2014 ARPA-E Energy Innovation Summit

Showcase Submission Information Template

Use this template to prepare your answers for the online Technology Showcase Submission Form. Required fields are identified below with a red asterisk. (*)

Important!
If you are an **ARPA-E awardee directly receiving funding from ARPA-E**, you will be invited to participate, please do **NOT** complete the online application. You will receive an email from the Technology Forums team including your ARPA-E project control number. If you are a subcontractor or prior ARPA-E Awardee, you may complete the application.

Primary Applicant Information
(You will be prompted to enter the information in title case (uppercase and lowercase))

- *First Name: Gary
- *Last Name: Rochau
- Suffix:
- Rank/Title:
- *Organization: Sandia National Laboratories
- Division/Branch:
- *Job Title: Manager, Advanced Nuclear Concepts
- *Address (City, State, Zip/Postal Code): P.O. Box 5800, MS-1136, Albuquerque, NM 87185-1136
- *Country: USA
- *Phone Number: (505)845-7543
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Submission Details

- * Title: Supercritical CO_2 Brayton for Compact High Efficiency Power Generation

Additional Details

- *Select Category
  - Lead Awardee (STOP – do not complete this application)
  - ARPA-E Awardee Subcontractor
  - ARPA-E Alumni
  - None of the above

- *Technology Summary: Describe the technology you are developing and how it works. (200 word max)

Sandia National Labs, through support from DOE-NE, is developing a thermal-to-electric power conversion technology in a configuration called the recompression closed Brayton cycle (RCBC). The closed Brayton cycle (CBC) is a proven power conversion technology that uses supercritical carbon dioxide (SCO_2) as the working fluid, rather than steam, which will dramatically increase conversion efficiency compared to the steam Rankine cycle. The primary reason for improved efficiency is that a sensible temperature difference between the hot turbine discharge and the cold compressor discharge drives heat transfer within the cycle, which provides the vast majority of the heat addition to the high pressure fluid. The heat rejected while condensing steam at constant temperature in a Rankine cycle is avoided. While this process of internal heat recuperation applies to any gaseous working fluid, SCO2 has the beneficial characteristic that it is relatively incompressible and dense at normal atmospheric temperatures. Therefore, the low temperature condition in the cycle that minimizes the work of compression is easily and cheaply achieved. Some studies show up to 5 percentage points in conversion.

- *Transformational Merit: What is transformational about this technology? How is it different from existing technologies? (200 word max)

The thermal-to-electric conversion efficiency of the closed Brayton cycle can be dramatically higher than other cycles for applications such as nuclear energy, concentrated solar power, and waste heat sources. System size is also significantly reduced compared to steam cycles which reduces capital expenditures such as for materials and facilities. This cycle can generate electricity from any heat source, including waste heat, making it highly versatile. It can be installed as a primary or bottoming cycle to the heat source. The benefits of this technology will dramatically reduce the costs of energy production, reduce greenhouse gas emissions, and is applicable to any heat source. The economic impact of this technology will be measured in $10's of billions of dollars on an annual basis.

- *Next Steps: List technical challenges, developmental milestones, and/or other next steps needed to get this technology into the market. (200 word max)

Technical challenges pertain primarily to system operations, high temperature materials development, and heat exchanger development. System operations research must answer the following: how to start the cycle up, operate safely and optimally at steady state, adjustments to operating conditions as boundary conditions change, emergency procedures, and shutdown procedures. The primary complication arises from operating the compressor near the SCO_2 critical point, where fluid properties vary rapidly with temperature. Cycle efficiency improves as operating temperatures increase, thus driving a need to develop high temperature materials. Compact, highly efficient, and reliable heat exchangers are an enabling technology for this cycle, and need to be developed. The engineering scale recompression cycle currently being tested at Sandia must be scaled up in a demonstration system to a size that is of interest to the private sector, which is currently estimated to be around 10 MWe. Industrial partners are sought for collaboration in all of these major activities with the objective of commercializing this technology by 2020 or earlier.

- *Public Summary: Please provide a Technology Summary to be published on the conference website and in the printed program guide. (100 word max)

Sandia National Labs is developing a new thermal-to-electric power conversion technology that uses carbon dioxide (CO_2) as the working fluid in a closed Brayton cycle. This technology promises to generate electricity at efficiencies dramatically higher than those achieved by present day steam Rankine cycles. Significantly reduced costs and greenhouse gas emissions will be realized. Because of the unique properties of CO_2, the cycle matches very well with the ambient environment and can convert thermal energy into electricity more efficiently than the conventional steam Rankine cycle. This cycle can be applied to any heat source, including waste heat streams, and is scalable from a few megawatts to the largest present-day power plants.

- *Developmental Status (Choose one from drop-down menu)
  - Technology Prototype

  - Proof of Concept
  - Product Prototype
  - Pilot-Scale Prototype
  - Full-Scale Prototype
- *Application Area: (Choose one from drop-down menu)
  - Advance Fuels
  - Advanced Magnets
  - Building Efficiency
  - Carbon Capture Utilization
  - Control Systems
  - Electricity Transmission & Distribution
  - Energy Storage, Portable
  - Energy Storage, Stationary
  - Industrial Efficiency
  - Renewable Power Generation
  - Thermal Energy Utilization
  - Traditional Power Generation
  - Vehicle Technologies
  - Water
  - Other
    - If other – please state area
- Website URL: http://energy.sandia.gov/?page_id=9861
- Organization Size (Choose one from drop-down menu)
  - 1-15
  - 16-99
  - 100-499
  - 500-2499
  - 2500+
- *Have you participated in the Showcase before? Yes or No
- If yes, what years did you participate?
- From whom did you hear about this opportunity? (Choose one from drop-down menu)
  - Other Organization
  - ACCT Canada
  - Advanced Energy Economy (AEE)
  - American Council on Renewable Energy (ACORE)
  - American Energy Innovation Council
  - American Public Power Association
  - ARPA-E Promotion (email, business card, etc.)
  - ARPA-E Program Director

- Biotechnology Industry Association (BIO)
- CALSTART
- Center for Science Policy and Outcomes
- Chambers for Innovation and Clean Energy (CICE)
- Clean Edge
- Clean Energy Trust
- Cleantech Open
- Collegiate Energy Association
- Colorado Cleantech Industry Association
- DEED
- Earth Techling
- Electricity Storage Association (ESA)
- Environmental Entrepreneurs (E2)
- Fuel Cell and Hydrogen Energy Association
- GUIRR
- Gas Turbine Association
- Government Executive Media Group
- GreenTech Media
- IEE
- Information Technology and Innovation Foundation (ITIF)
- International Green Energy Council
- Licensing Executives Society
- MIT Technology Review
- NVCA
- National Hydropower Association
- New England Clean Energy Council
- N/A
- Northeast Sustainable Energy Association (NESEA)
- Pike Research
- Prescience International's Environmental Business Cluster (EBC)
- Scientific American
- U.S. Energy Association (USEA)
- UIDP

- Booth Features (Check all that apply)
  - Live Demo
  - Oversized or Special Items that Might Require Accommodation
  - Prototype
  - Video
  - Slideshow
  - Posters

- Banners or Large Signage
- Other
- No Information at this Time

- *Keyword: Enter a number of keywords separated by commas that will help attendees find your organization and technology.

Energy Conversion, Closed Brayton Cycles, Power Generation,