PROGRAM AREA OVERVIEW: OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY

The Office of Energy Efficiency and Renewable Energy (EERE) leads the Federal government's research and development (R&D) efforts in energy efficiency and renewable energy. It invests in clean energy R&D designed to reduce the cost of technologies that enable the efficient use of energy and/or the generation of renewable energy. EERE's SBIR/STTR efforts are part of an integrated portfolio that will lead to economic and environmental benefits.

The U.S. Department of Energy (DOE) EERE program is interested in receiving proposals for research and development projects that offer potential for achieving EERE technology cost and performance targets. Applications must include a detailed explanation, with analytical data, to describe how the proposed technology and approach will enable substantial progress toward the identified technology target. In addition to cost reduction analysis, applications must describe how technology or system performance will be maintained or improved compared to the state of the art. Prior to the opening of the Funding Opportunity Announcement (FOA), potential applicants may contact the EERE program point of contact (POC) to discuss the proposed technology development effort. After the FOA opens, all questions regarding the topics must be submitted via the FedConnect Portal. Please refer to the respective SBIR/STTR FOA for guidance on submitting questions about the topics through FedConnect. Applicants are strongly encouraged to visit the SBIR/STTR Programs and the EERE website for information about program goals and priorities. Each application may address one topic only.

For additional information regarding EERE priorities, click here or visit www.eere.energy.gov.

Technical Narratives submitted in response to EERE topics must: (1) include a review of the state-of-the-art of the technology and application being targeted; (2) provide a detailed evaluation of the proposed technology and place it in the context of the current state-of-the-art in terms of performance, lifecycle cost, reliability, and/or other key attributes; (3) analyze the proposed technology development process, the pathway to commercialization, the large potential markets it will serve, and the attendant potential public benefits that would accrue; and (4) address the ease of implementation of the new technology.

All applicants must demonstrate how energy savings, energy production, performance and materials and manufacturing costs are estimated to justify how their technology holds promise to approach, meet or exceed the targets given in this document for the different sub-topics, as applicable. All calculations must be explained and supported with sources, where applicable. Unsupported calculations or unsubstantiated claims regarding meeting performance targets are not acceptable.

Phase I projects must complete (1) a preliminary design, (2) a characterization of laboratory devices using the best measurements available, including a description of the measurement methods, and (3) the preparation of a road map with major milestones, that would lead to a production model of a system that would be built in Phase II. In Phase II, devices suitable for near-commercial applications must be built and tested, and issues associated with manufacturing the units in large volumes at a competitive price must be addressed.

1. ADVANCED MANUFACTURING

The DOE Office of Energy Efficiency and Renewable Energy, Advanced Manufacturing Office (AMO) (http://www1.eere.energy.gov/manufacturing/) seeks transformational manufacturing and materials technologies that reduce primary energy use in manufacturing by 50% without sacrificing product quality, production throughput or life cycle cost. The technology should provide a pathway to a doubling of energy productivity in a U.S. industry through innovative manufacturing and novel materials concepts, including (a) manufacturing process and (b) advanced materials technologies.

Grant applications are sought in the following subtopics:

a. Manufacturing Process
Manufacturing technologies of interest include innovations in: reactions and separations such as high performance membranes and catalysts; alternatives to conventional high-temperature processing technologies; and waste heat recovery and recycling that reduce energy use ≥50%.

b. Advanced Materials
Materials technologies of interest include: thermal and degradation resistant materials such as advanced ceramics and coatings; highly-functional, high-performance materials, such as advanced composites, engineered polymers, and low-density and relatively high-strength metals; and lower cost materials for solid state energy technologies such as photovoltaic and thermoelectric materials that reduce energy use ≥50%.

2. BIOMASS

The Office of Energy Efficiency and Renewable Energy, Office of the Biomass Program (OBP) (http://www1.eere.energy.gov/biomass/) supports research, development, deployment, and demonstration activities to support diverse, cost-effective bioenergy technologies including (a) Cellulosic and Algal Biofuels and (b) Biobased Products.

Grant applications are sought in the following subtopics:

a. Cellulosic and Algal Biofuels
Technologies for the use of cellulosic and algal biomass in the production of drop-in biofuels, such as renewable gasoline, diesel, and JP-8 to less than $3 per gallon at the plant gate (in 2007 dollars and in gallons of gasoline equivalent (gge)).

b. Biobased Products
Product diversification through technologies relevant to the production of biobased products that (a) can increase the feasibility of fuel production in a biorefinery by reducing the minimum fuel sales price (MFSP) by at least $0.35/gge at the plant gate and (b) have a market potential of 500,000 metric tons/year. To ensure competitiveness, the projected sales price of any non-fuel, biobased products must be shown to be lower than from existing sources.

3. BUILDINGS

Buildings use more energy than any other sector of the U.S. economy, consuming more than 70% of electricity and 50% of natural gas. The Office of Energy Efficiency and Renewable Energy Building Technologies Program (BTP) (www1.eere.energy.gov/buildings/) seeks technologies that have the potential to contribute to a 50% reduction in energy demand by residential and commercial buildings at less than the cost of the energy saved (800 Trillion BTUs in annual savings by 2020; 3,000 in 2030). In particular, BTP seeks projects in the following areas: (a) Solid State Lighting Devices and Packages, (b) Cold Climate Air Source Heat Pumps (c) High COP Electric Water Heater, (d) GSHP Loop Cost Reduction, (e) Fast Payback Solar Water Heaters, (f) Building Envelope Materials (g) Building Controls and (h) Commercial Building Power Meters.

Grant applications are sought in the following subtopics:

a. Solid State Lighting (SSL) Devices and Packages

Improvements in SSL devices suitable for existing and future domestic building use are sought that will increase package efficacy beyond the SSL 2015 Multi-Year Program Goals of 224 lumens per watt (LPW) for packaged LEDs or 125 for OLED panels, while simultaneously improving light quality by increasing the color rendering index (CRI) above 90, reducing color variations by 10X (i.e., Duv < 0.0014) and by reducing manufacturing costs 10X for both OLED and LED packaged products and components. These goals may be achieved by solving technical barriers such as light extraction and panel production for OLEDs, or by improving the efficiency of LED monochromatic light production in the red, green and amber regimes or by creating entirely novel geometries or materials systems for both LEDs and OLEDs. Complete technical details, performance goals and metrics can be found in the most recent program plan available at:
http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/ssl_mypp2011_web.pdf

b. Cold Climate Air Source Heat Pumps

Innovative technologies for High Performance Air Source Cold Climate Heat Pumps with a maximum capacity degradation of ≤25% between -13°F and 47°F are sought.

c. High COP Electric Water Heaters

Innovative technologies for electric water heating that would result in a system having a coefficient of performance (COP) of at least 1.1 and the potential of achieving a first cost target of no more than $500 (mass produced, 50 gallon residential electric water heater unit) are needed.

d. GSHP Ground Loop Cost Reduction

Innovative technologies for low cost ground source heat pump (GSHP) systems that specifically address a significant reduction (e.g. for Illinois be able to demonstrate a ground loop installation cost that is <<$1100/ton that is typical for that region) in the current high cost of the ground loop installation.

e. Fast Payback Solar Hot Water

Innovative technologies for solar water heating systems with simple payback of no greater than 5 years.

f. Building Envelope Materials
Advanced building envelope materials that can dramatically improve energy efficiency are needed including: innovative higher performing insulations (≥R8/inch or ≥30% higher R-value than existing materials); advanced window coatings (e.g. <$7/sq ft dynamic control, Solar Heat Gain Coefficient <0.10 to >0.55, transparent conducting glazings that cost ≥ 30% less than existing indium tin oxide glass with glazings comparable electrical characteristics, variable emissivity coatings (emissivity <0.2 to >0.60), vacuum glazing with glass bonding able to withstand ASTM2190), and dynamic roof surfaces (e.g. with variable solar reflectance <0.20 to >0.55).

g. Building Controls
Innovative interoperable controls software for self-commissioning; optimization and/or demand-response of buildings, including control of HVAC, lighting, daylighting and advanced facades that yield ≥20% annual reduction in energy demand are needed.

h. Commercial Building Power Meters
Innovative low-cost, wireless, three-phase, true power meters that measure and report electricity consumption for commercial office buildings with a target cost of $20 per meter are needed.

References

Subtopic h:

1. Brambley, M. R., et al. "Advanced Sensors and Controls for Building Applications: Market Assessment and Potential R&D Pathways, April 2005, http://apps1.eere.energy.gov/buildings/publications/pdfs/corporate/pnnl-15149_market_assessment.pdf.

4. HYDROGEN AND FUEL CELL TECHNOLOGIES

Key objectives of EERE's Hydrogen and Fuel Cell Technologies (FCT) Program include (http://www1.eere.energy.gov/hydrogenandfuelcells/index.html) reducing fuel cell system cost to $30/kW (equivalent to the cost of a gasoline internal combustion engine) and improving durability to 5,000 hours (equivalent to 150,000 miles of driving) for automotive fuel cell systems by 2017, and meeting the hydrogen fuel threshold cost of $2–4/gallon gasoline equivalent (gge) by 2020.

Grant applications that enable the following are sought:

a. Transportation Fuel Cells
Transportation fuel cell system components that could contribute to an 80 kW (net) fuel cell system cost of $30/kw, produced at high volume (500,000 systems per year), and 5,000 hours durability (the projected time to 10% voltage degradation).

b. Hydrogen Storage
Development of fibers, resins and/or composite additives that will result in composites for gas cylinders for hydrogen storage that meet or exceed the performance specifications of today's cylinders manufactured with composites using T700 carbon fiber (e.g., greater than 600 ksi

ultimate tensile strength) but with costs at least 25% lower than the currently projected cost of the carbon fiber layer for a 700 bar tank system ($ 2720) when manufactured in high volumes.

References

Subtopic a:

1. An overview of the Fuel Cells subprogram can be found in the DOE Hydrogen and Fuel Cells program's annual progress report, with the subprogram's section found on http://www.hydrogen.energy.gov/annual_progress11_fuelcells.html. These progress reports summarize the year's fuel cell R&D activities and accomplishments. This work was conducted by industry, academia, and national laboratories for the DOE Hydrogen and Fuel Cells Program and the Office of Energy Efficiency and Renewable Energy.

Subtopic b:

1. System Level Analyses of Hydrogen Storage Options, Proceeding of 2010 DOE Annual Merit Review, available on the DOE/FCT website: http://www.hydrogen.energy.gov/pdfs/review10/st001_ahluwalia_2010_o_web.pdf.
2. Analyses of Hydrogen Storage Materials and On-Board Systems, Proceeding of 2010 DOE Annual Merit Review, available on the DOE/FCT website: http://www.hydrogen.energy.gov/pdfs/review10/st002_lasher_2010_o_web.pdf.
3. Technical Assessment of Compressed Hydrogen Storage Tank Systems for Automotive Applications, September 2010, published on the DOE/FCT website: http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/compressedtank_storage.pdf
4. Low Cost Carbon Fiber Research in the LW Materials Program Overview, Proceeding of 2009 DOE Annual Merit Review, available on the DOE/VT website: http://www1.eere.energy.gov/vehiclesandfuels/pdfs/merit_review_2009/light-weight_materials/lm_02_warren.pdf.
5. 5. DOE Targets for On-Board Hydrogen Storage Systems for Light-Duty Vehicles, February 2009, published on DOE/FCT website: http://www1.eere.energy.gov/hydrogenandfuelcells/storage/pdfs/targets_onboard_hydro_storage.pdf.
6. High Strength Carbon Fibers, Proceeding of 2010 DOE Annual Merit Review, available on the DOE/FCT website: http://www.hydrogen.energy.gov/pdfs/review10/st093_paulauskas_2010_p_web.pdf.

5. SOLAR

The DOE SunShot Initiative (www.energy.gov/SunShot) aims to achieve subsidy-free, cost competitive solar by the end of the decade. That translates to about $1/watt installed system price at the utility scale or 5-6 cents per kilowatt-hour. SunShot seeks proposals for the development of innovative technologies the broad areas of: (a) Photovoltaic (PV) modules, (b) Power Electronics & Balance of System (Hardware) (c) Balance of System (Non-hardware), and (d) Concentrating Solar Power.

Grant applications are sought in the following subtopics:

a. PV module
Photovoltaic module cost reductions which achieve an installed system cost of $0.50/W by 2020 are needed. Silicon, copper indium gallium selenide (CIGS), cadmium telluride (CdTe), multi-junction, concentrating photovoltaics, transparent conductive oxide (TCO), and building-integrated photovoltaics (BIPV) are example PV module types.

b. Power Electronics & Balance of System (Hardware)
Power electronics cost reduction (inverter, micro-inverters, reduction in components, DC/DC converters, plug and play innovations, etc.) which achieves an installed system price of $0.10/W by 2020. A hardware balance of system cost reduction (innovative racking systems, penetrating and non-penetrating mounting solutions, BIPV designs, wire management) which achieves an installed system price of $0.18/W by 2020 is sought.

c. Balance of System (Non-Hardware)
Non-hardware balance of system cost reduction (customer acquisition, permitting, installation, inspection, interconnection, operations and maintenance, etc.) which achieves an installed system price of $0.22/W by 2020.

d. Concentrating Solar Power
Concentrating Solar Power breakthroughs (heliostat, trough, molten salt, power cycle, materials reduction, etc.) which achieve a levelized cost of electricity of $0.05-0.06 kWh are needed.

6. VEHICLES

EERE's Vehicles Technologies Program (VTP) (http://www1.eere.energy.gov/vehiclesandfuels/) is focused on developing technologies to enable average new vehicle fuel economy of more than 60 miles per gallon for cars and more than 43 miles per gallon for trucks by 2025. VTP seeks projects in the following areas: (a) High-energy, high-power electric drive vehicle batteries (b) Catalyst materials for exhaust aftertreatment (c) Engine boosting technologies (d) Differential compression and expansion technologies, (e) Subsystem component technologies (f) Thermoelectric technologies, and (g) Materials for traction drive motor laminations, cores, or structures.

Grant applications are sought in the following subtopics:

a. Electric Drive Vehicle Batteries
Applicants are sought to develop electrochemical energy storage technologies which support commercialization of micro, mild, and full HEVs, PHEVs, and EVs. Some specific improvements which are of interest, but are not limited to, include: new low-cost materials, improvements in manufacturing processes, speed or yield, improved cell/pack design minimizing inactive material, significant improvement in specific energy (Wh/kg) or energy density (Wh/L), and improved safety. Proposals must clearly demonstrate how they advance the current state of the art and address the relevant performance metrics listed at www.uscar.org/guest/article_view.php?articles_id=85. When appropriate, evaluation of the technology should be performed in accordance with applicable test procedures or

recommended practices as published by the Department of Energy (DOE) and the U.S Advanced Battery Consortium (USABC). These test procedures can be found at, www.uscar.org/guest/article_view.php?articles_id=86. Phase I feasibility studies must be evaluated in full cells (not half cells) greater than 200mAh in size while Phase II technologies should be demonstrated in full cells greater than 2Ah. Proposals will be deemed non-responsive if the proposed technology is prohibitive to market penetration due to high cost; requires substantial infrastructure investments or industry standardization to be commercially viable; cannot accept high power recharge pulses from regenerative breaking. Proposals deemed to be duplicative of research that is already in progress or similar to proposals already reviewed this year will not be funded; therefore all submissions should clearly explain how the proposed work differs from other work in the field.

b. Exhaust Aftertreatment Materials

In order of priority, low temperature exhaust after-treatment catalysts are needed for the reduction of Oxides of Nitrogen (1, NOx), Carbon Monoxide (2, CO), or unburned hydrocarbons (3, HCs) from internal combustion engines. To meet the demands of future high efficiency engines new low temperature catalyst materials for exhaust after-treatment having the ability to reach 90% efficiency at or below 150°C are needed.

c. Innovative Engine Boosting Technologies

Innovative technologies for engine boosting (turbocharger and supercharger)systems that will improve the FTP cycle fuel economy by 3 percent, expand the effective operating range by 15-20 percent over current production systems with improved transient response, and decreased system cost are needed.

d. Differential Compression and Expansion Technologies

Innovative technologies to enable differential compression and expansion in piston engines resulting in significantly improved efficiencies compared to state-of-the-art engines (currently 38% for gasoline and 42% for diesel engines).

e. Subsystem Component Technologies

Innovative subsystem component technologies in the areas of high resolution low cost sensors:

1. NOx Sensor
    a. Measurement of 10-1000 ppm NOx in engine exhaust upstream of active NOx catalysts for the purpose of controlling active regeneration with a response time of less than 50ms.
    b. Measurement of 1-10 ppm NOx in engine exhaust at tailpipe positions to insure emission regulation compliance with a response time of less than 1 sec.
2. NH3 Sensor
    a. Measurement of 10-1000 ppm NH3 in engine exhaust upstream of active NOx catalysts for the purpose of controlling active regeneration with a response time of less than 1 sec.
    b. Measurement of 1-100 ppm NH3 in engine exhaust at tailpipe positions to insure emission regulation compliance with a response time of less than 1 sec.

f. Thermoelectric Technologies

The efficiency of thermoelectric couples is determined by the Figure of Merit (ZT) which is defined as the Seebeck Coefficient (S) squared multiplied by the electrical conductivity (e) divided by thermal conductivity (k). The current state of the art couples have a ZT=1.3. The applicant must demonstrate how the technology can lead to thermoelectric couples that have a ZT>1.6 across a thermal gradient of 650^{o}C to 30^{o}C. Applicant also must demonstrate a reasonable context of commercial viability. In Phase II, the applicant must develop an assembly or module that could lead to $1.00/Watt installed in a vehicle thermoelectric generator at high volume production.

g. Materials for Traction Drive Motor Laminations, Cores, or Structures

New materials for automotive traction drive motor laminations, cores, or structures that could achieve significant cost savings and contribute to achieving the DOE motor cost target of $4.7/kW in 2020 are needed. Applications should propose specific material innovations in one of these three areas and address how they can lead to reduced costs with respect to currently available materials.

h. Engine Friction Reduction

Applicants are sought to develop innovative technologies to enable the reduction of friction in engine/driveline systems of existing vehicles. Technology must be able to be used as a drop-in or be retrofitted into existing on road vehicles and demonstrate at least a 3% reduction in energy required to propel the vehicle. Incremental costs associated with the technology must be shown to be absorbed by the associated fuel use reduction

7. WATER

EERE is seeking the development of innovative technologies in targeted broad areas identified by its the Water Power Technology Program (www.eere.energy.gov/topics/water.html) seeks proposals for large cost reductions in the deployment of U.S. water (hydro- and marine) power resources to enable water power to provide 15% of our nation's electricity by 2030, including (a) Marine Energy and (b) Hydropower and Hydrokinetic Applications.

Grant applications are sought in the following subtopics:

a. Marine and Hydrokinetic Energy

For Marine Energy (Water and Off-shore Wind) and Hydrokinetic Applications: Rapid and adaptable subsea geotechnical survey methods and techniques to accelerate the deployment of foundations (e.g. piles) or moorings (e.g. anchors) for marine energy devices. Site investigation is a significant cost driver for commercial marine energy installations. Proposals are sought for innovative methods that reduce costs by quickly and accurately delivering sufficient geotechnical information to properly characterize the seafloor under variable environmental conditions (e.g. currents, tides, waves). Applicants must provide a basis of estimate demonstrating technology capable of reducing the time for investigation of a single piling site by 50% relative to use of conventional geotechnical survey methods (e.g. penetration testing, core sampling) (water depth at applicant's discretion). Proposed

technologies should be applicable to inland waterways and/or offshore sites: shallow water (0-30 m), transitional depth (30-60 m), or both.

b. Hydropower Applications
Development of cost-effective (targeting a levelized cost of energy (LCOE) of less than 6¢ per kWh), modular civil works package for hydropower applications including innovative, non-metallic hydropower turbine designs; innovative turbines that increase the range of peak or near peak efficiency for various head and flow conditions; modular turbines for small hydropower applications (100kw – 5MW); alternative pipe material for small hydropower applications; and advanced tunneling methods for hydropower stations.

8. WIND

The Office of Energy Efficiency and Renewable Energy Wind Technology Program (http://www1.eere.energy.gov/wind/) seeks proposals for innovations that significantly advance the goal of large cost reductions in the deployment of U.S. wind power resources, including (a) Logistics for Land-Based Wind Power and (b) Development of a Met-Ocean Package for Offshore Wind.

Grant applications are sought in the following subtopics:

a. Logistics for Land-Based Wind Power
Innovations are needed that overcome the logistical limits of current methods for the transportation, assembly and installation of land-based wind power and lead to land-based turbine size increases beyond 3.5 MW in land-based turbine systems. Technologies used to achieve > 3.5 MW include 25% higher hub heights, 26% larger swept area (larger blades) and access to areas with class 5 or better wind resource. These can be achieved with: innovative designs for larger blades and towers that permit transportation by current methods; new transportation methods for large blades and tower sections; approaches to the assembly and installation of land-based wind turbines that overcome logistical and cost barriers; higher hub heights; larger swept areas; and access to areas with higher class wind resource leading to an overall >20% reduction in the cost of energy for land-based turbines.

b. Development of a Met-Ocean Package for Offshore Wind
Development of a Standardized Met-Ocean Monitoring Package which would serve as one of the core elements of a standardized backbone data collection network for the offshore renewable energy industry is urgently needed. Projects are sought to develop one or more standardized, commercially viable monitoring equipment package configurations to address met-ocean data needs, with emphasis on offshore wind, along with support likely needed for full validation. Key requirements are that measurements must support improved assessment of wind speed and direction, atmospheric stability, ocean waves, swells and currents, data sampling and communication rates consistent with advanced rapid refresh weather modeling data assimilation needs. These monitoring packages must also be able to serve as companion measurement platforms to specialized floating LIDAR systems for now in early stages of application. Applicants are required to justify the economic viability of the proposed package assuming near term (< 5 years) industry deployment for project resource characterization.

Examples of current standard met-ocean packages include the NOAA Automated Surface Observing System (ASOS) and the NDBC Coastal-Marine Automated Network stations (www.nws.noaa.gov/asos/); NOAA National Data Buoy Center (NDBC) buoys (http://www.ndbc.noaa.gov/); and the University of Maine NERACOOS buoy package (http://gyre.umeoce.maine.edu/buoyhome.php).