced polymer composites. The Institute will target continuous or discontinuous, primarily carbon fiber or glass systems, with thermoset or thermoplastic resin materials.

The quantitative technical objectives of the R&D work of the Institute are to:

i) Reduce production cost of finished carbon fiber composites for targeted applications (vehicles, wind, high-pressure gas storage at a minimum) by >25% in five years, on a pathway to a reduction of cost >50% over ten years;[82]
ii) Demonstrate production of fiber reinforced polymer composites with cost and embodied energy parity to today's glass fiber technology[83] and performance of today's carbon fiber composites for target application areas and relevant production speed in five years; [82,84]
iii) Demonstrate technologies, at sufficient scale, that reduce the embodied energy[85] (and associated greenhouse gas emissions) of carbon fiber composites by 50% compared to today's technology on a pathway to 75% reduction in ten years;[86] and

[81] See Appendix A for a definition of energy productivity.
[82] Data for key application areas for clean energy are provided in Table 2 with more specific proposed cost targets for carbon fiber composites at representative performance requirements and production volumes.
[83] See Table 1 for representative values.
[84] This target addresses potentially viable innovative manufacturing research agnostic to fiber reinforcements.
[85] Embodied energy refers to the energy required to make the materials and manufacture a composite part, it does not include distribution, use phase or end-of-life energy consumption of a product.
[86] Literature estimates that thermoset composites (234 MJ/kg) have higher embodied energy than thermoplastics (155 MJ/kg), indicating further energy reduction is required for thermoset composites. Data Source: Suzuki and

iv) Demonstrate technologies, at sufficient scale, for >80% recyclability or reuse of fiber reinforced polymer composites in five years into useful components with projected cost and quality at commercial scale competitive with virgin materials on a pathway to >95% recyclability or reuse starting in ten years.

At a minimum, the Applicant is expected to propose work to address the primary focus of the Institute within the three target application areas identified in the FOA. Applicants may propose to address additional applications and other fiber reinforcements (e.g. biobased, natural fibers, cellulosic materials, etc.) but must justify the benefit of this additional work along a pathway towards achieving the goals of this FOA. The Applicant must identify clear milestones (cycle time, energy intensity/embodied energy, repeatability, high volume cost estimate, performance targets, etc.) and how the Institute will demonstrate progress towards the defined targets for the award period at regular intervals and show a path to achieve the long term goals identified post award period. For any and all proposed application areas, it is strongly encouraged to have end users/OEMs from the relevant industries included in the Institute, demonstrating market pull and technical relevance for subsequent technology transfer and commercial adoption.

Takahashi (2005). *Prediction of Energy Intensity of Carbon Fiber Reinforced Plastics for Mass-Produced Passenger Cars.* pp.16-17.

Application	Estimated Current CFC Cost	Institute CFC Cost Reduction Target (2018)[88]	CFC Ultimate Cost Target[87] (2024)	CFC Tensile Strength	CFC Stiffness	Production Volume Cycle Time
Vehicles (Body Structures)	$26-33/kg[88]	>35%[89]	<$11/kg by 2025[89] ~60%	0.85GPa[90] (123ksi)	96GPa[91] (14Msi)	100,000 units/yr <3min cycle time (carbon) <5min cycle time (glass)[89,90]
Wind (Blades)	$26/kg[91]	>25%[93]	$17/kg[92] ~35%	1.903 GPA (276ksi)[93]	134GPa (19.4Msi)[94]	10,000 units/yr (at >60m length blades)[90]
Compressed Gas Storage (700 bar – Type IV)	$20-25/kg[94]	>30%[90]	$10-15/kg ~50%[95]	2.55 Gpa (370ksi)[95]	135 Gpa (20Msi)[96]	500,000 units/yr (carbon fiber)[95]

Table 2. Institute cost targets for carbon fiber composites (CFC) for key application areas at relevant production targets and representative strength and stiffness values for 0-degree unidirectional laminates.

[87] Cost targets are at identified production volumes and performance targets with consistent quality and repeatability.

[88] Data identified by workshop participants, as published in VTO Report, these are not indicative of VTO program targets. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/wr_ldvehicles.pdf

[89] AMO RFI responses indicate 60-80% cost reduction to current niche costs for automotive, >25% cost reduction for >60m blades at 10,000 units a year and a 30% cost reduction to current for hydrogen storage tanks.

[90] AMO estimate of 0-degree unidirectional composite laminate strength for 60% fiber volume fraction and epoxy resin based on VTO carbon fiber targets of 250ksi tensile strength and 25MSI modulus. http://www1.eere.energy.gov/vehiclesandfuels/pdfs/program/2012_lightweight_materials.pdf. Assumes a 49% effective strength and 58% effective stiffness reduction when comparing fiber to composite.

[91] Cost estimate based on input to Sandia National Laboratory Wind Blade Cost Estimate Tool ~$26.4/kg prepreg.

[92] Sandia National Laboratory Report 2013-2734, *Large Blade Manufacturing Cost Studies Using the Sandia Blade Manufacturing Cost Tool and Sandia 100-meter Blades,* Griffith and Johanns, p.27 indicates for a 100m blade based on a carbon spar cap design, that the material cost of the carbon fiber prepreg would need to be reduced by 34% from the assumed value to have an equivalent cost as an all fiberglass blade design.

[93] Panex 35 prepreg selected as a representative material for material suitable for wind blade applications. http://www.compositesworld.com/articles/carbon-fiber-in-the-wind. Properties from Zoltek data sheet for Panex 35 Prepreg Unidirectional Tape http://www.zoltek.com/wp-content/uploads/2012/06/Prepreg-TDS.pdf

[94] AMO estimates of CFC cost based on Fuel Cells Fact Sheet information based on type IV tank holding 5.6kg H2 at 700bar, and 91kg of CFC used per tank at 500,000/yr production targets. $17/kWhr estimate of $20-25/kg CFC based on Current Price information and $10-15/kg CFC for the $8/kWhr Ultimate Target. http://www.hydrogen.energy.gov/pdfs/13010_onboard_storage_performance_cost.pdf

[95] Material data sheet for reference material in the Fuel Cell Technologies Office Record #: 13010 Toray T700 + Toray 250F Epoxy Resin 60% fiber volume; http://www.toraycfa.com/pdfs/T700SDataSheet.pdf

To achieve these objectives and goals, consistent with the technical topic area as described and the Clean Energy Manufacturing Institute goals, the Institute created through this FOA will:

a) become a financially self-sustaining, world-leading innovation hub, preferably managed by an independent, not-for profit entity, that brings together private and public entities to develop and accelerate adoption of innovative next generation manufacturing technologies;

b) establish an Institute leadership team with the demonstrated experience and capability to execute and manage diverse technical and manufacturing RD&D teams, recruit and manage a complex industrial partnership to address pre-competitive manufacturing challenges, establish benchmarks and assessment tools for projects management and build a culture of team oriented collaborative execution and delivery of results;

c) support a core set of shared RD&D infrastructure that provides a clear center of gravity for the Institute and enables affordable access to physical and virtual tools, as well as expertise, to reduce the cost and risk of commercialization, address technical challenges that may arise from scale-up and production at a manufacturing relevant scale and provide data to enable business case and value proposition development;

d) establish, execute and report a process for convening stakeholders and developing a multi-year industry roadmap for the manufacturing technology or make substantial contributions to an existing roadmap effort including periodic update to the roadmap (annual or bi-annual);

e) establish, execute and assess an annually reviewed manufacturing RD&D technical strategic plan for the institute, reflective of addressing an industry roadmap, that enables applied projects (TRL/MRL 4-7) that support new processes, equipment, design tools, and capabilities for innovative production or materials technologies; accelerate certification and qualification of processes and products; maintain data and models and develop testing protocols and standard as appropriate for the technology area; and provide quantitative and measurable progress towards the quantitative goals of this FOA;

f) define clear and transparent Institute by-laws, policies and strategies for participation of a wide range of stakeholders in the Institute, in particular, to engage Small and Medium Enterprises (SMEs) through outreach and intermediaries, including programs like the National Institute of Standards and Technology Manufacturing Extension Partnership (NIST MEP) network where appropriate, and provide sufficient financial and contractual mechanisms and a plan to engage stakeholders along the supply chain, including end-users, to benefit from the Institute resources and support a strong domestic integrated supply chain;

g) provide capabilities for and collaboration on open, pre-competitive work, among multiple parties in an Intellectual Property (IP) protected environment, as well as proprietary activities as appropriate to engage stakeholders as relevant to the technology area;

h) establish a technical education and workforce development plan to support technical and career education that will leverage relevant existing resources like the National Science Foundation Advanced Technology Education (NSF ATE) Centers and the Department of

Labor Trade Adjustment Assistance Community College and Career Training (TAACCCT) Program, industry validated certifications and apprenticeship programs, etc. to develop the workforce needed to serve in our nation's high value, next generation manufacturing facilities, as appropriate to the technology area; and

i) leverage relevant existing private and public sector resources and facilities such as NSF ATE Centers, NIST MEPs, national laboratories, university centers and other government investments.

Note: While the Institute should address higher level education and include these activities in the plan as appropriate, applicants should note that DOE funds can only be used for activities that directly support the project (e.g. costs incurred by graduate students directly supporting the project based on the hours worked).

Applicants with existing facilities and operations must clearly demonstrate how the Institute will differ from the purpose of existing facilities and staff, as well as outline how the proposed new procedures and capabilities are in line with the goals of this FOA. The Institute will not house all possible test, validation and production equipment for integration into all possible end use applications.

The Institute will accelerate market penetration and establish the value proposition for end-use adoption to increase product sales of these next generation manufacturing technologies and retain U.S. leadership through development and support of a fully integrated domestic supply chain. Incorporation of upstream supply chain entities and innovations, for example, use of alternative carbon fibers, novel reinforcement materials, resin development, etc. in order to achieve the objectives of the Institute is permissible to a reasonable extent. Figure 4 is representative of the composite supply chain and indicates intended focus area for the Institute in dark blue with relevant upstream areas in lighter blue.

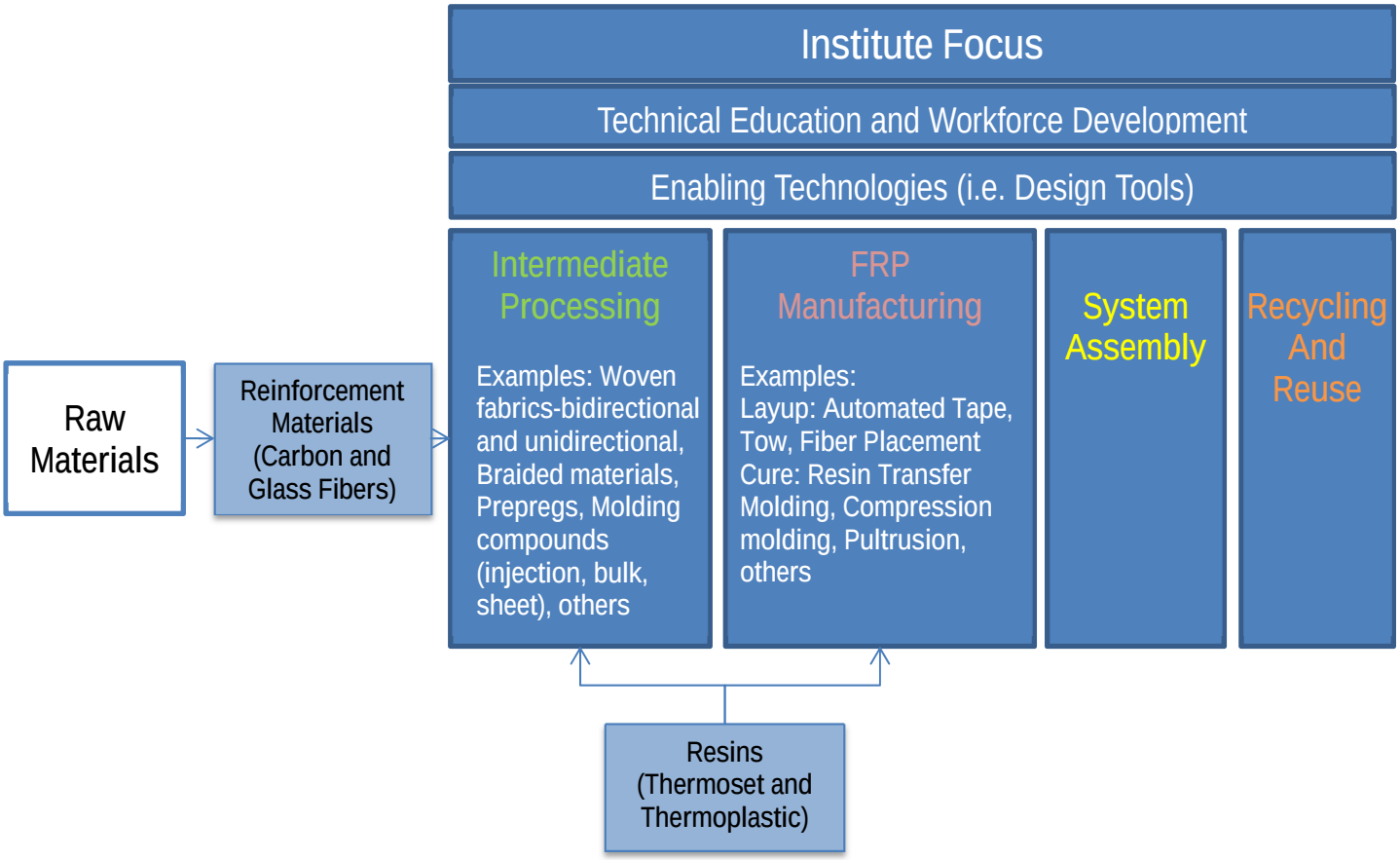

Figure 4. Representative composite supply chain and Institute focus.

Institute Best Practices

DOE has identified several best practices for management and operations that the proposed Institute applicants are expected to align with and plans to address these points are to be included in the project narrative. Deviations from these best practices shall be adequately justified by the applicant with a strong alternative plan.

- The Institute management is expected to be primarily focused on the operation and management of the proposed Institute. The Institute Director/Executive is expected to be a full time position and key management staff (i.e. Deputy Directors) give >75% time commitment to the Institute.

- The Institute organization is encouraged to be an independent, not-for-profit entity that can support and maintain a neutral and non-biased role, during the execution of the institute effort, and during any subsequent period as an industry supported institute.

- In the case where a new not-for-profit entity will be established for the management and execution of the institute, a clear plan and timeline for establishing the not-for-profit institute as a new legal entity during the contract negotiation phase post-selection should be provided.

- As a public-private partnership, the DOE (and other Federal government participants identified by DOE) expects to participate in decision making bodies (boards/committees) at both a strategic and technical level within the Institute.

- The proposed Institute that is the goal of this FOA will be expected to coordinate with, share and establish best practices, and participate in meetings with other institutes for manufacturing innovation established by DOE and other Federal agencies and support the creation of a National Network for Manufacturing Innovation (NNMI). Applicants are to describe the plan for coordination and inclusion of these activities in the future as needed.

- The Institute will be a national leader in the field and the annual planning process will include how the best ideas and new participants will be included in Institute activities. The management and operations plan and budget must include adequate funding and a plan to ensure there is sufficient funding available to encourage openness and new participants as the Institute goes forward. Plans should also include how changes to the strategic plan will be managed to align with roadmaps and enable partnerships with other Federal government agencies.

- The Institute will develop an industry roadmap that is to be updated on an annual or bi-annual basis. In the case of an existing road-mapping organization for an industry, identify mechanisms by which the Institute will substantively contribute to the roadmap and the subsequent roadmap will inform an annual technical strategic plan of the institute. Such a roadmap at a minimum should: project over the period of time of the proposed Institute (preferably beyond), identify and quantify current state of the art practices and possible improvements; identify emerging laboratory scale technologies which have the potential for maturation over the relevant timelines; highlight technical and non-technical challenges or roadblocks to manufacturing; clarify competitive or precompetitive nature of technical or non-technical roadblocks; quantify impacts of new manufacturing technologies (relevant to FOA goals) and possible complimentary technologies or capabilities (e.g. metrology) needed to achieve manufacturing technology goals.

In addition, the Advanced Manufacturing National Program Office has issued two additional draft documents regarding Institutes and the National Network for Manufacturing Innovation, one about Intellectual Property Rights and the other on Performance Metrics. Applicants to this FOA **are not required** to follow the guidance in these documents released by the AMNPO but are encouraged to review them and consider what guidance may be appropriate to incorporate.

The Draft Guidance on Intellectual Property Rights for the National Network for Manufacturing Innovation and Draft Institute Performance Metrics for the National Network for Manufacturing Innovation documents can be found on the AMNPO website http://manufacturing.gov/amnpo_draft_documents.html.

II. AWARD INFORMATION

A. AWARD OVERVIEW

1. ESTIMATED FUNDING

EERE expects to make up to approximately $70,000,000 of Federal funding available for a new award under this FOA subject to the availability of appropriated funds. EERE anticipates making one award under this FOA. EERE may issue one or no awards. The individual award may vary between $35,000,000 and $70,000,000.

EERE will establish budget periods, on an approximate annual basis, for the award and initially fund only the first budget period. Up to $14,000,000 is anticipated to be available for the first budget period. Funding for all budget periods, including the first budget period, is not guaranteed. Before the expiration of each budget period, EERE will perform a Go/No-Go decision review (See FOA, Section VI.C.13). Continued Federal funding will be contingent upon availability of funds appropriated by Congress for the purpose of this program, the availability of future-year budget authority, satisfactory performance, and the Go/No-Go decision review process.

2. PERIOD OF PERFORMANCE

EERE anticipates making one award that will run up to 60 months in length. Project continuation will be contingent upon satisfactory performance and go/no-go decision review. At the go/no-go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, strategic plan execution and assessment processes and overall contribution to the program goals and objectives. As a result of this evaluation, EERE will make a determination to continue funding the project, re-direct the project, or discontinue funding the project.

3. NEW APPLICATIONS ONLY

EERE will accept only new applications under this FOA. EERE will not consider applications for renewals of existing EERE-funded awards through this FOA.

B. EERE FUNDING AGREEMENTS

Through Cooperative Agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the United States Government.

1. COOPERATIVE AGREEMENTS

Through Cooperative Agreements, EERE provides financial or other support to accomplish a public purpose of support or stimulation authorized by Federal statute. Under Cooperative Agreements, the Government and Prime Recipients share responsibility for the direction of projects.

EERE has substantial involvement in all projects funded via Cooperative Agreement. See Section VI.C.8 of the FOA for more information on what substantial involvement may involve.

2. FUNDING AGREEMENTS WITH FFRDCS

In most cases, Federally Funded Research and Development Centers (FFRDC) are funded independently of the remainder of the Project Team. The FFRDC then executes an agreement with any non-FFRDC Project Team members to arrange work structure, project execution, and any other matters. Regardless of these arrangements, the entity that applied as the Prime Recipient for the project will remain the Prime Recipient for the project.

3. RESERVED

4. TECHNOLOGY INVESTMENT AGREEMENTS

If determined appropriate, EERE will consider awarding a Technology *Investment Agreement (TIA) to a non-FFRDC applicant. TIAs, governed by 10 CFR Part 603, are* assistance instruments used to increase the involvement of commercial entities in the Department's research, development, and demonstration programs. A TIA may be either a type of cooperative agreement or an assistance transaction other than a cooperative agreement, depending on the intellectual property provisions. In both cases, TIAs are not necessarily subject to all of the requirements of 10 CFR Part 600.

In a TIA, EERE may modify the standard Government terms and conditions, including but not limited to:

- Intellectual Property Provisions: EERE may negotiate special arrangements with Recipients to avoid the encumbrance of existing intellectual property rights or to

facilitate the commercial deployment of inventions conceived or first actually reduced to practice under the EERE funding agreement.

- Accounting Provisions: EERE may authorize the use of generally accepted accounting principles (GAAP) where Recipients do not have accounting systems that comply with Government recordkeeping and reporting requirements.

EERE will be more amenable to awarding a TIA in support of an application from a consortium or a team arrangement that includes cost sharing with the private sector, as opposed to an application from a single organization. Such a consortium or teaming arrangement could include a DOE/NNSA FFRDC, other Federal agency, or other Federal agency FFRDC. If the DOE/NNSA FFRDC is a part of the consortium or teaming arrangement, the value of, and funding for the DOE/NNSA FFRDC portion of the work will be authorized and funded under the DOE field work authorization system and performed under the laboratory's Management and Operating contract. Funding for another Federal agency or its FFRDC would be through an interagency agreement under the Economy Act or other statutory authority. Other appropriate contractual accommodations, such as those involving intellectual property, may be made through a "funds in" agreement to facilitate the FFRDCs participation in the consortium or teaming arrangement. If a TIA is awarded, certain types of information described in 10 CFR 603.420(b) are exempt from disclosure under the Freedom of Information Act for five years after DOE receives the information.

An applicant may request a TIA if it believes that using a TIA could benefit the RD&D objectives of the program (see section 10CFR 603.225) and can document these benefits. If an applicant is seeking to negotiate a Technology Investment Agreement, the applicant must include an explicit request in its Full Application. After an applicant is selected for award, the Contracting Officer will determine if awarding a TIA would benefit the RD&D objectives of the program in ways that likely would not happen if another type of assistance agreement (e.g., cooperative agreement subject to the requirements of 10 CFR Part 600). The Contracting Officer will use the criteria in 10 CFR 603, Subpart B, to make this determination.

III. ELIGIBILITY INFORMATION

To be considered for substantive evaluation, an applicant's submission must meet the criteria set forth below. If the submission does not meet these requirements it will be considered ineligible and not considered for further evaluation.

A. ELIGIBLE APPLICANTS

1. INDIVIDUALS

U.S. citizens and lawful permanent residents are eligible to apply for funding as a Prime Recipient or Subrecipient.

2. *DOMESTIC ENTITIES*

For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular State or territory of the United States are eligible to apply for funding as a Prime Recipient or Subrecipient. Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995, are not eligible to apply for funding.

State, local, and tribal government entities are eligible to apply for funding as a Prime Recipient or Subrecipient.

DOE/NNSA Federally Funded Research and Development Centers (FFRDCs) are eligible to apply for funding as a Prime Recipient or Subrecipient.

Non-DOE/NNSA FFRDCs are eligible to apply for funding as a Subrecipient, but are not eligible to apply as a Prime Recipient.

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

3. *FOREIGN ENTITIES*

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA.

Other than as provided in the "Individuals" or "Domestic Entities" sections above, all Prime Recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. If a foreign entity applies for funding as a Prime Recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a State or territory of the United States to be the Prime Recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

Foreign entities may request a waiver of the requirement to designate a subsidiary in the United States as the Prime Recipient in the Full Application (i.e., a foreign entity may request that it remains the Prime Recipient on the award). To do so, the Applicant must submit an explicit waiver request in the Full Application, which includes the following information:

- Entity name;
- Country of incorporation;
- Description of the work to be performed by the entity for whom the waiver is being requested; and
- Countries where the work will be performed.

In the waiver request, the Applicant must demonstrate to the satisfaction of EERE that it would further the purposes and objectives of this FOA and is otherwise in the interests of EERE to have a foreign entity serve as the Prime Recipient. The Contracting Officer may require additional information before considering the waiver request. Save the waiver request(s) in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_Waiver". The Applicant does not have the right to appeal this decision concerning a waiver request.

A foreign entity may receive funding as a Subrecipient.

4. INCORPORATED CONSORTIA

Incorporated consortia, which may include domestic and/or foreign entities, are eligible to apply for funding as a Prime Recipient or Subrecipient. For consortia incorporated (or otherwise formed) under the laws of a State or territory of the United States, please refer to "Domestic Entities" above. For consortia incorporated in foreign countries, please refer to the requirements in "Foreign Entities" above.

Each incorporated consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the EERE Contracting Officer.

5. UNINCORPORATED CONSORTIA

Unincorporated Consortia, which may include domestic and foreign entities, must designate one member of the consortium to serve as the Prime Recipient/consortium representative. The Prime Recipient/consortium representative must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. The eligibility of the consortium will be determined by the eligibility of the Prime Recipient/consortium representative under Section III.A of the FOA.

Upon request, unincorporated consortia must provide the EERE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortiums:

- Management structure;
- Method of making payments to consortium members;
- Means of ensuring and overseeing members' efforts on the project;
- Provisions for members' cost sharing contributions; and

- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

B. COST SHARING

The cost share must be at least 50% of the total allowable costs for demonstration projects (i.e., the sum of the Government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-Federal sources unless otherwise allowed by law. (See 10 CFR 600.30 for the applicable cost sharing requirements.)

To assist Applicants in calculating proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation as Appendices B and C to this Funding Opportunity Announcement.

1. LEGAL RESPONSIBILITY

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the Prime Recipient, the Prime Recipient is legally responsible for paying the entire cost share. The Prime Recipient's cost share obligation is expressed in the Assistance agreement as a static amount in U.S. dollars (cost share amount) and as a percentage of the Total Project Cost (cost share percentage). If the funding agreement is terminated prior to the end of the project period, the Prime Recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The Prime Recipient is solely responsible for managing cost share contributions by the Project Team and enforcing cost share obligation assumed by Project Team members in subawards or related agreements.

2. COST SHARE ALLOCATION

Each Project Team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual Project Team members may vary, as long as the cost share requirement for the project as a whole is met.

3. COST SHARE TYPES AND ALLOWABILITY

Every cost share contribution must be allowable under the applicable Federal cost principles, as described in Section IV.I.1 of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

Project Teams may provide cost share in the form of cash or in-kind contributions. Cash contributions may be provided by the Prime Recipient or Subrecipients. Allowable in-kind

contributions include, but are not limited to: personnel costs, indirect costs, facilities and administrative costs, rental value of buildings or equipment, and the value of a service, other resource, or third party in-kind contribution.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding was not provided to the state or local government by the Federal Government.

The Prime Recipient may not use the following sources to meet its cost share obligations including, but not limited to:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;
- Federal funding or property (e.g., Federal grants, equipment owned by the Federal Government); or
- Expenditures that were reimbursed under a separate Federal program.

In addition, Project Teams may not use independent research and development (IR&D) funds to meet their cost share obligations. Project Teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the Prime Recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same Federal regulations as Federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 10 CFR Parts 600 and 603 for additional guidance on cost sharing, specifically 10 CFR §§600.30, 600.123, 600.224, 600.313, and 603.525-555.

4. COST SHARE CONTRIBUTIONS BY FFRDCS

Because FFRDCs are funded by the Federal Government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or another non-Federal source.

5. *COST SHARE VERIFICATION*

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, Applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to Appendix B of the FOA for guidance on the requisite cost share information and documentation.

6. *COST SHARE PAYMENT*

All proposed cost share contributions must be reviewed in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

EERE requires Prime Recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the Prime Recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated).

In limited circumstances, and where it is in the government's interest, the EERE Contracting Officer may approve a request by the Prime Recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the Prime Recipient must be up-to-date on cost share at each interval. Such requests must be sent by email to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the Prime Recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they may go into effect.

C. COMPLIANCE CRITERIA

To be considered for substantive evaluation, an applicant submission must meet the Compliance criteria set forth below. **Concept Papers, and Full Applications must meet all Compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions**, including Letters of Intent, Concept Papers, Full Applications, and Replies to Reviewer Comments that were: submitted through means other than EERE Exchange; submitted after the applicable deadline; and/or submitted incomplete. EERE will not extend the submission deadline for Applicants that fail to submit required information due to server/connection congestion.

1. *COMPLIANCE CRITERIA*

i. Concept Papers

Concept Papers are deemed compliant if:

- The Applicant successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in this FOA
- The Concept Paper complies with the content and form requirements in Section IV.C of the FOA; and
- Must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

ii. Full Applications

Full Applications are deemed compliant if:

- The Applicant submitted a compliant Concept Paper;
- The Full Application complies with the content and form requirements in Section IV.D of the FOA
- The Full Application is limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Full Application; and
- The Applicant entered successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in the FOA.

iii. Replies to Reviewer Comments

Replies to Reviewer Comments are deemed compliant if:

- The Reply to Reviewer Comments complies with the content and form requirements in Section IV.F of the FOA; and
- The Applicant successfully uploaded all required documents to EERE Exchange by the deadline stated in the FOA.

D. NONRESPONSIVE APPLICATIONS

The following types of applications will be deemed nonresponsive and will not be reviewed or considered for any award:

- Applications that fall outside the technical parameters specified in Section I.C of the FOA, including but not limited to:
    - Manufacturing, joining or other techniques solely focused on well established markets such as aerospace applications or applications which have no justified impact to energy goals (i.e. sporting goods);
    - An Institute focused solely on carbon fiber precursor development or carbon fiber conversion technologies, the Institute should leverage and tie into existing R&D efforts for these areas; and
    - An Institute solely focused on polymer or glass chemistry development
    - An Institute that is solely focused on and duplicates large scale final product testing and end use validation that is broadly available such as crash testing, integration of components like a blade into test wind turbines, hydrostatic pressure vessel testing, etc. that already exists.

- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the law of thermodynamics).

- Applications which are not related to the Advanced Manufacturing of Composite Materials and Structures.

E. OTHER ELIGIBILITY REQUIREMENTS

1. REQUIREMENTS FOR DOE/NNSA FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS (FFRDC) LISTED AS THE APPLICANT

A DOE/NNSA FFRDC is eligible to apply for funding under this FOA if its cognizant Contracting Officer provides written authorization and this authorization is submitted with the application. If a DOE/NNSA FFRDC is selected for award, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's Management and Operating (M&O) contract.

The following wording is acceptable for the authorization:

> Authorization is granted for the _____ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.

2. *REQUIREMENTS FOR DOE/NNSA AND NON-DOE/NNSA FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS INCLUDED AS A SUBRECIPIENT*

DOE/NNSA and non-DOE/NNSA FFRDCs may be proposed as a Subrecipient on another entity's application subject to the following guidelines:

i. Authorization for non-DOE/NNSA FFRDCs

The Federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

ii. Authorization for DOE/NNSA FFRDCs

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

> Authorization is granted for the _____ Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.

iii. Value/Funding

The value of and funding for the FFRDC portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and other FFRDC through an interagency agreement with the sponsoring agency.

iv. Cost Share

Although the FFRDC portion of the work is usually excluded from the award to a successful applicant, the applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC's portions of the project.

v. Limit on FFRDC Effort

The scope of work to be performed by the FFRDC may not be more significant than the scope of work to be performed by the applicant.

vi. Responsibility

The Prime Recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the Prime Recipient and the FFRDC contractor.

F. Limitation on Number of Concept Papers and Full Applications Eligible for Review

Applicants may only submit one Concept Paper and one Full Application for consideration under this FOA as the Prime Applicant. The Concept Paper and Full Application must address the topic area identified in Section I.C of the FOA. If an applicant submits more than one Concept Paper or Full Application, EERE will only consider the last timely submission for evaluation. Any other submissions received listing the same applicant will be considered noncompliant and not eligible for further consideration. This limitation does not prohibit an applicant from collaborating on other applications (e.g., as a potential Subrecipient or partner) so long as the entity is only listed as the Prime Applicant on one Concept Paper and Full Application submitted under this FOA.

G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process will include two phases: a Concept Paper phase and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application**. At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths, described below, and must be submitted via EERE Exchange at https://eere-exchange.energy.gov/, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE Exchange, submissions submitted after the applicable deadline, and incomplete submissions**. EERE will not extend deadlines for Applicants who fail to submit required information and documents due to server/connection congestion. Applicants will receive a control number upon submission of their Concept Paper. This control number must be included with all Application documents, as described below.

The Concept Paper, Full Application, and Reply to Reviewer Comments must conform to the following requirements:

- Each must be submitted in Adobe PDF format unless otherwise directed in the FOA.
- Each must be written in English.
- All pages must be formatted to fit on 8.5 x 11 inch paper with margins not less than one inch on every side. Use Times New Roman typeface, a black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10 point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement.
- The Control Number must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page.
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If Applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages.

Applicants are responsible for meeting each submission deadline. **Applicants are strongly encouraged to submit their Concept Papers and Full Applications at least 48 hours in advance of the submission deadline**. Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), Applicants should allow at least 1 hour to submit a Concept Paper, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application or Reply to Reviewer Comments are submitted in EERE Exchange, Applicants may revise or update their submissions until the expiration of the applicable deadline.

EERE urges Applicants to carefully review their Concept Papers, and Full Applications and to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V.A.2 of the FOA.

B. Application Forms

The application forms and instructions are available on EERE Exchange. To access these materials, go to https://eere-Exchange.energy.gov and select the appropriate funding opportunity number.

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:
ControlNumber_LeadOrganization_Project_Part_1
ControlNumber_LeadOrganization_Project_Part_2, etc.

C. CONTENT AND FORM OF THE CONCEPT PAPER

To be eligible to submit a Full Application, Applicants must submit a Concept Paper by the specified due date and time.

1. CONCEPT PAPER CONTENT REQUIREMENTS

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

The Concept Paper must conform to the following content requirements:

SECTION	PAGE LIMIT	DESCRIPTION
Technology Description	[6] pages maximum	Applicants are required to describe succinctly: • The proposed technical approach, including the core focus areas, and how it is unique and innovative; • The proposed technology's target level of performance (Applicants should provide technical data or other support to show how the proposed target could be met); • The current state-of-the-art in the relevant fields and applications, including key shortcomings, limitations, and challenges; • How the proposed integrated Institute approach for the key elements, operations and management, shared RD&D facilities, initial R&D projects, stakeholder engagement and road-mapping efforts, strategic planning, technical education and workforce development and commercialization activities will overcome the shortcomings, limitations, and challenges in the relevant fields and applications; • The potential impact that the proposed Institute would have on the relevant field and applications and U.S. manufacturing competitiveness; • The key technical risks/issues associated with the proposed technology development plan and Institute operations; and • The impact that EERE funding would have on the proposed Institute and rationale for the Institute approach.

Operations and Management Approach Description	[4] pages maximum	Applicants are required to describe succinctly: • The proposed management and operations structure and approach, including the role of the U.S. government in the management of the proposed Institute • The identified key management and technical personnel for the proposed Institute • Strategy for participation of a wide range of stakeholders in the Institute, in particular, to engage with SMEs • IP management plan concept to adequately and appropriately support both collaborative and IP protected work
Addendum	[10] pages maximum	Applicants may provide graphs, charts, or other data to supplement their Technology Description. Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed Project Team, including: • the skills and expertise of the Principal Investigator (PI) and Project Team needed to successfully execute the Institute plan; • Whether the Applicant has prior experience which demonstrates an ability to manage and perform tasks of similar risk and complexity; • Whether the Applicant has worked together with its teaming partners on prior projects or programs; and • Whether the Applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how it intends to obtain access to the necessary equipment and facilities.

EERE will not review or consider ineligible Concept Papers (see Section III of the FOA).

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.1 of the FOA. EERE will encourage a subset of Applicants to submit Full Applications. Other Applicants will be discouraged from submitting a Full Application. An applicant who receives a "discouraged" notification may still submit a Full Application. EERE will review all eligible Full Applications. However, by discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project in an effort to save the Applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

In order to provide Applicants with feedback on their Concept Papers, EERE will include general comments provided from independent reviewers on an Applicant's Concept Paper in the encourage/discourage notification sent to Applicants at the close of that phase.

D. CONTENT AND FORM OF THE FULL APPLICATION

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. Applicants must complete the following application forms found on the EERE Exchange website at https://eere-Exchange.energy.gov/, in accordance with the instructions.

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification to prepare and submit a Full Application. Regardless of the date the Applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.

Applicants will receive a control number upon submission of their Concept Paper, and must include that control number in the file name of their Full Application submission (i.e., Control number_Applicant Name_Full Application)." All Full Application documents must be marked with the Control Number issued to the Applicant.

1. FULL APPLICATION CONTENT REQUIREMENTS

EERE will not review or consider ineligible Full Applications (see Section III of the FOA).

Each Full Application must be limited to a single concept or technology. Unrelated concepts and technologies must not be consolidated in a single Full Application.

Full Applications must conform to the following requirements:

SUBMISSION	COMPONENTS	FILE NAME (IF NECESSARY)
Full Application (PDF, unless stated otherwise)	Technical Volume (See Chart in Section IV.D.2)	ControlNumber_LeadOrganization_TechnicalVolume
	SF-424 (no page limit)	ControlNumber_LeadOrganization_App424
	Budget Justification (EERE 159) (no page limit, Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Budget_Justification
	Summary for Public Release (1 page max)	ControlNumber_LeadOrganization_Summary
	Summary Slide (1 page limit, Microsoft PowerPoint format)	ControlNumber_LeadOrganization_Slide
	Subaward Budget Justification (EERE 159) (no page limit, Microsoft Excel format. Applicants must use the template available in EERE Exchange);	ControlNumber_LeadOrganization_Subawardee_Budget_Justification
	Budget for Federally Funded Research and Development Center Contractor File, (if applicable)	ControlNumber_LeadOrganization_FWP

	Authorization from cognizant Contracting Officer for FFRDC, if applicable	ControlNumber_LeadOrganization_FFRDC Auth
	SF-LLL Disclosure of Lobbying Activities	ControlNumber_LeadOrganization_SF-LLL
	Foreign Entity and Performance of Work in the United States waiver requests (if applicable)	ControlNumber_LeadOrganization_Waiver
	U.S. Manufacturing Plan	ControlNumber_LeadOrganization_USMP
	Draft IP Management Plan	ControlNumber_LeadOrganization_IPP
	Conflict of Interest Statement (if applicable)	ControlNumber_LeadOrganization_COI
	Compliance Matrix	ControlNumber_LeadOrganization_Matrix

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:

ControlNumber_LeadOrganization_Project_Part_1
ControlNumber_LeadOrganization_Project_Part_2, etc.

EERE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.

EERE provides detailed guidance on the content and form of each component below.

2. TECHNICAL VOLUME

The Technical Volume must be submitted in Adobe PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If Applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. This volume must address the Merit Review Criteria as discussed in Section V.A.2 of the FOA. Save the Technical Volume in a single PDF file using the following convention for the title: "ControlNumber_LeadOrganization_TechnicalVolume".

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. EERE and reviewers may review primary research literature in order to evaluate applications. However, EERE and reviewers are under no obligation to review cited sources (e.g., internet websites).

The Technical Volume to the Full Application may not be more than 100 pages, including the cover page, table of contents, and all citations, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation criteria (see Section V.A.2 of the FOA) when preparing the Technical Volume.

SECTION/PAGE LIMIT	DESCRIPTION
Cover Page	The cover page should include the Institute title, both the technical (Institute Director/Executive) and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Institute Overview (This section should constitute approximately 5% of the Technical Volume)	The Institute Overview should contain the following information: • Background: The Applicant should discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application. • Institute Goals: The Applicant should explicitly identify the goals of the Institute and targeted improvements to the baseline technologies and the critical success factors in achieving those goals. • DOE Impact: The Applicant should discuss the impact that DOE funding would have on the proposed Institute. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the Institute objectives.
Technical Description, Innovation, and Impact (This section should constitute approximately 15% of the Technical Volume)	The Technical Description should contain the following information: • Relevance and Outcomes: The Applicant should provide a detailed description of the Institute technology focus, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed Institute to the goals and objectives of the FOA listed in Section I, including the potential to meet specific DOE technical targets or other relevant performance targets. The Applicant should clearly specify the expected outcomes of the Institute. • Feasibility: The Applicant should demonstrate the technical feasibility of the proposed technology developments and capability of achieving the anticipated performance targets, including a description of previous work done and prior results. • Innovation and Impacts: The Applicant should describe the current state of the art in the applicable fields, the specific innovation of the proposed technology developments, the advantages of proposed technology developments over current and emerging technologies, and the overall impact on advancing the state of the art/technical baseline if the Institute is successful. Applicants must provide realistic estimates of the impact of the Institute with respect to the primary and technical objectives. Applicants must estimate the Institute impact on aggregate energy savings (TBTUs), and reduction in GHG (tons of CO_2 equivalents) on a life-cycle basis over ten years relative to existing available technologies for the identified applications and markets. A definition of energy productivity is provided in Appendix A. Applicants must provide justification for all estimates and assumptions. Leveraged resources: The Applicant should illustrate the specific ways in which DOE funding will complement existing physical infrastructure, human capital,

	intellectual property, or other resources and thereby lead to outcomes that are more impactful than these resources would be in isolation. • Technical Education and Workforce Development Plan Summary: The Applicant should summarize the technical education and workforce development plan and how these activities will be incorporated into the overall Institute plan and operations. Details are to be provided in the Workplan section.
Workplan (This section should constitute approximately 40% of the Technical Volume)	The Workplan should contain the following information: • Institute Objectives: The Applicant should provide a clear and concise (high-level) statement of the goals and objectives of the overall Institute and for key elements of the Institute, at a minimum: management and operations; RD&D shared facilities; initial R&D projects; stakeholder engagement and road-mapping efforts; technical education and workforce development; and commercialization activities as well as the expected outcomes for all elements identified. • Technical Scope Summary: The Applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by performance periods that are separated by discrete, approximately annual decision points (see below for more information on go/no-go decision points). The applicant should describe the specific expected end result of each performance period. • Work Breakdown Structure (WBS) and Task Descriptions: The Workplan should fully describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the all Institute goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of tasks and subtasks by performance period (approximately annual), which is typical of a standard work breakdown structure (WBS) for any project. The Workplan shall contain a concise detailed description of the specific activities to be conducted over the life of the Institute. "Detailed" is defined as a full explanation and disclosure of the Institute being proposed (i.e., a statement such as "we will then complete a proprietary process" is unacceptable). The Applicant should show tasks for key elements of the Institute, at a minimum: management and operations; RD&D shared facilities; initial R&D projects; stakeholder engagement and road-mapping efforts; technical education and workforce development; and commercialization activities. It is the Applicant's responsibility to prepare an adequately detailed task plan to describe the proposed Institute and the plan for addressing the objectives of this FOA. To this end each task and subtask is to have a unique number and title and an indication of the duration of the task or subtask in months. Each task and subtask is to have a task summary that describes the objectives, what work is to be accomplished, and relationship to Institute deliverables or expected results. Appropriate milestones should be incorporated into the task and subtask structure. Each task and subtask is to have a technical details section, as appropriate, to discuss how the work will be done,

	anticipated problems or uncertainties, and any further clarification, such as why a specific approach is being taken. An example Work Breakdown Structure is provided in Appendix D. • Milestones: The Applicant should provide appropriate milestones throughout the Institute to demonstrate success, where success is defined as technical achievement rather than simply completing a task. To ensure that milestones are relevant, Applicants should follow the SMART rule of thumb, which is that all milestones should be **S**pecific, **M**easurable, **A**chievable, **R**elevant, and **T**imely. Unless otherwise specified in the FOA, the minimum requirement is that each Institute element identified (at a minimum: operations and management; shared RD&D facilities; R&D projects; stakeholder engagement and road-mapping efforts; technical education and workforce development; and commercialization activities) must have at least one milestone per quarter for the duration of the project (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The Applicant should also provide the means by which the milestone will be verified. In addition to describing milestones in the Workplan text and including them in the schedule, the Applicant is required to complete the Milestone Summary Table shown in Appendix D. • Go/No-Go Decision Points: The Applicant should provide Institute-wide go/no-go decision points at appropriate points in the Workplan. A go/no-go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. Unless otherwise specified in the FOA, the minimum requirement is that each Institute element identified (at a minimum: operations and management; shared RD&D facilities; R&D projects; stakeholder engagement and road-mapping efforts; technical education and workforce development; and commercialization activities) must have at least one project-wide go/no-go decision point for each year (12-month period) of the project. The Applicant should also provide the specific technical criteria to be used to make the go/no-go decision. In addition to describing the go/no-go decision points in the Workplan text and including them in the schedule, the Applicant is required to complete the Milestone Summary Table shown in Appendix D, which must include go/no-go decision points and their method of verification. • Project Schedule (Gantt chart or similar): The Applicant should provide a detailed schedule for the entire Institute award, including task and subtask durations, milestones, and go/no-go decision points. • Project Level Management: The Applicant should discuss the team's proposed management plan for any initial proposed R&D projects or technical work in the RD&D facilities, including the following (overall Institute operations and management is addressed in a separate section):

	○ The overall approach to and organization for managing the work ○ The roles of each Project Team member ○ Any critical handoffs/interdependencies among Project Team members ○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices ○ The approach to project risk management ○ A description of how project changes will be handled ○ If applicable, the approach to Quality Assurance/Control ○ How communications will be maintained among Project Team members • Market Transformation/Commercialization Plan: The Applicant should provide a market transformation/commercialization plan for any initial proposed R&D projects or technical work in the RD&D facilities, including the following: ○ Identification of target market, competitors, and distribution channels for proposed technology developments along with known or perceived barriers to market penetration, including a mitigation plan ○ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan etc., and product distribution.

Technical Qualifications and Resources (Approximately 15% of the Technical Volume)	The Technical Qualifications and Resources should contain the following information: • Describe the Institute Team's unique qualifications and expertise, including those of key subrecipients. • Describe the Institute Team's existing equipment and facilities that will facilitate the successful completion of the proposed Institute; include a justification of any new equipment or facilities requested as part of the Institute. • Applicants must clearly differentiate between existing and anticipated financial or physical resources and how the Institute will operate as a separate entity. • This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the Applicant to achieve the Institute objectives. • Describe the time commitment of the key team members to support the Institute. It is expected that the Institute Director/Executive will be a full time position and that key management staff (i.e. Deputy Directors) will commit >75% of their time Institute activities.

	• Attach one-page resumes for key participating team members as an appendix. Resumes do not count towards the page limit. Multi-page resumes are not allowed. • Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. • Attach any letters of support from partners/end users as an appendix (1 page maximum per letter). Letters of support do not count towards the page limit. • The Applicant must summarize the letters of support in a table in the Technical Volume, clearly defining cost share contributions based on cash, in-kind and other contributions to the Institute with a total calculation for each type of cost share. The cost share summary must also include a breakdown of the source of the funding showing total percent contribution by industry, academia, states and others to the cost share total.
Operations and Management Plan (Approximately 15% of the Technical Volume)	Describe succinctly: • The roles and the work to be performed by the Applicant, each PI and Key Participants including the time commitment by Key Participants and staffing plans. • Business agreements between the Applicant and each PI and Key Participant. • How the proposed Institute will operate as an independent, neutral and non-biased entity to coordinate and convene a broad range of stakeholders (best practice indicates this should be an independent not-for-profit organization). • How the operations and management plan and structure will integrate the individual Institute elements (shared RD&D facilities, initial R&D projects, stakeholder engagement and road-mapping efforts, technical education and workforce development and commercialization activities, etc.) to provide value that is greater than the sum of the individual activities (i.e. how will the shared facilities support the technical education and workforce development plans and project activities). • The plan for coordination and communication with other institutes as they are established and external stakeholder dissemination of knowledge. The proposed Institute that is the goal of this FOA will be expected to coordinate with, share and establish best practices, and participate in meetings with other institutes for manufacturing innovation established by DOE and other Federal Agencies and support the creation of a national network for manufacturing innovation. • The proposed participation structure (i.e. tiered membership structure, pay-for-use arrangements, etc.) and the benefits and restrictions for each level of participation including IP rights. • The industry road-mapping process and mechanism for identification of technical and non-technical challenges appropriate to be addressed by the institute, including quantified targets associated with roadmap goals

	as well as the plan to update the roadmap periodically (annual or bi-annual). • The annual strategic planning and project review/assessment process for the Institute. The process by which the industry roadmap will inform and establish priorities for the institute strategic plan. How the annual planning process will encourage new ideas and participants in the Institute activities. • The process for making decisions on scientific/technical direction including how R&D projects and technical work in the proposed RD&D facilities will be prioritized, relate to road-mapping efforts and how conflicts will be resolved. • The plan to encourage openness and new participants as the Institute goes forward including plans to fund expansion of R&D activities as the Institute evolves. • The plan to keep the Institute relevant and accommodate the strategic changes that may occur to align with the industry roadmap and enable partnerships with other Federal government agencies. • How the Institute with encourage participation by small and medium sized enterprises (examples include providing free or low-cost access to the shared infrastructure, low barrier or no entry fees to membership, job swapping arrangements between Institute and SME staff, engagement of the MEP Centers, etc.). • If the Applicant anticipates significant involvement of foreign-based entities, describe how the Institute will handle participation of foreign-based entities as users, members or otherwise engage in RD&D activities at the Institute or in connection with the Institute to ensure domestic production benefits. • The proposed governance structure and explain how decisions will be made and how any governing entities/advisory boards will function and what authority they will have. • How Federal government will participate in the governance of the Institute. As a public-private partnership, the DOE (and other Federal government participants identified by DOE) expects to participate in decision making bodies (boards/committees) at both a strategic and technical level within the Institute. • Provide a proposed organizational chart to including management structure, Institute Director/Executive, key management staff as well as technical advisory and strategic governance boards. • Proposed Institute metrics, including but not limited to technical targets, impact to U.S. manufacturing, energy productivity goals, management performance, financial performance, industry participation especially SMEs, and education and outreach. At least one performance metric is anticipated for each major Institute element. • How Institute performance will be tracked and evaluated; describe plans for program reviews, etc. frequency and methodology for how

	they will be conducted. • A risk assessment and risk mitigation plan for the technical, economic and operational aspects of the proposed Institute including Intellectual Property management and securing U.S. manufacturing competitiveness.
Summary of Intellectual Property (IP) Management Plan (Approximately 5% of the Technical Volume)	This section of the Project Narrative must include: • A detailed summary of the major points in the draft IP Management Plan submitted as an Appendix and how the IP management plan will support domestic manufacturing and encourage participation by domestic industry in the Institute.
Transition Plan (Approximately 5% of the Technical Volume)	Creation of financially viable organization that will have a significant and enduring impact on the U.S. manufacturing sector is a key goal of the Institute initiative. • Describe the sustainability plan for the proposed Institute past the award period, including realistic strategies to increase revenue in later years of the award period in order to achieve financial self-sufficiency within five years from dedicated Institute funding. • Describe the proposed sources of funding/revenue model which will support the Institute operations beyond the award period. • Explain the strategy to keep the Institute relevant to industry, what resources will support Institute operations beyond the award period and how will manufacturing professionals will be recruited and trained over time to support the Institute. • Provide estimate profit and loss for three years after the initial five year award period demonstrating how the Institute will maintain financial self-sufficiency.

3. SF-424: APPLICATION FOR FEDERAL ASSISTANCE

Complete all required field in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period. Save the SF-424 in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_App424".

4. BUDGET JUSTIFICATION WORKBOOK (EERE 159)

Applicants are required to complete the Budget Justification Workbook. This form is available on EERE Exchange at https://eere-Exchange.energy.gov/. Prime Recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the Prime Recipient and its Subrecipients and Contractors, and provide all requested documentation (e.g., a Federally-approved forward pricing rate agreement, Defense

Contract Audit Agency or Government Audits and Reports, if available). Applicants should include costs associated with required annual audits and incurred costs proposals in their proposed budget documents. The "Instructions and Summary" included with the Budget Justification Workbook will "auto-populate" as the Applicant enters information into the Workbook. Applicants must carefully read the "Instructions and Summary" tab provided within the Budget Justification Workbook. Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Budget_Justification".

5. SUMMARY/ABSTRACT FOR PUBLIC RELEASE

Applicants are required to submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identified the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a description of the project, including methods to be employed, the potential impact of the project (i.e., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as the Department may make it available to the public after selections are made. The project summary must not exceed 1 page when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 11 point. Save the Summary for Public Release in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Summary".

6. SUMMARY SLIDE

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format. This slide is used during the evaluation process. Save the Summary Slide in a single Microsoft PowerPoint file using the following convention for the title "ControlNumber_LeadOrganization_Slide".

The Summary Slide template requires the following information:

- A technology Summary;
- A description of the technology's impact;
- Proposed project goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Project title, Prime Recipient, Principal Investigator, and Key Participant information; and
- Requested EERE funds and proposed applicant cost share.

7. SUBAWARD BUDGET JUSTIFICATION (EERE159)

Applicants must provide a separate budget justification, EEERE 159 (i.e., budget justification for each budget year and a cumulative budget) for each subawardee that is expected to perform work estimated to be more than $250,000 or 25 percent of the total work effort (whichever is less). The budget justification must include the same justification information described in the "Budget Justification" section, above. Save each subaward budget justification in a single, separate Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Subawardee_Budget_Justification".

8. BUDGET FOR DOE/NNSA FFRDC (IF APPLICABLE)

If a DOE/NNSA FFRDC contractor is to perform a portion of the work, the Applicant must provide a DOE Field Work Proposal (FWP) in accordance with the requirements in DOE Order 412.1A, Work Authorization System. DOE Order 412.1A is available at the following link: https://www.directives.doe.gov/directives/0412.1-BOrder-a/view. Save the FWP in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FWP".

9. AUTHORIZATION FOR NON-DOE/NNSA, DOE/NNSA FFRDCS

The Federal agency is sponsoring the FFRDC contractor must authorize in writing the use of the FFRDC contractor on the proposed project and this authorization must be submitted with the application. The use of a FFRDC contractor must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth".

10. SF-LLL: DISCLOSURE OF LOBBYING ACTIVITIES

Prime Recipients and Subrecipients may not use any Federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Prime Recipients and Subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (http://www.whitehouse.gov/sites/default/files/omb/grants/sflllin.pdf) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence any of the following in connection with your application:

- An officer or employee of any Federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

Save the SF-LLL in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_SF-LLL".

11. WAIVER REQUESTS: FOREIGN ENTITIES AND PERFORMANCE OF WORK IN THE UNITED STATES

i. Foreign Entity Participation:

As set forth in Section III.A.3, all Prime Recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. To request a waiver of this requirement, the Applicant must submit an explicit waiver request in the Full Application. Waiver information is provided in Section III.A.3 of the FOA.

ii. Performance of Work in the United States

All work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the Prime Recipient should make every effort to purchase supplies and equipment within the United States. Section IV.I.3 lists the necessary information that must be included in a request to waive this requirement.

12. U.S. MANUFACTURING PLAN

As part of the application, Applicants are required to submit a U.S. Manufacturing Plan. The U.S. Manufacturing Plan represents the applicant's measurable commitment to support U.S. manufacturing of the results from its award.

The nature and specificity of the applicants' U.S. Manufacturing Plans are expected to vary based on the FOA. A higher level of specificity is expected in U.S. Manufacturing Plans for technologies at higher technology readiness levels due to the greater certainty surrounding the commercialization of these awards. U.S. Manufacturing Plans submitted in response to FOAs targeting technologies at high technology readiness levels or demonstration activities should include specific commitments to manufacturing in the U.S. For example, a U.S. Manufacturing Plan may commit to manufacturing products that embody or are made through the use of IP developed under the award in the U.S. or making investments in U.S. facilities to support product manufacture. U.S. Manufacturing Plans submitted in response to FOAs directed at technologies at lower technology readiness levels may have fewer specific manufacturing details and may focus more on licensing and other strategies to promote U.S. manufacturing.

The weight given to the U.S. Manufacturing Plans during the review and selection process varies based on the particular FOA. Applicants should review Section V.A.2 of this FOA to determine the weight given to the U.S. Manufacturing Plans under this FOA.

When an applicant is selected for an award, the U.S. Manufacturing Plan submitted by the applicant becomes part of the terms and conditions of the award.

13. Draft Intellectual Property Management Plan

As part of the application, Applicants are required to submit a draft IP Management Plan as an Appendix that will form the basis of the final and executed IP Management Plan as described in Section VI.C.11 of this FOA. The draft is expected to cover the major points as described Section VI.C.11 of this FOA. The Prime Recipient must submit a completed and signed Intellectual Property Management plan to DOE within 30 days of the notification of selection. All Intellectual Property Management Plans are subject to the terms and conditions of the funding agreement and its intellectual property provisions, and applicable Federal laws, regulations, and policies, all of which take precedence over the terms of Intellectual Property Management Plans. When public funding directly supports research and development efforts as a result of this FOA, it is further expected that some portion of or all of the results are to be shared with the greater manufacturing community and the public as appropriate. An additional objective with regard to public funding is to ensure that the underlying data for such projects be made available in an open and digitally accessible manner that also protects confidentiality (see the open data initiatives summarized in the Administration's Digital Government strategy: http://www.whitehouse.gov/sites/default/files/omb/egov/digital-government/digital-government.html). The draft IP Management plan should address both of these objectives as well.

14. Conflict of Interest Statement

Due to the high profile nature of this Institute and its impact on U.S. manufacturing, it is important that any conflicts of interest (COI), whether actual or perceived, affecting the proposed senior leadership team for the Institute be identified and a mitigation plan be developed. Examples of conflicts of interest include, but are not limited to: financial holdings, business relationships, professional affiliations, and personal relationships and/or affiliations that currently exist or may arise during the operation of the institute involving foreign or domestic institutions or individuals.

The Applicant must provide a COI Statement, as an Appendix, for key Institute management and technical personnel. Identify potential, apparent, or actual organizational and individual conflicts of interest. This shall include applicants, their team members, and senior/key personnel named in the application. Negative responses are also required.

15. Compliance Matrix

Applicants shall provide a "Compliance Matrix" in table format (separate and exempt from total word count) that explains how and where each merit review criteria are addressed in the Project Narrative and Application documentation. The table's format is at the discretion of the applicant.

E. POST-AWARD INFORMATION REQUESTS

If selected for award, EERE reserves the right to request additional or clarifying information for any reason deemed necessary, including but not limited to:

- Indirect cost information
- Other budget information
- Commitment Letters from Third Parties Contributing to Cost Share, if applicable
- Name and phone number of the Designated Responsible Employee for comply with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Environmental Questionnaire

F. CONTENT AND FORM OF REPLIES TO REVIEWER COMMENTS

EERE will provide Applicants with independent reviewer comments following evaluation of all eligible Full Applications. Applicants will a brief opportunity to review the comments and prepare a short Reply to Reviewer Comments responding to comments however they desire. The Reply to Reviewer Comments is due by the date and time provided on the cover page of this FOA. Applicant should anticipate receiving the independent reviewer comments approximately three business days before this date. The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments.

EERE will not review or consider ineligible Replies to Reviewer Comments (see Section III of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three pages in length, EERE will review only the first three pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	2 pages max	Applicants may respond to one or more reviewer comments or supplement their Full Application.
Optional	1 page max	Applicants may use this page however they wish; text, graphs, charts, or other data to respond to reviewer comments or supplement their Full Application are acceptable.

G. SUBMISSION DATES AND TIMES

Concept Papers, Full Applications, and Replies to Reviewer Comments must be submitted no later than the dates and times provided on the cover page of this FOA.

H. INTERGOVERNMENTAL REVIEW

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

I. FUNDING RESTRICTIONS

1. ALLOWABLE COSTS

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable Federal cost principles.

Refer to the following applicable Federal cost principles for more information:

- 2 CFR 220 for Educational Institutions;
- 2 CFR 225 for State, Local, and Indian Tribal Governments;
- 2 CFR 230 for Non Profit Organizations; and
- FAR Part 31 for For-Profit entities.

2. PRE-AWARD COSTS

Selectees may charge pre-award costs incurred on R&D awards within the 90-day period immediately preceding the effective date of the award. If the Selectee is a for-profit, non-profit, or University, prior approval by the Contracting Officer to incur pre-award costs is not required unless the costs are more than $25,000. If the Selectee is a governmental entity, it must request prior approval from the Contracting Officer to incur pre-award costs, regardless of the amount.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis. Pre-award costs can only be incurred if such costs would be reimbursable under the agreement if incurred after award.

Pre-Award expenditures are made at the Selectee's risk; EERE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the Selectee anticipated.

i. Pre-Award Costs Related to National Environmental Policy Act (NEPA) Requirements

EERE's decision whether and how to distribute federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse costs where the Prime Recipient incurred the costs prior to receiving written authorization from the Contracting Officer. If the Applicant elects to undertake activities that may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the Applicant is doing so at risk of not receiving Federal funding and such costs may not be recognized as allowable cost share. Likewise, if a project is selected for negotiation of award, and the Prime Recipient elects to undertake activities that are not authorized for Federal funding by the Contracting Officer in advance of EERE completing a NEPA review, the Prime Recipient is doing so at risk of not receiving Federal Funding and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override these NEPA requirements to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives.

3. PERFORMANCE OF WORK IN THE UNITED STATES

a. Requirement.

All work performed under EERE Awards must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment; however, the Recipient should make every effort to purchase supplies and equipment within the United States. The Recipient must flow down this requirement to its subrecipients.

b. Failure to Comply.

If the Recipient fails to comply with the Performance of Work in the United States requirement, EERE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable Recipient cost share. The Recipient is responsible should any work under this Award be performed outside the United States, absent a waiver, regardless of if the work is performed by the Recipient, subrecipients, vendors or other project partners.

c. Waiver.

There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the Unites States requirement, the Applicant must submit a written waiver request to EERE, which includes the following information:

- The countries in which the work is proposed to be performed;
- A description of the work to proposed to performed outside the U.S.;
- Proposed budget of work to be performed; and
- The rationale for performing the work outside the U.S.

For the rationale, the Applicant must demonstrate to the satisfaction of EERE that a waiver would further the purposes and objectives of the FOA that the Award was selected under and is otherwise in the interests of EERE and the United States. EERE may require additional information before considering a waiver request. Save the waiver request(s) in a single PDF file titled "ControlNumber_PerformanceofWork_Waiver". The Applicant does not have the right to appeal this decision concerning a waiver request.

4. CONSTRUCTION

Funding from this FOA (including required cost share) is NOT permitted (or allowed) for construction of new buildings or for major renovation of existing buildings. Allowable costs include those necessary to house the Institute (including a possible lease for the first five years of the project), to make minor modifications as needed to accommodate or install unique research equipment and instrumentation in an existing building, and to purchase research equipment and instrumentation. Costs for new construction (including new buildings or additions to existing buildings) will not be allowed in the Institute award. Recipients are required to obtain written authorization from the Contracting Officer before incurring any minor modification costs.

5. FOREIGN TRAVEL

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 USC 40118), commonly referred to as the "Fly America Act," and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. flag carrier, if service is available.

6. *EQUIPMENT AND SUPPLIES*

To the greatest extent practicable, all equipment and products purchased with funds made available under this award should be made or manufactured in the United States. This requirement does not apply to used or leased equipment.

Property disposition will be required at the end of a project if the property is no longer used by the Prime Recipient for the objectives of the project, and the fair market value of property exceeds $5,000. The rules for property disposition are set forth in the following sections of 10 CFR Part 600:

- 10 CFR 600.130 to 600.137 for Universities, Hospitals, or other Nonprofit Institutions;
- 10 CFR 600.231 to 600.233 for State and Local Governments; and
- 10 CFR 600.320 to 600.325 for For-Profit organizations.

7. *LOBBYING*

Recipients and Subrecipients may not use any Federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and Subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (http://www.whitehouse.gov/sites/default/files/omb/grants/sflllin.pdf) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence any of the following in connection with your application:

- An officer or employee of any Federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

V. APPLICATION REVIEW INFORMATION

A. TECHNICAL REVIEW CRITERIA

1. *CONCEPT PAPERS*

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies must not be consolidated in a single Concept Paper. Concept Papers are evaluated based on the following criteria:

Criterion 1: Impact of the Proposed Institute (35%)
This criterion involves consideration of the following factors:

- Method used to identify current state of the art technology; and
- If technical success is achieved, the proposed Institute would significantly improve technical, non-technical and economic performance relative to the state of the art and support U.S. manufacturing competitiveness.

Criterion 2: Overall Scientific and Technical Merit (35%)
This criterion involves consideration of the following factors:

- The proposed Institute plan and facilities will support innovation
- The proposed Institute plans show potential to address technical challenges achieving to institute goals; and
- The proposed approach is without major technical flaws.

Criterion 3: Overall Management Approach (30%)
This criterion involves consideration of the following factors:

- The proposed Institute operations and management approach is without major flaws
- The proposed Institute management team and resources are adequate

2. FULL APPLICATIONS

Each Full Application must be limited to a single concept or technology. Unrelated concepts and technologies must not be consolidated in a single Full Application. Full Applications will be evaluated against the technical merit review criteria shown below.

Criterion 1: Technical Merit, Innovation, and Impact (25%)
Technical Merit and Innovation

- Quality of the overall approach for the proposed Institute to the develop and deploy innovative next generation manufacturing technologies that meet national needs and the goals of this FOA;
- Extent to which the proposed technology developments are innovative and have the potential to advance the state of the art;
- Degree to which the current state of the technology and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly explains how the applicant will move the state of the art to the proposed advancements demonstrating a deep technical understanding and industry needs by the Applicant;
- Degree to which the applicant adequately addressed the three focus areas identified in Section I of this FOA and adequately justifies additional focus areas to achieve the goals of the FOA;
- Quality of the technical education and workforce development plan to support technical education and career training and level of integration into the Institute technical activities;

- Extent to which the Institute will leverage existing educational resources and support dissemination of curriculum materials; and
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work.

Impact of the Institute

- How the Institute supports the FOA goals, topic area objectives and target specifications and metrics;
- The potential impact of the Institute on advancing the state of the art;
- Extent to which the applicant demonstrates the potential impact of the Institute for aggregate cumulative energy savings (TBTU) and reduction in GHG (tons of CO2 equivalent) on a life-cycle basis over ten years relative to existing available technologies;
- Degree of commitment to support U.S. manufacturing as demonstrated in the U.S. Manufacturing Plan;
- Extent to which the applicant demonstrates the potential impact of the Institute to support U.S manufacturing competitiveness, in particular to increase energy productivity, domestic production capacity, impact domestic job creation, trade balance and/or GDP, as well as regional economic development as a result of successful technology deployment and commercialization from Institute related activities over ten years;
- If the application includes participation of foreign-based entities, the adequacy of the justification for their participation and the estimated domestic production benefits; and
- The adequacy and reasonableness of assumption in estimating the potential impact of the Institute.

Criterion 2: Institute Workplan and Commercialization Plan (25%)

Approach and Workplan

- Degree to which the approach and critical paths have been clearly described and thoughtfully considered;
- Degree to which the Applicant has identified and clearly described the goals for the overall Institute and major Institute elements, at a minimum, operations and management; shared RD&D facilities; R&D projects; stakeholder engagement and road-mapping; technical education and workforce development; and commercialization; and
- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed Workplan will succeed in meeting the Institute goals.

Identification of Risks

- Discussion and demonstrated understanding of the key technical risk areas involved in the proposed work and the quality of the mitigation strategies to address them.

Baseline, Metrics, and Deliverables

- The level of clarity in the definition of the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

Market Transformation Plan

- For initial proposed project and technical work, the identification of target markets, competitors, and distribution channels for proposed technology developments along with known or perceived barriers to market penetration, including mitigation plan; and
- For initial proposed project and technical work, comprehensiveness of commercialization plan including but not limited to product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan etc., and product distribution.

Criterion 3: Team and Resources (20%)

Institute Team and Participants

- The capability of the Institute Director(s), lead organization and the proposed team to address all aspects of the proposed work with a good chance of success;
- Qualifications, relevant expertise, experience of the proposed Institute Director/Executive and key management staff in successfully managing a collaborative and/or multi-user facility;
- Level of time commitment to Institute management by the proposed Institute Director/Executive (expected full time role) and other key management staff (>75% time commitment);
- Degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies;
- Quality of the Institute participants and their level of commitment to support U.S. manufacturing competitiveness as defined in the U.S. Manufacturing Plan; and
- Level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan.

Facilities

- The sufficiency of the existing and proposed facilities and capabilities to support the work;
- Degree of clarity in the differentiation between existing and new facilities and resources;
- Adequacy of the plan to update facilities and incorporate R&D developments into the shared facilities; and

- Degree to which the Institute will appropriately leverage existing resources and facilities including but not limited to NIST MEP Centers, NSF ATE Centers, national laboratories, and other government investments.

Budget and Spend Plan

- Reasonableness of budget and spend plan for proposed project and objectives;
- Accuracy of thee representation of the value of in-kind contributions; and
- Adequacy of funding availability to encourage openness and new participants as the Institute goes forward and to accommodate changes in strategic direction that may occur once the Institute is formalized and aligned with strategic roadmaps.

Criterion 4: Operations and Management Plan (15%)

Management and Governance Approach

- Reasonableness and effectiveness of management approach and structure to enable strategic decision-making;
- Adequacy of the inclusion of federal government (DOE and other Federal government participants identified by DOE) on decision making bodies (boards/committees) at both a strategic and technical level within the Institute;
- Degree to which the Institute can operate as an independent, neutral, non-biased coordinating and convening body for a diverse set of stakeholders;
- Quality of the proposed organization structure to support the Institute objectives, incentivize private sector participation and encourage SMEs participation in the Institute; and
- Adequacy of the plan to communicate and coordinate with, share and establish best practices, and participate in meetings with other institutes for manufacturing innovation established by DOE and other Federal Agencies and support the creation of a national network for manufacturing innovation.

Operations

- The adequacy and quality of the annual strategic planning process, including the plan for industry roadmap activities, periodic update of the industry roadmap (annual or bi-annual) and incorporation of the industry roadmap to Institute strategic planning;
- The adequacy and quality of the planned periodic (annual) review processes for Institute and project performance;
- Adequacy of the proposed Institute performance metrics and how metrics will be tracked to gauge success of the Institute and impact in the technology area
- Strength of methodology for selecting and prioritizing R&D work, and tracking performance for work;
- Adequacy of the plan to handle participation of foreign-based entities and ensure domestic production benefits;
- Quality of the stakeholder engagement plan, in particular with SMEs and ability to engage stakeholders along the supply chain including end-users and degree to which the annual planning process encourages new ideas and participants;

- Degree to which the Institute elements will be integrated and will provide value that is more than the sum of the individual activities and achieve the objectives of the FOA, in particular how will improvements developed through R&D projects be incorporated into shared RD&D facilities over time;
- Degree to which the Institute will provide capabilities for and collaboration in open, pre-competitive work, among multiple parties in an Intellectual Property (IP) protected environment, as well as proprietary activities as appropriate to engage stakeholders as relevant to the Institute objectives and goals of the FOA; and
- Degree to which the management and operations plan will enable the Institute to adapt to changing industry conditions and needs that may arise due to road-mapping efforts, as well as enable partnerships with external entities, such as other Federal government agencies.

Identification of Operational Risks

- Adequacy of the discussion of the economic and operational key risk areas involved in the operations and management plan, and the quality of the mitigation strategies to address them, specifically with respect to Intellectual Property management and securing U.S. manufacturing competitiveness.

Criterion 5: Intellectual Property Management Plan (10%)

- Adequacy of the IP management plan for supporting the needs of the Institute, its participants, and the broader U.S. manufacturing sector;
- Extent to which the IP management plan will incentivize private sector involvement;
- Quality of the IP Management plan and any other IP agreements (attached as an Appendix of the Narrative) demonstrating that the IP issues inherent with collaborations and/or multi-user facilities are addressed; and
- Extent to which the applicant demonstrates an understanding of and adequate plan to address export control (ITAR and any other) regulations, address classified work as needed and conflicts of interest;

Criterion 6: Transition Plan (5%)

- Likelihood that the Institute can achieve financial self-sufficiency from dedicated federal funding within five years;
- The adequacy of the description of the funding/revenue model which will support Institute operations beyond the award period;
- Adequacy the plan to keep the Institute resources and approach relevant during the award period and after the end of the award period; and
- Reasonableness of the extended profit and loss estimates for an additional three years beyond the award period.

3. *Criteria for Replies to Reviewer Comments*

EERE has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are attached to the original applications and evaluated as an extension of the Full Application.

B. Standards for Application Evaluation

Applications that are determined to be compliant will be evaluated in accordance with this FOA, by the standards set forth in EERE's Notice of Objective Merit Review Procedure (76 Fed. Reg. 17846, March 31, 2011) and the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance," which is available at: http://energy.gov/sites/prod/files/meritrev.pdf.

C. Other Selection Factors

1. *Program Policy Factors*

In addition to the above criteria, the Selection Official may consider the following program policy factors in determining which Applicants to encourage to submit Full Applications and which Full Applications to select for award negotiations:

- The degree to which the proposed project, including proposed cost shares, optimizes the use of available EERE funding to achieve programmatic objectives and alignment with national manufacturing goals and objectives[96];
- The level of industry involvement and demonstrated ability to commercialize energy or related technologies;
- Technical, market, organizational, and environmental risks associated with the project;
- Whether the proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty;
- The degree to which the proposed project directly addresses EERE's statutory mission and strategic goals.

D. Evaluation and Selection Process

1. *Overview*

The evaluation process consists of multiple phases that each include an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are

[96] National Science and Technology Council. "A National Strategic Plan for Advanced Manufacturing." Web. February 2012. http://www.whitehouse.gov/sites/default/files/microsites/ostp/iam_advancedmanufacturing_strategicplan_2012.pdf

conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

2. PRE-SELECTION INTERVIEWS

As part of the evaluation and selection process, EERE may invite one or more applicants to participate in Pre-Selection Interviews. Pre-Selection Interviews are distinct from and more formal than pre-selection clarifications (See Section V.D.3 of the FOA). The invited applicant(s) will meet with EERE representatives to provide clarification on the contents of the Full Applications and to provide EERE an opportunity to ask questions regarding the proposed project. The information provided by applicants to EERE through Pre-Selection Interviews contributes to EERE's selection decisions.

EERE will arrange to meet with the invited applicants in person at EERE's offices or a mutually agreed upon location. EERE may also arrange site visits at certain Applicants' facilities. In the alternative, EERE may invite certain applicants to participate in a one-on-one conference with EERE via webinar, videoconference, or conference call.

EERE will not reimburse Applicants for travel and other expenses relating to the Pre-Selection Interviews, nor will these costs be eligible for reimbursement as pre-award costs.

EERE may obtain additional information through Pre-Selection Interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without Pre-Selection Interviews. Participation in Pre-Selection Interviews with EERE does not signify that Applicants have been selected for award negotiations.

3. PRE-SELECTION CLARIFICATION

EERE may determine that pre-selection clarifications are necessary from one or more applicants. These pre-selection clarifications will solely be for the purposes of clarifying the application, and will be limited to information already provided in the application documentation. The pre-selection clarifications may occur before, during or after the merit review evaluation process. The pre-selection clarifications are information requests that are separate and independent from the Replies to Reviewer Comments process. Information provided by an applicant that is not necessary to address the pre-selection clarification question will not be reviewed or considered. Typically, a pre-selection clarification will be carried out through either written responses to EERE's written clarification questions or video or conference calls with EERE representatives.

The information provided by Applicants to EERE through pre-selection clarifications is incorporated in their applications and contributes to the merit review evaluation and EERE's selection decisions. If EERE contacts an applicant for pre-selection clarification purposes, it does

not signify that the applicant has been selected for negotiation of award or that the applicant is among the top ranked applications.

EERE will not reimburse applicants for expenses relating to the pre-selection clarifications, nor will these costs be eligible for reimbursement as pre-award costs.

4. SELECTION

The Selection Official may consider the merit review recommendation, program policy factors, and the amount of funds available in arriving at selections for this FOA.

VI. AWARD ADMINISTRATION INFORMATION

A. ANTICIPATED NOTICE OF SELECTION AND AWARD DATES

EERE anticipates notifying the applicant selected for negotiation of award by the end of August 2014 and making the award by December 2014.

B. AWARD NOTICES

1. INELIGIBLE SUBMISSIONS

Ineligible, Concept Papers and Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the Applicant in EERE Exchange. The notification letter will state the basis upon which the Concept Paper or the Full Application was ineligible and not considered for further review.

2. CONCEPT PAPER NOTIFICATIONS

EERE will notify Applicants of its determination to encourage or discourage the submission of a Full Application. EERE will send a notification by email to the technical and administrative points of contact designated by the Applicant in EERE Exchange.

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. The purpose of the Concept Paper phase is to save Applicants the considerable time and expense of preparing a Full Application that unlikely to be selected for award negotiations.

A notification letter encouraging the submission of a Full Application does not authorize the Applicant to commence performance of the project. Please refer to Section IV.J.2 of the FOA for guidance on pre-award costs.

3. *Full Application Notifications*

EERE will notify Applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the Applicant in EERE Exchange. The notification letter will inform the Applicant whether or not its Full Application was selected for award negotiations.

4. *Successful Applicants*

Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the Applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by the EERE to issue an award. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement.

The award negotiation process will take approximately 60 days. Applicants must designate a primary and a backup point-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. The Applicant must be responsive during award negotiations (e.g., provide requested documentation) and meet the negotiation deadlines. If the Applicant fails to do so or if award negotiations are otherwise unsuccessful, EERE will cancel the award negotiations and rescind the Selection. EERE reserves the right to terminate award negotiations at any time for any reason.

Please refer to Section IV.I.2 of the FOA for guidance on pre-award costs.

5. *Postponed Selection Determinations*

A notification letter postponing a final selection determination until a later date does not authorize the Applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

6. *Unsuccessful Applicants*

EERE shall promptly notify in writing each applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds. If the application was not selected, the written notice shall explain why the application was not selected.

C. ADMINISTRATIVE AND NATIONAL POLICY REQUIREMENTS

1. REGISTRATION REQUIREMENTS

There are several one-time actions before submitting an Application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

i. EERE Exchange

Register and create an account on EERE Exchange at https://eere-Exchange.energy.gov. This account will then allow the user to register for any open EERE FOAs that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Applicants should also designate backup points of contact so applicants may be easily contacted if deemed necessary. **This step is required to apply to this FOA.**

The EERE Exchange registration does not have a delay; however, **the remaining registration requirements below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA**. Therefore, although not required in order to submit an Application through the EERE Exchange site, all potential applicants lacking a DUNS number, or not yet registered with SAM or FedConnect should complete those registrations as soon as possible.

ii. DUNS Number

Obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number (including the plus 4 extension, if applicable) at http://fedgov.dnb.com/webform.

iii. System for Award Management

Register with the System for Award Management (SAM) at https://www.sam.gov. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in SAM registration. Please update your SAM registration annually.

iv. Fedconnect

Register in FedConnect at https://www.fedconnect.net/. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at https://www.fedconnect.net/FedConnect/PublicPages/FedConnect_Ready_Set_Go.pdf.

v. Grants.gov

Register in Grants.gov (http://www.grants.gov) to receive automatic updates when Amendments to this FOA are posted. However, please note that Concept Papers, and Full Applications will not be accepted through Grants.gov.

vi. Electronic Authorization of Applications and Award Documents

Submission of an application and supplemental information under this FOA through electronic systems used by the Department of Energy, including EERE Exchange and fedconnect.net, constitutes the authorized representative's approval and electronic signature.

2. AWARD ADMINISTRATIVE REQUIREMENTS

The administrative requirements for DOE grants and cooperative agreements are contained in 10 CFR 600. Grants and cooperative agreements made to universities, non-profits, and other entities subject to 10 CFR 600 are subject to the Research Terms and Conditions located on the National Science Foundation website at: http://www.nsf.gov/bfa/dias/policy/rtc/index.jsp.

3. RESERVED

4. LIMITATIONS ON COMPENSATION COSTS

The annual compensation costs for an individual allowable under this Award are limited to $250,000 (i.e., $250,000 is the maximum amount that EERE will reimburse a Recipient for any one individual's annual compensation and EERE will not recognize such costs above $250,000 as Recipient cost share).

This limitation does not restrict the Recipient or its subrecipients from providing annual compensation to an individual that exceeds $250,000. However, any amount above $250,000 cannot be included in the total project costs (i.e., Federal share or Recipient cost share). For purposes of this requirement only, the term "annual compensation costs" is defined to include the total amount of wages and salary paid to the employee, which have been approved by the Contracting Officer.

5. SUBAWARD AND EXECUTIVE REPORTING

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime Recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier Subrecipients. Prime Recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

6. *National Policy Requirements*

The National Policy Assurances that are incorporated as a term and condition of award are located at: http://energy.gov/management/downloads/national-policy-assurances-be-incorporated-award-terms.

7. *Environmental Review in Accordance with National Environmental Policy Act (NEPA)*

EERE's decision whether and how to distribute Federal funds under this FOA is subject to the National Environmental Policy Act (42 USC 4321, *et seq.*). NEPA requires Federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at http://nepa.energy.gov/.

While NEPA compliance is a Federal agency responsibility and the ultimate decisions remain with the federal agency, all Recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project.

8. *Applicant Representations and Certifications*

i. *Lobbying Restrictions*

By accepting funds under this award, the Recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. §1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

ii. *Corporate Felony Conviction and Federal Tax Liability Representations (March 2012)*

By submitting an application in response to this FOA, the Applicant represents that:

It is not a corporation that has been convicted (or had an officer or agent of such corporation acting on behalf of the corporation convicted) of a felony criminal violation under any Federal law within the preceding 24 months;

No officer or agent of the corporation have been convicted of a felony criminal violation for an offence arising out of actions for or on behalf of the corporation under Federal law in the past 24 months; or

It is not a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not

being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these representations, the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

9. STATEMENT OF FEDERAL STEWARDSHIP

EERE will exercise normal Federal stewardship in overseeing the project activities performed under EERE Awards. Stewardship Activities include, but are not limited to, conducting site visits; reviewing performance and financial reports, providing assistance and/or temporary intervention in usual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

10. STATEMENT OF SUBSTANTIAL INVOLVEMENT

EERE has substantial involvement in work performed under Awards made following this FOA. In addition to the administrative requirements of the Award, EERE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes, but is not limited to, the following:

1. EERE shares responsibility with the Recipient for the management, control, direction, and performance of the Project.
2. EERE may intervene in the conduct or performance of work under this Award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.
3. EERE may redirect or discontinue funding the Project based on the outcome of EERE's evaluation of the Project at a Go/No Go decision point.
4. EERE participates in major project decision-making processes.
5. EERE reviews and approves in a timely manner project plans, including project management, testing and technology transfer plans, and recommending alternate approaches, if the plans do not address the critical programmatic issues.
6. EERE participates in project management planning activities, including risk analysis, to ensure EERE Technology Office requirements or limitations are considered in performance of the work elements.
7. EERE promotes and facilitates technology transfer activities, including disseminating Technology Office results through presentations and publications.
8. EERE participates in any governance or management boards that may be established and may invite other U.S. Government officials for participation in advisory capacity.

9. To adequately monitor project progress and provide direction to the Institute, the Prime Recipient must provide EERE with an adequate level of insight into various Institute activities. Government Insight activities by EERE include attendance at Institute meetings, reviews and tests, and project management and monitoring activities which may result in co-location and physical accommodation of a Federal employee or Federal contractor onsite. The Prime Recipient must notify EERE of meetings, reviews, and tests in sufficient time to permit EERE participation and provide all appropriate documentation for EERE review. The Prime Recipient may be asked to provide a suitable physical location for a Federal employee or contractor for a specific time or as part of ongoing project management and monitoring by EERE.
10. EERE may choose to engage a private, independent engineering (IE) firm to assist in assessing the progress of the project and provide timely and accurate reports to EERE. The Prime Recipient will ensure that the IE has access to any and all relevant documentation sufficient to allow the IE to provide independent evaluations to EERE on the progress of the project. The Prime Recipient may require the IE to sign a non-disclosure agreement, and will negotiate the agreement in good faith and in a timely manner. EERE will evaluate the quality and completeness of information and documentation provided by the Prime Recipient to EERE and its consultants (i.e., IE) in order to allow EERE to provide technical direction to the Prime Recipient about how best to achieve the objectives of the Institute. Consultants to EERE may not provide technical direction to the Prime Recipient.

11. INTELLECTUAL PROPERTY MANAGEMENT PLAN

Within 30 days of notification of selection, the applicant selected for award negotiations (Selectee) must submit an executed IP Management Plan between the members of the consortia or team. The award will set forth the treatment of and obligations related to intellectual property rights between EERE and the individual members. The IP Management Plan should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with Federal IP laws, regulations, and policies (see Sections VIII.L-VIII.O of this FOA for more details on applicable Federal IP laws and regulations).

The following is a non-exhaustive list of examples of items that the IP Management Plan should cover:

- The treatment of confidential information including company sensitive information, trade secrets between members, as well as between members and Institute personnel (e.g., the use of non-disclosure agreements);
- The treatment of background IP (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the project (e.g., any requirements for disclosing to the other members, filing patent applications, paying for patent

prosecution, and cross-licensing or other licensing arrangements between the members);

- The treatment of data produced, including software, under the project (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members) including:
    - licensing new learning materials and curriculum to the public under a Creative Commons Attribution License (CCBY) and
    - specific datasets to be delivered in an open, machine-readable format to publically accessible data discovery platforms like www.OpenEI.org, www.data.gov or equivalent open web technologies in order to further this objective of the FOA;
- Physical and digital systems to support a secure data environment, including clearance processes for personnel and members to access data, equipment and tools;
- Any technology transfer and commercialization requirements or arrangements between the members;
- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team;
- The handling of conflicts of interest among participants in the Institute and conflicts of interest for management and technical staff of the Institute; and
- The handling of disputes related to intellectual property between the members.

12. Conflict of Interest Identification and Mitigation

Due to the high profile nature of this Institute and its impact on U.S. manufacturing, it is important that any conflicts of interest (COI), whether actual or perceived, affecting the proposed senior leadership team for the Institute be identified and a mitigation plan be developed. Examples of conflicts of interest include, but are not limited to: financial holdings, business relationships, professional affiliations, and personal relationships and/or affiliations that currently exist or may arise during the operation of the institute involving foreign or domestic institutions or individuals.

The Selectee must further identify any and all potential conflicts of interest beyond those submitted with the initial Application for the Institute and the leadership team on an individual basis, with any proposed mitigation efforts. This information will be due to EERE no later than seven (7) business days after notice of selection for award negotiations.

Further, the Selectee must provide EERE with a comprehensive COI identification and mitigation plan that addresses how the Institute will handle COI matters during the lifetime of the Institute. Such COI Management Plan will be subject to further modification and review during award negotiations.

All conflicts must be identified, documented and resolved through a conflict mitigation and avoidance plan approved by the Contracting Officer. The Selectee must obtain this approval

from the Contracting Officer prior to involvement by any representatives in any negotiations with EERE or Institute activities.

13. Risk Mitigation Plan

If selected for award negotiations, the details of the Selectee's Risk Mitigation Plan will be subject to review and approval by EERE. The Risk Mitigation plan will need to address control of sensitive information within and outside the Institute. Components for risk mitigation plan should include: (1) vetting of staff working on projects, and (2) identifying, handling, and managing sensitive information. As part of a Risk Mitigation Plan, EERE will require the following conditions be included:

- EERE reserves the right for final determination of identification, categorization and treatment of information generated through Institute activities.

- The Institute must document to the satisfaction of the Contracting Officer that the Institute has properly vetted all individuals proposed to participate in Institute projects in accordance with the Information Risk Mitigation Plan. This documentation must be provided to EERE with sufficient time for review prior to individuals' participation in project activities.

14. Data Management Plan

The Selectee will be required to submit a Data Management Plan during the award negotiations phase. The Data Management Plan is a document that outlines the proposed plan for data sharing or preservation. Submission of this plan is required, and failure to submit the plan may result in the termination of award negotiations. As a courtesy, guidance for preparing a Data Management Plan is provided in Appendix C of the FOA.

15. Subject Invention Utilization Reporting

In order to ensure that Prime Recipients and Subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE requires that each Recipient holding title to a subject invention submit annual reports for 10 years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by Recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the Prime Recipient, and such other data and information as EERE may specify.

16. INTELLECTUAL PROPERTY PROVISIONS

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards.

17. REPORTING

Reporting requirements are identified on the Federal Assistance Reporting Checklist, DOE F 4600.2, attached to the award agreement. The checklist can be accessed at: http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms under heading Award Form.

18. GO/NO-GO REVIEW

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. Federal funding beyond the Go/No Go decision point is contingent on (1) the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) meeting the objectives, milestones, deliverables, and decision point criteria of Recipient's approved project and obtaining approval from EERE to continue work on the project; (3) and submittal of required reports in accordance with the statement of project objectives.

As part of the Go/No-Go Review, EERE may conduct site visits, as required, to participate in recipient "kick off" meetings; gain clearer understanding of problems or issues; observe testing; meet with stakeholders/attend public meetings; verify equipment installations; validate reported progress; review confidential/proprietary information that is pertinent to the award; participate in progress and cost/financial reviews; and conduct structured project review per programmatic direction. In conducting the Go/No-Go Review, the Government may seek the advice of qualified non Federal personnel as reviewers. See Section VIII.F.

As a result of the Go/No Go Reviews, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on Federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, EERE may take appropriate action consistent with 10 CFR §§ 600.24 and 600.25, including but not limited to, redirecting, suspending or terminating the award.

VII. QUESTIONS/AGENCY CONTACTS

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with Applicants regarding the FOA except through the established question and answer process as described below. Specifically, questions regarding the content of this FOA must be submitted to: FRCManufacturing@go.doe.gov not later than 3 business days prior to the application due date.

All questions and answers related to this FOA will be posted on EERE Exchange at: https://eere-exchange.energy.gov. **Please note that you must first select this specific FOA Number in order to view the questions and answers specific to this FOA**. EERE will attempt to respond to a question within 3 business days, unless a similar question and answer has already been posted on the website.

Questions related to the registration process and use of the EERE Exchange website should be submitted to: EERE-ExchangeSupport@hq.doe.gov.

VIII. OTHER INFORMATION

A. FOA MODIFICATIONS

Amendments to this FOA will be posted on the EERE Exchange website and the Grants.gov system. However, you will only receive an email when an amendment or a FOA is posted on these sites if you register for email notifications for this FOA in Grants.gov. EERE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.

B. INFORMATIONAL WEBINARS

EERE will conduct one informational webinar during the FOA process. The webinar will be held after the initial FOA release but before the due date for Concept Papers. The purpose of this webinar will be to give applicants a chance to ask questions about the FOA process generally. Attendance is not mandatory and will not positively or negatively impact the overall review of any Applicant submissions. As the webinar will be open to all Applicants who wish to participate, Applicants should refrain from asking questions or communicating information that would reveal confidential and/or proprietary information specific to their project. The specific date for the webinar can be found on the cover page of the FOA.

C. GOVERNMENT RIGHT TO REJECT OR NEGOTIATE

EERE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

D. COMMITMENT OF PUBLIC FUNDS

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

E. TREATMENT OF APPLICATION INFORMATION

In general, EERE will use data and other information contained in applications for evaluation purposes only unless such information is generally available to the public or is already the property of the Government.

Applicants should not include trade secrets or commercial or financial information that is privileged or confidential in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the FOA. Applications containing trade secrets or commercial or financial information that is privileged or confidential, which the applicant does not want disclosed to the public or used by the Government for any purpose other than application evaluation, must be marked as described in this section.

The cover sheet of the application must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

> Notice of Restriction on Disclosure and Use of Data:
> Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential, and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source.
> [End of Notice]

The header and footer of every page that contains trade secrets or commercial or financial information that is privileged or must be marked as follows: “May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure.”

In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in brackets.

The above markings enable EERE to follow the provisions of 10 CFR 1004.11(d) in the event a Freedom of Information Act (FOIA) request is received for information submitted with an application. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under a FOIA request or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

Subject to the specific FOIA exemptions identified in 5 U.S.C. 552(b), all information submitted to EERE by a FOA applicant is subject to public release under the Freedom of Information Act, 5 U.S.C. §552, as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175. It is the applicant's responsibility to review FOIA and its exemptions to understand (1) what information may be subject to public disclosure and (2) what information applicants submit to the Government that are protected by law. In some cases, DOE may be unable to make an independent determination regarding which information submitted by an applicant is releasable and which is protected by an exemption. In such cases, DOE will consult with the applicant, in accordance with 10 C.F.R. §1004.11, to solicit the applicant's views on how the information should be treated.

F. Evaluation and Administration by Non-Federal Personnel

In conducting the reviews of Concept Papers, merit review evaluation of Full Applications, and Go/No-Go Reviews, the Government may seek the advice of qualified non Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

G. Notice Regarding Eligible/Ineligible Activities

Eligible activities under this Technology Office include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

H. Notice of Right to Conduct a Review of Financial Capability

EERE reserves the right to conduct an independent third party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

I. NOTICE OF POTENTIAL DISCLOSURE UNDER FREEDOM OF INFORMATION ACT

Applicants should be advised that identifying information regarding all applicants, including applicant names and/or points of contact, may be subject to public disclosure under the Freedom of Information Act, whether or not such applicants are selected for negotiation of award.

J. REQUIREMENT FOR FULL AND COMPLETE DISCLOSURE

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;
- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of Federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

K. RETENTION OF SUBMISSIONS

EERE expects to retain copies of all Letters of Intent, Concept Papers, Full Applications, Replies to Reviewer Comments, and other submissions. No submissions will be returned. By applying to EERE for funding, Applicants consent to EERE's retention of their submissions.

L. TITLE TO SUBJECT INVENTIONS

Ownership of subject inventions is governed pursuant to the authorities listed below.

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions.
- All other parties: The Federal Non Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (see below).
- Class Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business

must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.

- Advance and Identified Waivers: Applicants may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.

- Determination of Exceptional Circumstances (DEC): Each applicant is required to submit a U.S. Manufacturing Plan as part of its application. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit recipients under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. For example, the commitments and enforcement of a U.S. Manufacturing Plan may be tied to subject inventions. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this DEC has the right to appeal it

M. GOVERNMENT RIGHTS IN SUBJECT INVENTIONS

Where Recipients and Subrecipients retain title to subject inventions, the U.S. Government retains certain rights.

1. GOVERNMENT USE LICENSE

The U.S. Government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the Government.

2. MARCH-IN RIGHTS

The U.S. Government retains march-in rights with respect to all subject inventions. Through "march-in rights," the Government may require a Prime Recipient or Subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the Government may grant licenses for use of the subject invention when a Prime Recipient, Subrecipient, or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by Federal statutes in a reasonably satisfied manner; or
- The U.S. Manufacturing requirement has not been met.

- Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

N. RIGHTS IN TECHNICAL DATA

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

"Limited Rights Data": The U.S. Government will not normally require delivery of confidential or trade secret-type technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

Government rights in Technical Data Produced under Awards: The U.S. Government normally retains unlimited rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of data generated under EERE awards may be protected from public disclosure for up to five years after the data is generated ("Protected Data"). For awards permitting Protected Data, the protected data must be marked as set forth in the awards intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

O. COPYRIGHT

The Prime Recipient and Subrecipients may assert copyright in copyrightable data, such as software, first produced under the award without EERE approval. When copyright is asserted,

the Government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the Government. In addition, for those awards requiring distribution of software as Open-Source Software (OSS), the additional information in Appendix D must be addressed in the application.

P. PROTECTED PERSONALLY IDENTIFIABLE INFORMATION

In responding to this FOA, Applicants must ensure that Protected Personally Identifiable Information (PII) is not included in the application, and specifically in the following documents: Project Abstract, Project Narrative, Biographical Sketches, Budget or Budget Justification. These documents will be used by the Merit Review Committee in the review process to evaluate each application. PII is defined by the Office of Management and Budget (OMB) and EERE as:

> Any information about an individual maintained by an agency, including but not limited to, education, financial transactions, medical history, and criminal or employment history and information that can be used to distinguish or trace an individual's identity, such as their name, social security number, date and place of birth, mother's maiden name, biometric records, etc., including any other personal information that is linked or linkable to an individual.

This definition of PII can be further defined as: (1) Public PII and (2) Protected PII.

Public PII: PII found in public sources such as telephone books, public websites, business cards, university listing, etc. Public PII includes first and last name, address, work telephone number, email address, home telephone number, and general education credentials.

Protected PII: PII that requires enhanced protection. This information includes data that if compromised could cause harm to an individual such as identity theft.

Listed below are examples of Protected PII that Applicants must not include in the files listed above to be evaluated by the Merit Review Committee. This list is not all inclusive.

- Social Security Numbers in any form
- Place of Birth associated with an individual
- Date of Birth associated with an individual
- Mother's maiden name associated with an individual
- Biometric record associated with an individual
- Fingerprint
- Iris scan
- DNA

- Medical history information associated with an individual
- Medical conditions, including history of disease
- Metric information, e.g. weight, height, blood pressure
- Criminal history associated with an individual
- Ratings
- Disciplinary actions
- Performance elements and standards (or work expectations) are PII when they are so intertwined with performance appraisals that their disclosure would reveal an individual's performance appraisal
- Financial information associated with an individual
- Credit card numbers
- Bank account numbers
- Security clearance history or related information (not including actual clearances held)

Q. ANNUAL COMPLIANCE AUDITS

If a for-profit entity is a Prime Recipient and has expended greater than $500K of Federal funds in a respective fiscal year, an annual compliance audit performed by an independent auditor may be required. For additional information, please refer to 10 C.F.R. § 600.316 and for-profit audit guidance documents posted under the "Coverage of Independent Audits" heading at http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms

If an educational institution, non-profit organization, or state/local government is a Prime Recipient or Subrecipient and has expended greater than $500K of Federal funds in a respective fiscal year, then an A-133 audit is required. For additional information, please refer to OMB Circular A-133 through the link below.
http://www.whitehouse.gov/sites/default/files/omb/assets/omb/circulars/a133/a133.pdf

Applicants and sub-recipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. EERE will share in the cost of the audit at its applicable cost share ratio.

APPENDIX A – DEFINITIONS

"**Applicant**" means the legal entity or individual signing the Application. This entity or individual may be one organization or a single entity representing a group of organizations (such as a Consortium) that has chosen to submit a single Application in response to a FOA.

"**Application**" means the documentation submitted in response to a FOA.

"**Authorized Organization Representative (AOR)**" is the person with assigned privileges who is authorized to submit financial assistance applications through Grants.gov on behalf of an organization. The privileges are assigned by the organization's E-Business Point of Contact designated in the SAM.

"**Award**" means the written documentation executed by a Contracting Officer, after an application is approved, which contains the negotiated terms and conditions for providing Financial Assistance to the recipient. A Financial Assistance Award may be a Grant, Cooperative Agreement, or Technology Investment Agreement. 10 CFR 600.3

"**Budget**" means the cost expenditure plan submitted in the Application, including both the EERE contribution and the Applicant Cost Share.

"**Compliance**" is an eligibility determination that refers to the non-technical requirements outlined in a FOA (e.g., formatting, timeliness of submission, or satisfaction of prerequisites).

"**Consortium (plural consortia)**" means the group of organizations or individuals that have chosen to submit a single Application in response to a FOA.

"**Contracting Officer**" means the DOE official authorized to execute Awards on behalf of DOE and who is responsible for the business management and non-program aspects of the Financial Assistance process. 10 CFR 600.3

"**Cooperative Agreement**" means a Financial Assistance instrument used by EERE to transfer money or property when the principal purpose of the transaction is to accomplish a public purpose of support or stimulation authorized by Federal statute, and Substantial Involvement (see definition below) is anticipated between EERE and the Recipient during the performance of the contemplated activity. Refer to 10 CFR 600.5 for additional information regarding cooperative agreements.

"**Cost Sharing**" means that portion of the project or program's costs not borne by the Federal Government. The percentage of Applicant Cost Share is to be applied to the Total Project Cost (i.e., the sum of Applicant plus EERE Cost Shares) rather than to the EERE contribution alone. 10 CFR 600.3. In addition, cost sharing information can be found in the Code of Federal

Regulations at 10 CFR 600.123 (non-profit and university), 600.224 (State and Local Governments), and 600.313 (for profit entities).

"**Data Universal Numbering System (DUNS) Number**" is a unique nine-character identification number issued by Dun and Bradstreet (D&B). Organizations must have a DUNS number prior to registering in the SAM. Call 1-866-705-5711 to receive one free of charge.

"**E-Business Point of Contact (POC)**" is the individual who is designated as the Electronic Business Point of Contact in the SAM registration. This person is the sole authority of the organization with the capability of designating or revoking an individual's ability to conduct SAM transactions.

"**EERE Exchange**" is the Department of Energy, Energy Efficiency and Renewable Energy's web system for posting Federal FOAs and receiving applications.
EERE Exchange website

"Energy Productivity" - A definition of energy productivity is provided here in the context of this FOA. This information and definition is to be used for this FOA specifically and while this information relates to an overall national goal for energy productivity it is provided here for convenience to applicants while a complete, formal definition of the national goals for energy productivity is under development. For this FOA, energy productivity (EP) is defined as the economic value of relevant market sectors ($ Value Add) per unit energy (TBTU) on a cumulative basis over a ten year period. Energy consumption is to be calculated on a life-cycle basis. To determine the increase in energy productivity – the energy productivity needs to be estimated for a baseline, "business as usual" scenario for economic output and energy consumption without the Institute is then compared to a scenario where the impact of the Institute activities are estimated for both economic output and energy consumption.

On a 10 year basis:

- EP Baseline (EP_B) No Institute = Cum.Value Add $(\$)_B$/Cum.Life-cycle Energy Consumption $(TBTU)_B$
- EP Institute (EP_I) Impact = Cum. Value Add $(\$)_I$/Cum. Life-cycle Energy Consumption $(TBTU)_I$
- EP Improvement = EP_I/EP_B

"**Financial Assistance**" means the transfer of money or property to a recipient or subrecipient to accomplish a public purpose of support or stimulation authorized by Federal statute through Grants or Cooperative Agreements and sub-awards. For EERE, it does not include direct loans, loan guarantees, price guarantees, purchase agreements, Cooperative Research and Development Agreements (CRADAs), or any other type of financial incentive instrument. 10 CFR 600.3

"**FedConnect**" is where federal agencies make awards via the web. It can be found at https://www.fedconnect.net/FedConnect/.

"**Federally Funded Research and Development Center (FFRDC)**" means a government-sponsored operation that exists for the purpose of carrying out various functions related to both basic and applied research and development on behalf of the Government. Typically, most or all of the facilities utilized in an FFRDC are owned by the Government, but the operations are not always managed by the Government; an FFRDC may be managed by a University or consortium of Universities, other not-for-profit or nonprofit organization, or a for-profit organization, with the Government performing an oversight function. FAR 2.101

"**Funding Opportunity Announcement (FOA)**" is a publicly available document by which a Federal agency makes known its intentions to award discretionary grants or cooperative agreements, usually as a result of competition for funds. FOAs may be known as FOAs, notices of funding availability, solicitations, or other names depending on the agency and type of program. See 10 CFR 600.8 for more information.

"**Grant**" means a Financial Assistance instrument used by EERE to transfer money or property when the principal purpose of the transaction is to accomplish a public purpose of support or stimulation authorized by Federal statute, and no Substantial Involvement is anticipated between EERE and the Recipient during the performance of the contemplated activity.

"**Grants.gov**" is the "storefront" web portal which allows organizations to electronically find grant opportunities from all Federal grant-making agencies. Grants.gov is THE single access point for over 900 grant programs offered by the 26 Federal grant-making agencies. It can be accessed at http://www.grants.gov.

"**Indian Tribe**" means any Indian tribe, band, nation, or other organized group or community, including Alaska Native village or regional or village corporation, as defined in or established pursuant to the Alaska Native Claims Settlement Act (85 Stat. 688)[43 U.S.C. § 1601 et seq.], which are recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

"**Key Personnel**" mean the individuals who will have significant roles in planning and implementing the proposed Project on the part of the Applicant and Participants, including FFRDCs.

"**Marketing Partner Identification Number (MPIN)**" is a very important password designated by your organization when registering in SAM. The E-Business Point of Contact will need the MPIN to assign privileges to the individual(s) authorized to perform SAM transactions on behalf of your organization. The MPIN must have 9 digits containing at least one alpha character (must be in capital letters) and one number (no spaces or special characters permitted).

"**Modification**" means a revision to a FOA.

"**Participant**" for purposes of this FOA only, means any entity, except the Applicant substantially involved in a Consortium, or other business arrangement (including all parties to the Application at any tier), responding to the FOA.

"**Principal Investigator**" refers to the technical point of contact/Project Manager for a specific project award.

"**Project**" means the set of activities described in an Application, State plan, or other document that is approved by EERE for Financial Assistance (whether such Financial Assistance represents all or only a portion of the support necessary to carry out those activities).

"**Project Team**" means the team which consists of the Prime Recipient, Subrecipients, and others performing or otherwise supporting work under an EERE funding agreement.

"**Recipient/Prime Recipient**" means the organization, individual, or other entity that receives a Financial Assistance Award from DOE (i.e., is the signatory on the award) and is financially accountable for the use of any DOE funds or property provided for the performance of the Project, and is legally responsible for carrying out the terms and condition of the award. 10 CFR 600.3

"**Responsiveness**" is an eligibility determination that refers to the objective technical requirements (not goals or targets) outlined in a FOA, such as a technology type or technical parameters. For example, submission of a photovoltaic solar panel design in response to a FOA calling for innovative geothermal drilling technologies should be found nonresponsive. Likewise, an application with a design that incorporates rare earth materials to a FOA that prohibits the use of rare earth materials should be found nonresponsive. Conversely, the belief that a technology will not achieve the technical targets of the FOA will never be used as a proper basis for a rejection as nonresponsive.

"**System for Award Management (SAM)**" is the primary database which collects, validates, stores and disseminates data in support of agency missions. It can be accessed at https://www.sam.gov.

"Selectee" means the applicant selected for award negotiations.

"**Selection**" means the determination by the EERE Selection Official that negotiations take place for certain Projects with the intent of awarding a Financial Assistance instrument.

"**Selection Official**" means the EERE official designated to select Applications for negotiation toward Award under a subject FOA.

"**Substantial Involvement**" means involvement on the part of the Government. EERE's involvement may include shared responsibility for the performance of the Project; providing technical assistance or guidance which the Applicant is to follow; and the right to intervene in

the conduct or performance of the Project. Such involvement will be negotiated with each Applicant prior to signing any agreement. See 10 C.F.R. 600.5(b)

"**Technology Investment Agreement (TIA)**" is a type of assistance instrument used to support or stimulate research projects involving for-profit firms, especially commercial firms that do business primarily in the commercial marketplace. 10 CFR 603.105. TIAs are different from grants and cooperative agreements in that the award terms may vary from the Government-wide standard terms. (See DOE TIA regulations at 10 CFR Part 603). The primary purposes for including a TIA in the type of available award instruments are to encourage non-traditional Government contractors to participate in an R&D program and to facilitate new relationships and business practices. A TIA can be particularly useful for awards to consortia (See 10 CFR 603.225(b) and 603.515, Qualification of a consortium).

"**Total Project Cost**" means all the funds to complete the effort proposed by the Applicant, including EERE funds (including direct funding of any FFRDC) plus all other funds that will be committed by the Applicant as Cost Sharing. 10 CFR 600.3

"**Tribal Energy Resource Development Organization or Group**" means an "organization" of two or more entities, at least one of which is an Indian Tribe (see "Indian Tribe" above) that has the written consent of the governing bodies of all Indian Tribes participating in the organization to apply for a grant or loan, or other assistance under 25 U.S.C. § 3503.

APPENDIX B – COST SHARE INFORMATION

Cost Sharing or Cost Matching

The terms "cost sharing" and "cost matching" are often used synonymously. Even the DOE Financial Assistance Regulations, 10 CFR Part 600, use both of the terms in the titles specific to regulations applicable to cost sharing. EERE almost always uses the term "cost sharing," as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here "cost matching" for the non-federal share is calculated as a percentage of the Federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. Following is an example of how to calculate cost sharing amounts for a project with $1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: Federal share ($) divided by Federal share (%) = Total Project Cost
  Example: $1,000,000 divided by 80% = $1,250,000

- Formula: Total Project Cost ($) minus Federal share ($) = Non-federal share ($)
  Example: $1,250,000 minus $1,000,000 = $250,000

- Formula: Non-federal share ($) divided by Total Project Cost ($) = Non-federal share (%)
  Example: $250,000 divided by $1,250,000 = 20%

See the sample cost share calculation for a blended cost share percentage below. Keep in mind that FFRDC funding is DOE funding.

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under an EERE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

- Institutions of Higher Education, Hospitals, and Other Nonprofit Organizations are found at 10 CFR 600.123;
- State and Local Governments are found at 10 CFR 600.224;
- For-profit Organizations are found at 10 CFR 600.313.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, EERE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, EERE generally does not allow pre-award costs prior to the signing of the Selection Statement by the EERE Selection Official.

Following is a link to the DOE Financial Assistance Regulations. You can click on the specific section for each Code of Federal Regulations reference mentioned above.

DOE Financial Assistance Rules (10 CFR 600)

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

(A) Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the Prime Recipient's cost sharing if such contributions meet all of the following criteria:

(1) They are verifiable from the recipient's records.

(2) They are not included as contributions for any other federally-assisted project or program.

(3) They are necessary and reasonable for proper and efficient accomplishment of project or program objectives.

(4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:

a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A–122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the Federal Acquisition Regulation, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations

b. Other types of organizations. Allowability of costs incurred by other types of organizations that may be Subrecipients under a prime award is determined as follows:

i. Institutions of higher education. Allowability is determined in accordance with: 2 CFR 220 Cost Principles for Educational Institutions

ii. Other nonprofit organizations. Allowability is determined in accordance with: 2 CFR 230 Cost Principles for Nonprofit Organizations

iii. Hospitals. Allowability is determined in accordance with the provisions of: Title 45 Appendix E to Part 74—Principles for Determining Costs Applicable to Research and Development Under Grants and Contracts With Hospitals

iv. Governmental organizations. Allowability for State, local, or federally recognized Indian tribal government is determined in accordance with: PART 225—Cost Principles for State, Local, and Indian Tribal Governments (OMB Circular A–87)

(5) They are not paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing or matching.

(6) They are provided for in the approved budget.

(B) Valuing and documenting contributions

(1) Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

(2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

(3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) Valuing property donated by third parties.

a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.

ii. The value of loaned equipment must not exceed its fair rental value.

(5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

b. The basis for determining the valuation for personal services and property must be documented.

APPENDIX C – DATA MANAGEMENT PLAN

A data management plan ("DMP") explains how data generated in the course of the work performed under an EERE award will be shared and preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate.

DMP Requirements

In order for a DMP to be considered acceptable, the DMP must address the following:

At a minimum, the DMP must describe how data sharing and preservation will enable validation of the results from the proposed work, or how results could be validated if data are not shared or preserved.

The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

The DMP should consult and reference available information about data management resources to be used in the course of the proposed work. In particular, a DMP that explicitly or implicitly commits data management resources at a facility beyond what is conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at DOE User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other DOE facilities can be found in the additional guidance from the sponsoring program.

The DMP must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all laws (e.g. export control laws), and DOE regulations, orders, and policies.

DMP Reviews

DMPs will be reviewed as part of a compliance review of full applications submitted in response to a FOA. If a DMP is not submitted or does not address the above elements, then the full applications will be considered non-compliant and will not be further considered by EERE.

Data Determination for a DMP

The Principal Investigator should determine which data should be the subject of the DMP and, in the DMP, propose which data should be shared and/or preserved in accordance with the DMP Requirements noted above.

For data that will be generated through the course of the proposed work, the Principal Investigator should indicate what types of data should be protected from immediate public disclosure by DOE (referred to as "protected data") and what types of data that DOE should be able to release immediately. Similarly, for data developed outside of the proposed work at private expense that will be used in the course of the proposed work, the Principal Investigator should indicate whether that type of data will be subject to public release or kept confidential (referred to as "limited rights data"). Any use of limited rights data or labeling of data as "protected data" must be consistent with the DMP Requirements noted above.

Suggested Elements for a DMP

The following list of elements for a DMP provides suggestions regarding the data management planning process and the structure of the DMP:

Data Types and Sources: A brief, high-level description of the data to be generated or used through the course of the proposed work and which of these are considered digital research data necessary to validate the research findings or results.

Content and Format: A statement of plans for data and metadata content and format including, where applicable, a description of documentation plans, annotation of relevant software, and the rationale for the selection of appropriate standards. Existing, accepted community standards should be used where possible. Where community standards are missing or inadequate, the DMP could propose alternate strategies for facilitating sharing, and should advise the sponsoring program of any need to develop or generalize standards.

Sharing and Preservation: A description of the plans for data sharing and preservation. This should include, when appropriate: the anticipated means for sharing and the rationale for any restrictions on who may access the data and under what conditions; a timeline for sharing and preservation that addresses both the

minimum length of time the data will be available and any anticipated delay to data access after research findings are published; any special requirements for data sharing, for example, proprietary software needed to access or interpret data, applicable policies, provisions, and licenses for re-use and re-distribution, and for the production of derivatives, including guidance for how data and data products should be cited; any resources and capabilities (equipment, connections, systems, software, expertise, etc.) requested in the research application that are needed to meet the stated goals for sharing and preservation (this could reference the relevant section of the associated research application and budget request); and whether/where the data will be preserved after direct project funding ends and any plans for the transfer of responsibilities for sharing and preservation.

Protection: A statement of plans, where appropriate and necessary, to protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; and avoid significant negative impact on innovation, and U.S. competitiveness.

Rationale: A discussion of the rationale or justification for the proposed data management plan including, for example, the potential impact of the data within the immediate field and in other fields, and any broader societal impact.

Additional Guidance

In determining which data should be shared and preserved, researchers must consider the data needed to validate research findings as described in the Requirements, and are encouraged to consider the potential benefits of their data to their own fields of research, fields other than their own, and society at large.

DMPs should reflect relevant standards and community best practices and make use of community accepted repositories whenever practicable.

Costs associated with the scope of work and resources articulated in a DMP may be included in the proposed research budget as permitted by the applicable cost principles.

To improve the discoverability of and attribution for datasets created and used in the course of research, EERE encourages the citation of publicly available datasets within the reference section of publications, and the identification of datasets with persistent identifiers such as Digital Object Identifiers (DOIs). In most cases, EERE can provide DOIs free of charge for data resulting from DOE-funded research through its Office of Scientific and Technical Information (OSTI) DataID Service.

Definitions

Data Preservation: Data preservation means providing for the usability of data beyond the lifetime of the research activity that generated them.

Data Sharing: Data sharing means making data available to people other than those who have generated them. Examples of data sharing range from bilateral communications with colleagues, to providing free, unrestricted access to anyone through, for example, a web-based platform.

Digital Research Data: The term digital data encompasses a wide variety of information stored in digital form including: experimental, observational, and simulation data; codes, software and algorithms; text; numeric information; images; video; audio; and associated metadata. It also encompasses information in a variety of different forms including raw, processed, and analyzed data, published and archived data.

Research Data: The recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This 'recorded' material excludes physical objects (e.g., laboratory samples). Research data also do not include:

> (A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and
>
> (B) Personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study."

Validate: In the context of DMPs, validate means to support, corroborate, verify, or otherwise determine the legitimacy of the research findings. Validation of research findings could be accomplished by reproducing the original experiment or analyses; comparing and contrasting the results against those of a new experiment or analyses; or by some other means.

APPENDIX D – EXAMPLE MILESTONE SUMMARY TABLE AND WORK BREAKDOWN STRUCTURE

Example Milestone Summary Table and Work Breakdown Structure are provided on following two pages.

Milestone Summary Table							
Recipient Name:							
Project Title:							
Task Number	Task Title or Subtask Title (If Applicable)	Milestone Type (Milestone or Go/No-Go Decision Point)	Milestone Number* (Go/No-Go Decision Point Number)	Milestone Description (Go/No-Go Decision Criteria)	Milestone Verification Process (What, How, Who, Where)	Anticipated Date (Months from Start of the Project)	Anticipated Quarter (Quarters from Start of the Project)

*Milestone numbering convention should align with Task and Subtask numbers, as appropriate. For example, M1.1, M3.2, etc.

Note 1: It is required that each project have at least one milestone per quarter for the entire project duration. It is not necessary that each task have one milestone per quarter.

Note 2: It is required that each project have at least one project-wide go/no-go decision point each year. If a decision point is not specific to a particular task, then you may leave the task information blank for those decision points.

Note 3: All milestones should follow the SMART rule of thumb: Specific, Measureable, Achievable, Relevant, and Timely

Example Work Breakdown Structure

Technical Summary: Provide a high-level overview of the final result of this project. Explain the final objective, outcome, milestone and/or deliverable that are to be produced and the rationale for why the applicant has organized the tasks in the way they have.

Technical Details (Optional): Describe the relevant management, engineering, design, process, scientific or other principles and aspects of the project that warrant discussion.

Task 1: Distinctive Title, Date range of the task in months (M1-M4)

Task Summary: Task summaries shall explicitly describe what work is to be accomplished, identify the project objectives/outcomes being addresses and provide a concise statement of the objectives of that task. In addition, the description should indicate the project deliverables that this task will help achieve (D1, D2, D5 etc. note that deliverables may be applicable to multiple or all tasks.)

Task Details: Within this section, the barriers and risks should be identified, as well as the approaches for overcoming those barriers and risks. Where appropriate, multiple pathways early in the effort can be outlined for risk reduction.

Milestone 1.1 (if applicable)
Milestone 1.2 (if applicable)
Etc.

Subtask 1.1: Date range (M1-M2)

Subtask Summary: Describe the specific and detailed work efforts that go into achieving the higher-level tasks.

Subtask Details: Describe the evaluation techniques that will be used and the expected result that will be generated from the effort.

Milestone 1.1.1 (if applicable)
Milestone 1.1.2 (if applicable)
Etc.

Subtask 1.2:
(Continue until all Task 1 subtasks are listed)

Task 2: (continue in the format above until all tasks and subtasks are listed)
Subtask 2.1: Description and Discussion
Subtask 2.2: Description and Discussion