EERE FY 2017 Phase I Release 2 Q&A by Subtopic

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SUBTOPIC 6A: BUILDINGS & SOLAR JOINT TOPIC: Solar Building Energy Storage Management

Applications are sought that will address current limitations of battery storage management software in effectively coordinating storage with electric load and generation to provide demonstrable benefits to the building owner in the form of economic savings, increased reliability, or richer information about building energy management. Robust software platforms that allow grid operators and/or utilities to reliably and routinely procure services from building energy storage without disrupting the supply of energy to the building and its occupants are also desired. Moreover, this topic seeks software solutions that can adequately model and/or monitor diverse battery technologies and enable their integration with a common platform for building energy management and the interactions between buildings and the electric grid. Applicants should address the following characteristics in their proposed solutions as applicable:

- Focus on leveraging software to enhance the interoperability of battery energy storage with electric loads and generators, and existing utility tariffs and electricity market opportunities.
- Identify the potential for software to increase the value of battery energy storage to building owners and to the wider grid system.
- Discuss how software could be used to monitor and control battery technologies in building applications.
- Address the potential for battery energy storage to coordinate with automated loads and building energy management systems to provide demand response or other grid services.
- Address the potential for battery energy storage to coordinate with on-site electric vehicle charging or solar energy generation.
- Address the potential to use battery energy storage to aggregate and offer building energy services to the electric utility or grid operator as a single controllable entity.

Questions – contact Sven Mumme: sven.mumme@hq.doe.gov.

SUBTOPIC 6A QUESTIONS:

1. **Will this solution need to include physical interfaces to the various components, or will it be software only? Is a physical appliance a valid strategy?**
   This solution does not need to include physical interfaces. We are looking for software solutions only, so a physical appliance wouldn't be a valid strategy in this case.

SUBTOPIC 7A: GEOTHERMAL & BUILDINGS JOINT TOPIC: Geothermal Heat Pumps

The Geothermal Technologies Office (GTO) and Buildings Technologies Office (BTO) collaborate to seek the development and commercialization of innovations that will reduce the cost and/or improve performance of GHP systems' ground loops. GHP systems achieve high efficiency by utilizing the relatively stable temperatures below the Earth's surface as a thermal source and sink. Because the ground maintains a moderate temperature year round compared to ambient air, the GHP system can transfer heat over a smaller temperature difference, raising efficiency in both the heating and cooling seasons. Despite this inherent efficiency advantage, GHP systems have been limited by the high initial cost of the ground loop installation and the site-specific assessment and engineering design 24 requirements that must carefully consider the building heating and cooling loads in the overall ground-loop design. Innovations may include, but are not limited to, advances in heat exchangers, integrated design and simulation tools, improved installation techniques, and lifecycle energy and cost evaluation tools. As part of their proposals, applicants should quantify the state of the art metrics relevant to their innovation and estimate the improvements possible if the proposed innovation is successful. DOE is seeking improvements of 25% or more over current state of the art. While the DOE is open to innovations that specialize in a specific climate zones (e.g. cold-climate, hot-dry, or hot-humid), the commercialization plan must show the ability to deploy the innovation to a wider geographic area so it could make a significant impact on the United States GHP industry.

Questions – contact Arlene Anderson: arlene.anderson@ee.doe.gov.

SUBTOPIC 7A QUESTIONS:

1. **Can these changes be at the fundamental level? For instance, you mention integrated design; can we integrate a scroll expander and compressor?**
   Yes, as long as that innovation would reduce the cost and improve the performance of the GHP system ground loop.
2. **Does Topic 7 include the development of innovative monitoring systems in subsurface in order to improve geothermal efficiency?**
   Possibly, we are looking for innovations that reduce the cost and improve performance of GHP ground loop systems.

SUBTOPIC 8B: ADVANCED MANUFACTURING: Intelligent Systems for Materials Discovery

Methods are needed that provide insight into the underlying mechanisms or the process for discovering more such processes. The availability of increasing digital computational capability and algorithms that can make use of this capability has dramatically expanded the possibilities for machine learning and artificial intelligence. Such capabilities have yet to be coupled with combinatorial methods of materials discovery, and this is the focus of this subtopic. Investigators from small businesses are invited to collaborate with other researchers in the

materials and computational sciences to develop combinatorial discovery systems that are aided by artificial intelligence (AI) to expand the ease and scope of combinatorial discovery methods… Interdisciplinary teams of investigators are invited to submit Phase 1 research proposals in the following areas:

- Heterogeneous catalyst discovery: Systems for combinatorial discoveries and improvements of heterogeneous catalysts are widely available, and systems to guide catalyst discoveries with the aid of artificial intelligence are solicited. All types of heterogeneous catalysts are covered by this subtopic area – including electrocataysts for fuel cells and chemical catalysts used in industrial chemistry.
- Polymer discovery: Large numbers of polymer samples are typically analyzed for various coatings and other applications; intelligent systems to guide this search process is 27 solicited. This would greatly reduce the time needed in combinatorial searches of polymeric materials for a desired end use.
- Thin films for energy applications: Applications for thin film semiconductor and dielectrics used in photovoltaic applications, fuel cells are solicited. etc. Many combinations of thin film materials are used to improve the performance of energy conversion devices, and routinely assayed by combinatorial methods.
- Other energy related materials such as thermoelectrics, thermocalorics, magnetic materials, and supercapacitors: These materials are sorted using combinatorial methods to find those that improve the performance of numerous renewable energy conversion systems.
- Small molecule drug discovery: The number of possible geometric, stereo-, and enantioisomers of small molecules increases factorially with the number of constituent atoms, making the discovery of small molecules with desired pharmaceutical properties arduous and time consuming and typically involving thousands of samples in combinatorial libraries. AI applied to guide the search through interpretation of the data obtained in the search would be of great benefit to those involved in the drug discovery process. This subtopic is for the discovery system only, and any regulatory aspects of the development of a commercial system must be addressed by the investigators in conjunction with the appropriate Federal regulatory agencies.

Questions – contact Brian Valentine: brian.valentine@ee.doe.gov.

SUBTOPIC 8B QUESTIONS:

1. **Are only AI based approaches encouraged? How about recursive design methodology using traditional MD approaches?**
   That's fine, as long as it provides an intelligent search to the methodology. Knowledge has to be gained from the work that can then be applied to improve the materials discovery method.

2. **Does "Thin films for energy applications" include perovskites?**
   Yes, perovskite thin film solar cells are included.

SUBTOPIC 9A: BIOENERGY: Biofuel and Bioproduct Precursors from Gaseous Waste Streams

The DOE seeks grant applications for development and demonstration of non-photosynthetic technologies and processes that capture and use carbon oxides to generate biomass, organic chemical intermediates, value-added organic chemicals and/or organic fuels. The integrated system can employ any combination of electrochemical, thermochemical, catalytic or biocatalytic (whole cell or cell free) unit processes to perform the non-photosynthetic conversion of inorganic carbon oxides into organic carbon species. Other considerations include:

- Proposed systems must utilize gaseous waste streams that would otherwise be released to the atmosphere as the primary feedstock to produce fuels. Flue or other waste gases containing CO2 and/or CO are the primary target.
- By Phase II, and preferably within Phase I, proposed projects should employ actual (rather than model or synthetic) waste streams as feedstocks.
- …must develop and run pilot systems by the end of Phase II, at a relevant scale (e.g., 100–1,000 L reactor volume).
- …must address the overall energy balance of the proposed system
- …must minimize the ratio of required energy inputs to the energy potential of proposed outputs.
- …must maximize utilization of the carbon available in relevant resource streams.
- Proposals that use algae or any other organism or process that requires sunlight will be considered non-responsive.
- …must present the possibility of producing commercially relevant and economically competitive higher hydrocarbons from gaseous sources to displace petroleum. Examples include formic acid, butanol, 1,4-butanediol, and medium-chain fatty acids, such as succinic, muconic, and lactic acids. Proposals that strive to complete the conversion of relevant feedstocks to jet or diesel fuels by the end of phase II are particularly encouraged.
- …may assume the availability of renewable electrons. However, by the end of phase II, projects must complete preliminary life cycle assessments that make realistic assumptions about the sources of energy used in conversion.
- If an external source of hydrogen is part of the process, it must be renewable by the end of phase II. Hydrogen from natural gas may be used as a test material in the early stages,

but the application must clearly articulate how renewable hydrogen will be supplied by the end of phase II.

Questions – contact Mark Philbrick: mark.philbrick@hq.doe.gov.

SUBTOPIC 9A QUESTIONS:

1. **What demo scale would be acceptable during Phase I?**
   It would need to be at least a liter; ideally a little bigger.

SUBTOPIC 9B: BIOENERGY: Manipulation of Nanocellulose into High-Value Products

The Department of Energy seeks grant applications for projects which use nanocellulose to create high-value products. The unique and variable properties of these materials, such as strength, elasticity, density, and ability to self-assemble, as well as their capacity to be functionalized make nanocellulose a promising substance for a number of uses. …. Depending on the extraction process the size, crystallinity and mechanical properties of nanocellulose fibers can vary greatly, implying that a wide variety of applications for the material are possible. Recent work has shown that applications as structural composites, insulation, membranes, filters, packaging materials, thickening agents, and electronics are possible from nanocellulose. …DoE is open to a variety of technologies and applications for this solicitation, however, a clear economic value to the nanocellulose based product must be demonstrated. Other items are:

- The target product must be clearly described, including its production and final structural, chemical, and mechanical properties. Description also must include the specific characteristics of the nanocellulose required to produce the target product and a brief description of how that particular nanocellulose would be acquired or generated for the proposed work.
- The current market for the target product and/or its existing counterpart must be clearly described.
- Applications must quantify the advantage of using nanocellulose for the target application in comparison to conventional materials. This can include reductions in production cost or fossil carbon usage or it can be based on improved properties of the target product.

Questions – contact Ian Rowe: ian.rowe@ee.doe.gov.

SUBTOPIC 9B QUESTIONS:

1. **Are cellulosic biomass deconstruction strategies of interest to EERE?**

Yes, they are of interest as long as whatever innovation involved in this deconstruction process enables the generation of nano-cellulosic fibers, while still allowing for the utilization of c5 hemicellulos.

SUBTOPIC 10A: BUILDINGS: Innovations to Improve Window Cost and Performance

The US DOE is interested in the development of low-cost, highly insulated windows in two ranges of insulation performance: 1) windows with NFRC U-values in the range of 0.20 to 0.14 [Btu/hr-ft2-F] (R5 to R7) and 2) windows with NFRC U values in the range of 0.13 to 0.10 [Btu/hr-ft2-F] (R8 to R10) that are marketable based on cost, visible light transmission, weight, and ease of installation. We also have interest in lower cost dynamic glazings that allow for significant modulation of the solar heat gain coefficient (SHGC), from 0.10 in the switched or darkened state to 0.50 in the clear state. In pursuit of these objectives DOE seeks:

- Low-cost, insulating glass unit filling such as noble gases like Argon and Krypton that are also fast, and efficient
- Window spacers that allow for installation of non-structural inter-panes or inter-layers to enable multiple cavity insulated glass units without increasing gas leakage potential;
- Low-cost and highly reliable glass to metal bonding for use in vacuum glazings including possible overall vacuum glass edge sealing that can withstand large thermal expansion structural loads and that allows for ease of glass sizing without complex customized molds or specialized glass processing;
- Low-cost and easily installed vacuum glass standoffs that minimize thermal conductions, compression stress points, and have minimal degradation of view through a vacuum glazing;
- Coating methods for dynamic glass that has the potential to offer very high durability (e.g. high temperature, high UV, and optical dynamic cycling concurrently in accordance with a variety of ASTM test protocols) at very low cost (e.g potential to achieve $5 per sq ft price premium over typical double pane low-e insulated glass units);
- Dynamic glazing designs that through lower cost designs, and system level applications, have the potential to achieve a simple payback of less than five years.

Questions – contact Marc LaFrance: marc.lafrance@ee.doe.gov.

SUBTOPIC 10A QUESTIONS:

1. **Can you explain the low-cost, fast, and efficient Krypton gas insulating glass unit filling? Is this system requiring a Krypton vacuum pump or compressor development? Is there a state-of-the art for this type of technology?**

Krypton filling for insulating glass panels are one of several inert/ noble gases used for such purposes

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SUBTOPIC 10B: BUILDINGS: Innovations in Solid-State Lighting for Buildings

The focus of this technical subtopic is identification of nascent and niche opportunities that will leverage the tremendous power of SSL towards achieving the DOE's aggressive energy conservation goals in buildings. These business opportunities might include new, novel or innovation applications of emerging technology that can be used to produce a commercially viable intermediate SSL products or components, provide unparalleled opportunities for lighting control or connectivity or addresses a unique lighting opportunity where energy conservation can be complemented by other lighting-related impacts such as improvements to animal or horticultural growth, productivity, health and well-being. Examples of applicable SSL components might include advancements in power supply design that overcomes certain performance and efficiency limitations especially during dimming or incorporation of light management techniques that direct more light where required thereby reducing power consumption. SSL is uniquely compatible with digital controls and evolving flexible connections to the Internet of Things (IOT). Today, the lighting industry is just beginning to identify opportunities to leverage the unique command and control attributes of SSL in large volume applications. But there are many smaller opportunities in the building environment where the introduction of novel and imaginative new products can leverage the power of connectivity. These might be certain niche applications that are unattractive for a large manufacturer due to their small market potential but may be just the right sized opportunity for a small business or one with highly flexible design and manufacturing capability. There may also be opportunities to power SSL products completely off grid eliminating the cost and complexity of delivering power to remote or difficult locations and harvesting the power of advanced photovoltaic, control and storage technologies by crosscutting with related DOE EERE program objectives. Combining the performance and spectral properties unique to SSL with animal, horticultural or human benefits is emerging as a potential high impact application whose value is just beginning to be realized. Applications that seek to combine the energy conservation and spectral benefits to commercial enterprises such as controlled environment agriculture or circadian regulation or other physiological effects are sought. The above are suggested opportunities and examples but should not be considered as a restriction to other imaginative new and novel intermediate components, luminaires or intellectual property. This subtopic is therefore open to any new and innovative concept that fits generally into the mission of the DDOE SSL Program and that demonstrate some level of technical risk and commercial viability. Applications that reflect ideas that have already been demonstrated by the DOE or other Federal Agencies or investment mechanisms are not eligible. Proposals that seek to advance existing designs or products with improvements normally associated with commercial product evolution are similarly ineligible. Likewise, concepts that fail to demonstrate a viable pathway to commercial

success and that represent the potential to make a lasting and positive impact on the evolution of energy efficient, high quality solid-state lighting will not be accepted. The key metric for judging responsiveness of all proposals will be the commercialization potential identified in the applications, quantitative comparison to existing products or components and technical risk retirement during Phase I.

Questions – contact James R. Brodrick: james.brodrick@ee.doe.gov.

SUBTOPIC 10B QUESTIONS:

1. **Would this Topic include development/cost reduction of phosphor materials?**
   Yes, that would be a viable Topic.

SUBTOPIC 10C: BUILDINGS: Innovations to Improve IAQ and Comfort Performance in Energy Efficient Residential Buildings

Since 1994, the rigor of the national energy code (IECC) has increased over 40% by applying high performance building envelope innovations proven with Building America research and demonstration. But, before substantial additional insulation and air-sealing requirements can be responsibly adopted into future advanced building energy codes and home energy upgrade programs, indoor air quality (IAQ) and comfort risks must be better managed by the housing industry. 41 Significant progress has been made, through research, demonstration, and development of ventilation equipment and standards. Building America Top Innovation Profiles highlight several of the most impactful residential IAQ technology and industry standard developments to date. However, significant technology gaps remain in residential building comfort and IAQ control. Research and field-testing by Building America industry teams and others have advanced relevant building science knowledge, developed best practice guidance, identified common IAQ and comfort failures, and identified additional research and technology needed to help the industry reliably achieve optimal IAQ, comfort, and energy efficiency in modern houses. The Building America Research to Market Plan includes two roadmaps for addressing these challenges - the Optimal Ventilation and IAQ Solutions and Optimal Comfort Systems for Low-Load Homes - which summarize the state of the art in IAQ and comfort performance and control technologies, lay out specific objectives related to these challenges, and include extensive reference lists for each roadmap. With this technical subtopic, BTO seeks to identify and encourage development of innovative technologies with the potential to improve IAQ and comfort in new and existing homes, without little or no energy penalty and very low incremental cost to builders and contractors. Preference will be given to technology solutions that are applicable to both new homes and the existing building stock. While modest feasibility studies are appropriate for Phase I funding, applications for this subtopics should be transitioning to manufacturing by Phase II to be considered for further funding. BTO strongly encourages applicants to include a strategy for obtaining manufacturing partners by the end of

Phase 1 as a part of their commercialization plan. Specifically, DOE is interested in the following IAQ and comfort control technology applications:

- Low-cost humidity control systems and solutions, particularly those that are integrated with central cooling and/or ventilation systems, and are cost competitive with current ERV technology;
- Low-cost, reliable add-on sensors and controls for improved operation and maintenance of existing HVAC systems, particularly those that enable system optimization and/or improve system reliability;
- Automated and/or assisted (i.e., "intelligent") HVAC system commissioning tools, particularly those that address total system performance including distribution efficiency;
- Smart ventilation/IAQ systems (sensors, controls, hardware, software) that optimize IAQ and minimize energy penalties, based on indoor conditions (i.e., temperature, RH, pollutant levels), outdoor conditions (i.e., temperature, RH, and/or pollutant levels), occupancy, and other variables such as weather forecast data.

Questions – contact Eric Werling: eric.werling@ee.doe.gov.

SUBTOPIC 10C QUESTIONS:

1. **Are there specific pollutants or species that are of interest for smart ventilation systems, and does an application need to address all of the elements, or can one element be addressed?**
   We have information on the Building America website [URL] about ongoing projects, and one of the projects identifies some of the pollutants that we identify as being of most concern. Any single element that would make a difference in controlling indoor air quality in a building would be open for our consideration.

SUBTOPIC 11A: FUEL CELLS: Innovative Materials and/or Technologies for Bipolar Plates for PEM Fuel Cell

Bipolar plates account for approximately 30% of the stack cost and 60% of the stack weight in polymer electrolyte membrane (PEM) fuel cells. This subtopic solicits applications that directly or indirectly address the cost and weight reduction of PEM fuel cell stacks. Applications should focus on innovative materials, manufacturing processes and/or designs of bipolar plates. Projects should aim to achieve one or more of the following:

- Development and testing of innovative materials with superior performance, high stability and corrosion resistance with reduced cost.

- Development of innovative designs to improve thermal and flow management that could lead to lowering balance of plant requirements. All proposed projects must demonstrate potential to meet or exceed DOE's 2020 bipolar plate technical targets as well as the cost target of $3/kW. To achieve the targets, advancements in manufacturing processes that result in lower production cost, accelerating the manufacturing and assembly time, and in enhanced bipolar plate durability should be considered. Manufacturing processes leading to lighter, thinner, more durable and easier to fabricate bipolar plates can include but are not limited to sealing, joining, and forming. All proposed designs should be suitable for transportation applications and contribute to meeting DOE's stack technical targets [2]. This subtopic is looking for completely innovative/out-of-the-box approaches and does not encourage the approaches that have already been funded by DOE.

Questions – contact Bahman Habibzadeh: bahman.habibzadeh@ee.doe.gov.

SUBTOPIC 11A QUESTIONS:

1. **Would a proposal to develop low-cost manufacturing and assembly methods for metal bipolar plates be responsive to this Topic?**
   Development of a design for low-cost manufacturing and assembly methods would be ok.

SUBOPIC 11C: FUEL CELLS: Emergency Hydrogen Refuelers

Fuel Cell Electric Vehicles (FCEVs) are now commercially available in certain parts of the U.S. and other countries of the world. The utility of FCEVs is limited by the installation of hydrogen fueling stations. Even though current commercial FCEVs have driving ranges of about 300 miles, due to the sparsity of hydrogen fueling stations in the early years of FCEV commercialization, it is expected that many FCEV drivers will experience range anxiety. The California Fuel Cell Partnership's hydrogen stations website lists a total of 41 retail hydrogen fueling station open or expected to be opened in the state by the second quarter of 2017 [1]. Based on feedback from stakeholders, one way to alleviate range anxiety is to provide drivers with an "emergency hydrogen refueler" capable of providing sufficient hydrogen for them to drive to the nearest hydrogen fueling station. Applications are sought for the development of two types of emergency hydrogen refuelers:

- Roadside assistance – portable emergency hydrogen refuelers to be carried on roadside assistance vehicles and capable of providing hydrogen to at least 3 stranded vehicles before needing to be recharged;

- Personal devices – portable emergency hydrogen refuelers that can be carried onboard the FCEV, such as in the trunk, easily handled by the driver and able to provide hydrogen to at least one stranded vehicle.

Emergency hydrogen refuelers must provide a high level of safety under both of the above use and storage conditions. The devices must be able to store hydrogen for extended periods of time without loss of hydrogen. They must also be capable of connecting to FCEVs and delivering hydrogen into the onboard hydrogen storage system on demand. Emergency hydrogen refuelers for use on roadside assistance vehicles should be rechargeable, whereas personal emergency hydrogen refuelers may be either rechargeable or one-time use devices. 46 Phase I of this effort is expected to include an in-depth analysis that includes storage technology choice, including the proposed material to be used for material-based systems, preliminary engineering designs and projected system costs. Justification for the amount of hydrogen stored should include the number of vehicles to be serviced between device recharging and the driving distance enabled. For reference, the rated fuel economy of available FCEVs is provided on the fueleconomy.gov website [2]. Projections of the system mass and volume should be provided. [2] The phase I effort should identify the key technology gaps and engineering requirements that need to be addressed for successful development of the proposed device. Identification of additional applications where the proposed device could be used and provide benefit in enabling commercialization of hydrogen fuel cell technologies will further strengthen the proposal. No material or hardware development should be proposed as part of the Phase I effort. Phase II of the effort should focus on development of the proposed emergency hydrogen refueler, addressing the key technology gaps and engineering requirements identified in phase I. Hardware development, testing, and demonstration is expected to be included in the phase II effort. Either sub-scale system or full scale systems may be proposed as appropriate. Identification of commercialization strategies and a market analysis should be included in the Phase II application. Identification of potential commercialization partners, with indication of commitment, also should be included in the Phase II proposals.

Questions – contact Ned Stetson: ned.stetson@ee.doe.gov.

SUBTOPIC 11C QUESTIONS:

1. **Emergency Refuelers: Please define specifications and current requirements under consideration.**
   These specifications are available at http://www1.eere.energy.gov/hydrogenandfuelcells.
2. **Could we design a system for powering drones (quadcopters)?**
   This Topic is for commercial non-airborne vehicles only.
3. **How much hydrogen pressure is needed for fuel cell electric vehicles refueling?**

Depending on whether you are proposing a materials base subsystem or compressed hydrogen, we have a target available at http://www1.eere.energy.gov/hydrogenandfuelcells.

4. **What is the driving distance that has to be enabled for a vehicle on average?**
   These specifications are available at http://www1.eere.energy.gov/hydrogenandfuelcells.
5. **In terms of price point for the material, does that have to be known at the end of Phase I or can it be finalized at some other point?**
   We do need the projected cost, and we will be taking this into consideration when we compare different proposals.

SUBTOPIC 12A: GEOTHERMAL: Innovations that Enable Commercial Deployment of Enhanced Geothermal Systems

The Geothermal Technologies Office seek the development and commercialization of innovations that will enable cost-competitive deployment of EGS-based electricity generation in the U.S. We are interested in a broad range of innovations, as described in GTO's 2013 EGS Roadmap. Innovations of interest can be in software, which may include, but are not limited to, models and algorithms, such as real-time joint inversion or multicomponent fully-coupled geomechanical models. Other innovations of interest can be in hardware, which may include, but are not limited to, tools and materials, such as zonal isolation tools, down-hole sensors, packers, or diverters. Specifically not of interest in this topic area is the development of new tracer materials to include synthetic or naturally occurring chemicals that are used determine fluid path and velocity within a reservoir. (Other innovations that make use of tracers are acceptable.) As part of their proposals for this topic, applicants should estimate the potential improvements over the state of the art using metrics relevant to their innovation. GTO is seeking improvements that will lower the Levelized Cost of Energy to 6¢/kWh for EGS, which can be modeled using the Geothermal Electricity Technology Evaluation (GETEM) model. Applicants should also provide their anticipated outcomes of Phase I as well as a path to phase up to potential Phase II follow on work and potential outcomes of Phase II. Proposals that include realistic scopes that would have them prepared for a field demonstration by the end of a Phase II will be given favorable consideration.

Questions – contact Josh Mengers: joshua.mengers@ee.doe.gov.

SUBTOPIC 12A QUESTIONS:

1. **What would be the interest level for a diagnostic instrument that would be able to detect early signs of mechanical fatigue to increase the reliability and decrease the cost of drilling operations and process piping?**

This does not sound EGS-specific – it sounds like drilling, which could be applied to many different operations that are beyond EGS. However, if you show us that this innovation is specific to EGS, then we will certainly take consider it.

2. **Are you looking for improvements in the power cycle?**
   We will not exclude that, but it would be very difficult to for this to be an EGS-specific innovation, which is what we are focused on. If you can show that the improvement to the power cycle is specific to EGS, then we would consider at it. We do encourage you to submit an LOI or contact us directly if you are uncertain.
3. **Does Topic 12 include the development of innovative monitoring systems in subsurface in order to improve geothermal efficiency?**
   It certainly can, but it needs to be EGS-specific. There are many things that need to be monitored that are EGS-specific, e.g. micro seismic sensors that can show reservoir volume and those sorts of measurements.

SUBTOPIC 13A: SOLAR: Next Generation CSP Components For High Temperature Molten Chloride Salt Development

The next generation of Concentrating Solar Power (CSP) systems is expected to operate at temperatures above 700°C to achieve high thermal-to-electric efficiency and enable cost competitiveness with conventional methods of electric power generation. To date, SETO has identified molten chloride salts (for example, a eutectic mixture of KCl-MgCl2, among other possible compositions) as a highly promising heat transfer fluid (HTF) and thermal energy storage (TES) media capable of operating between 550°C and 750°C. The high working temperatures and corrosive properties of these salts represent aggressive environments for CSP system components. This subtopic is focused on RD&D leading to demonstrating major subcomponents (i.e. solar concentrators, receivers, thermal energy storage systems, and power cycles) that can operate at high efficiency and low-cost under these conditions. The development of the next generation of components will require demonstration in a fully integrated facility at a commercially relevant scale. For this purpose, the DOE is seeking proposals that involve development of the following aspects of the molten salt system: [1] Impellers for molten salt pumps require materials and manufacturing techniques that are far less susceptible to corrosion and blade tip erosion than current technologies. [2] Seals and bearings must be redesigned to perform robustly and reliably for this high temperature corrosive environment. Bearings in particular must be impervious to salt migration and freezing of rotating assemblies. [3] Molten chloride salt tanks for thermal energy storage containment costs must be reduced; For example, use of high nickel content alloys should be minimized or eliminated—especially for large tanks. [4] Systems to remove O2 and H2O in high temperature molten salt such as gas bubbling, gas sparging or chemical means to reduce chloride salt corrosion. [5] Systems to monitor O2 and H2O at parts per million levels are needed for larger scale testing and reliability.

SUBTOPIC 13A QUESTIONS:

1. **Would the DOE be interested in pursuing ceramic impeller designs which possess corrosion resistance and wear resistance? As an alternative solution, would the application of coatings on impellers to impart corrosion and wear resistance be considered?**
   Any solution to one of the five identified aspects of next generation molten salt systems that is cost effective, and robust, at the temperatures identified in the solicitation, will be of interest.
2. **Is this Topic only interested in using Chloride salts? Or is the Topic about practical uses of the concepts related to Molten Salt stored energy? Can other salts be used in the storage device for this proposal?**
   Applications to for Topic 13a must be able to address one or all of the 5 aspects of molten salt system described in the topic. DOE is agnostic as to the specific composition of the salt, but it must be capable of achieving temperatures greater than 700 C.
3. **Will you accept for evaluation any SBIR proposal that addresses the first subtopic focus (major subcomponents such as solar concentrators, receivers, storage systems), even if they do not include one of the five specific aspects described in the second paragraph (impellers, seals, tanks, systems for removal or monitoring O2 and H2O)**
   Under Topic 13a, DOE is seeking applications to develop components that address any or all of the 5 aspects of molten salt systems described.
4. **You mention Power Cycles. Can you give an idea of what type of power output you're look at? What is a commercially relevant scale?**
   We are looking at subcomponents able to generate a power output in the range of 50-150 MW. We expect a demonstration of the new technology in a fully integrated facility in the 3-10 MW scale.
5. **Will we consider molten salt pumps without impellers?**
   Yes, as long as these solutions meet the high-performance and cost criteria discussed in the sub-Topic.

SUBTOPIC 13B: SOLAR: CSP Operation and Maintenance (O&M) Innovation

Existing CSP installed capacity in the U.S. is more than 1 GW and growing worldwide. Improvements in O&M practices to assure performance at nameplate ratings are desired. Advances are sought in Detection and correction of heliostat aiming and mirror canting that is rapid, accurate, and cost effective.

SUBTOPIC 13B QUESTIONS:

1. **Is the O&M funding only for those four CSP projects that were referenced in your clarification?**

We would prioritize the O&M based on applicability to existing commercial systems in the US, but would broaden this to say any existing CSP system that is in operation.

SUBTOPIB 13C: SOLAR: Photovoltaic Performance and Reliability Tools And Characterization Methods

For all sized PV system sizes, primary drivers of the levelized cost of photovoltaic (PV) electricity and investor return on investment, are the lifetime and reliability of system components. The reliability of a given component is set on the manufacturing floor and extends through its entire deployed lifetime. In order to ensure proper function over the entire lifecycle of a deployed system, applications are sought in: 1. Methods for detailed active monitoring of PV systems from small residential to large utility scale. Metrology and characterization tools to advance efficiency and reliability of fielded PV systems. 2. Hardware and/or software tools to facilitate operations and management of PV systems. 3. Areas of interest include: (1) Technology- and manufacturer-agnostic detection hardware or software tools capable of identifying, locating, and/or diagnosing the cause of underperforming modules and system hardware within a given array; (2) Tools and procedures for automating or streamlining the identification of maintenance events, defective part replacement, and other corrective procedures that will maximize the long term value of the array; (3) Advancing and developing essential in-line metrology tools connecting to device and module performance/reliability; (4) Characterization tools for understanding device and module performance and degradation consistently connecting to the device and module behavior. In addition, methods or tools developed for should focus on minimizing the capital cost of the product to have a minimal impact on project or product return on investment.

SUBTOPIC 13C QUESTIONS:

1. **Does the Phase I project have to be a full-scale (i.e. module-size) characterization prototype?**
   No, it does not have to be a full size tool in Phase 1, but the output of the project should be able to confirm the functionality of the proposed tool and have a line of sight to being made and sold competitively at its full production scale.

SUBTOPIC 14A: VEHICLES: Electric Drive Vehicle Batteries

Applications are sought to develop electrochemical energy storage technologies that support commercialization of micro, mild, and full HEVs, PHEVs, and EVs. Some specific improvements of interest include the following: new low-cost materials; high voltage and high temperature non-carbonate electrolytes; improvements in manufacturing processes – specifically the production of mixed metal oxide cathode materials through the elimination or optimization of

the calcination step to reduce cost and improve throughput, speed, or yield; novel SEI stabilization techniques for silicon anodes; improved cell/pack design minimizing inactive material; significant improvement in specific energy (Wh/kg) or energy density (Wh/L); and improved safety. Applications must clearly demonstrate how they advance the current state of the art and meet the relevant performance metrics listed at www.uscar.org/guest/article_view.php?articles_id=85. When appropriate, the technology should be evaluated 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. Applications will be deemed nonresponsive if the proposed technology is high cost; requires substantial infrastructure investments or industry standardization to be commercially viable; and/or cannot accept high power recharge pulses from regenerative breaking or has other characteristics that prohibit market penetration. Applications deemed to be duplicative of research that is already in progress or similar to applications already reviewed this year will not be funded; 53 therefore, all submissions should clearly explain how the proposed work differs from other work in the field.

Questions - contact Brian Cunningham: brian.cunningham@ee.doe.gov.

SUBTOPIC 14A QUESTIONS:

1. **Can hybrid, ceramic, and polymer electrolytes be considered?**
   Yes, we just want to make sure that they are addressing the separator goals that were posted online.
2. **If I have a technology that meets the overall goal of making safer, more energy-dense, and less expensive batteries, even if it doesn't explicitly fit within the USABC goals for electrolytes or separators, does that still fall within this Topic?**
   As long as it is an electrochemical device, the answer would be yes.

SUBTOPIC 14C: VEHICLES: Fuel Efficiency Improvement Technologies for Conventional Stoichiometric Gasoline Direct Injection Multi-Cylinder Internal Combustion

Engine Exhaust after-treatment systems have been extensively used and are effective in reducing engine out exhaust emissions from automobile engines. The intent of this subtopic is to pursue the development of technologies that can improve the fuel economy of vehicles with modern Gasoline Direct Injection (GDI) engine powertrains while meeting regulated exhaust emissions requirements with modern 3-way catalytic converters under stoichiometric conditions. For Phase I, applications must propose the development and demonstration of a

functioning prototype by modifying a mass-produced, commercially available, GDI multicylinder automotive reciprocating engine, retrofitted with the subject technology. Reporting must include fuel consumption test results over representative operating points of the engine map with the prototype technology installed compared with test results over the same operating points of the unmodified engine. All fuel consumption testing must be conducted according to automotive industry norms. Only statistically valid fuel economy improvements (95% confidence level) will be considered for Phase II funding consideration. Phase II work will focus on improving the effectiveness or durability of technologies successfully demonstrated in Phase I. For this subtopic, novel ignitions systems by themselves will not be considered. Novel ignition systems may be considered as part of an improved technology package if they are necessary to employ other parts of the technology package.

Questions - contact Leo Breton: leo.breton@ee.doe.gov.

SUBTOPIC 14C QUESTIONS:

1. **Is it limited to gasoline fuel only or can we bring an ethanol water methanol component on demand to boost engine efficiency?**
   Ethanol on demand would certainly fit here. Our focus is being able to have an engine that can meet emission standards. Any modification, as long there's no reason to believe it will render mission controls inoperable, would fit this description.
2. **Is there a National Lab or facility that can be used for testing where such a program is in progress?**
   There at least three National Labs that could be coordinated with, and the best option would depend on what the approach is.

SUBTOPIC 14D: VEHICLES: Wide-Range High-Boost Turbocharging System

Turbocharging is recognized as one of the best options for improving fuel economy with engine downsizing. While this strategy has already demonstrated a degree of success, downsizing and fuel economy gains are currently limited by the ability of low-cost turbocharging systems to provide high boost pressures over a wide range of engine speeds. A turbocharging system is needed that provides high boost pressure from a single turbocharger over an engine speed range of approximately 1000 rpm to 5000 rpm. Applications are sought to develop and test an advanced low-complexity turbocharging systems that provides high boost pressure at all engine speeds and that has minimal turbo lag. The boosting system should support a maximum engine brake mean effective pressure of at least 25 bar as well as have high efficiency in order to maximize vehicle fuel economy. The turbocharging system should be compatible with current technology as well as emerging technology for engines, such as Miller Cycle engines variable valve timing systems, variable compression ratio engines, etc. Because of the ongoing emphasis on downsizing, these engines are expected to have high mechanical compression ratios, which

should be considered. Low cost solutions are needed to support sales volumes of these highly boosted engines on a large enough scale to have a measurable impact on reducing national fuel consumption. Technologies that will not be considered under this subtopic include electrically, hydraulically or mechanically driven boost devises and the use of multiple turbochargers.

Questions - contact Roland Gravel: roland.gravel@ee.doe.gov.

SUBTOPIC 14D QUESTIONS:

1. **What is the target market for the turbocharger? Automated gasoline engines?**
   The target market is for light duty passenger vehicle engines.

SUBTOPIC 15A: WIND: Enabling Wind Power Nationwide

The Wind Energy Technologies Office is seeking proposals for technology innovations with the potential to enable wind power to generate electricity offshore and in all 50 states cost competitively with other sources of generation. This is an open call and areas of interest include, but are not limited to, the following:

- Lower cost monopole tower and foundation designs for small wind (100kW or less) applications. Current tower and foundation designs can account for up to 50% of installed costs. [1,2]
- Advanced, innovative manufacturing technologies capable of increasing production volumes and reducing costs of wind turbine components for small wind [1,2]
- Advanced manufacturing technologies and processes to facilitate assembly-line production methodologies of offshore foundations for fixed bottom or floating applications [3,5]
- Mooring systems for floating wind turbines in deep waters (over 1000m depth) [3,5]
- Technologies that overcome transportation constraints for towers taller than 140m [4]
- Technologies that overcome transportation constraints for rotor blades longer than 65m [4]
- Technology solutions to mitigate wildlife impacts for land-based and/or offshore wind plants [4,5,6,8]
- Addressing the high investment and processing costs to recycle wind turbine blades, for the existing fleet and/or new blade materials that can facilitate recycling in the next generation of blades [7]
- Innovative materials research/applications, including additive manufacturing, recycling, and low cost carbon fiber that lower cost and increase reliability.

All applications must:

- Propose a tightly structured program which includes technical milestones that demonstrate clear progress, are aggressive but achievable, and are quantitative;
- Include projections for price and/or performance improvements that are tied to a baseline (i.e. Vision or Roadmap targets and/or state of the art products or practices);
- Explicitly and thoroughly differentiate the proposed innovation with respect to existing commercially available products or solutions;
- Include a preliminary cost analysis;
- Justify all performance claims with theoretical predictions and/or relevant experimental data.

Questions – contact Michael Derby: michael.derby@ee.doe.gov.

SUBTOPIC 15A QUESTIONS:

1. **I am interested in proposing a coating for wind turbine blades. Is this Topic acceptable?**
   Yes, this would be of interest, as there are issues of blade erosion and addressing those issues could affect the overall performance of the wind plant and the cost of energy.