SUNPOWER

AMETEK

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Sunpower Inc. is awarded $3.5 million ARPA-E GENSETS program

Athens Ohio- Sunpower Inc., the inventor of the Free-Piston Stirling Engine (FPSE) technology, was awarded a $3.5 million award to develop a 40% efficient Stirling engine for the domestic micro combined heat and Power (mCHP) residential market.

From the ARPA-E website:

Critical Need:
In 2013, centralized U.S. power plants had an average electricity generation efficiency of only 33%, wasting 67% of primary energy as heat and emitting 2 billion tons of CO_2, about 38% of U.S. total emissions. Further, 6% of electricity is generally lost during transmission and distribution from the power plant to the customer. An alternative to centrally produced power is distributed generation, in which electricity is generated at the point of use. Residential combined heat and power (CHP) systems can burn natural gas to produce electricity for a home while also using the waste heat for space and water heating. The potential energy efficiency for CHP systems is more than 80% and significant adoption of such systems would enable dramatic reductions in primary energy use and concurrent CO_2 emissions. However, usage of small CHP systems is not widespread because systems currently on the market are limited by high price, low efficiency, and short lifetime. The GENSETS program seeks to develop 1 kW (electric) CHP generators that have high fuel-to-electricity generation efficiency, long life, low cost, and low emissions.

Project Innovation + Advantages:
Sunpower, Inc., in partnership with Aerojet Rocketdyne and Precision Combustion Inc. (PCI), proposes a high-frequency, high efficiency 1 kW free-piston Stirling engine (FPSE). A Stirling engine uses a working gas such as helium, which is housed in a sealed environment. When heated by the natural gas-fueled burner, the gas expands causing a piston to move and interact with a linear alternator to produce electricity. As the gas cools and contracts, the process resets before repeating again. Advanced Stirling engines endeavor to carefully manage heat inside the system to make the most efficient use of the natural gas energy. New innovations from this team include the highly efficient and high frequency design which reduces size and cost and can be wall mounted. The heater-head assembly acts as the heat exchanger between the burner and the enclosed working gas, and the higher temperature allows for greater efficiency. Aerojet Rocketdyne will assist this effort by developing high temperature materials to use in this process, while PCI will add a novel catalytically-assisted, two-stage, burner to maximize heat transfer to the heater-head.

Potential Impact:
If successful, Sunpower's project will facilitate development and commercialization of economical, efficient, and durable CHP systems for residential use. These advancements support progress toward ARPA-E's overall goals as follows:

Security:
Innovations developed in this project could help households and businesses become more energy self-reliant and less susceptible to energy-related outages through distributed, local generation of power and heat.

Environment:

Widespread adoption of high-efficiency residential CHP systems could decrease overall primary energy consumption and therefore reduce CO_2 emissions associated with electricity generation by up to 10%.

Economy:

Cost-effective natural gas-fueled residential CHP systems could offer consumers lower electricity and heating bills.

The project will last until 5/31/2018, and the goal will be a commercially available mCHP engine.