Generators for Small Electrical and Thermal Systems (GENSETS SBIR/STTR)

GENSETS Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) project teams will design, build and test improved electric-power generators for use in residential Combined Heat and Power (CHP) systems, which capture the generator's heat output for space and water heating. These CHP systems will be powered with natural gas and can supply the majority of a household's electricity and water heating needs as well as help heat the residence. In order to make small-scale CHP systems more affordable and stimulate their adoption, the GENSETS SBIR/STTR program aims to develop 1 kWe (electric) sized generators that are highly efficient (40% or greater), long lasting (10 years or more), low cost ($3,000 or less), and clean. The projects fall under three areas of technology focus: Stirling engines, internal combustion engines, and microturbines.

PROJECT DESCRIPTIONS

Stirling Engines

Sencera Energy, Inc. – Charlotte, NC

Kinematic Flexure-Based Stirling-Brayton Hybrid Engine Generator for Residential CHP - $1,754,452

Sencera Energy, Inc, will develop a novel kinematic Stirling-Brayton hybrid engine using flexure based volume displacement in lieu of conventional displacer and power pistons. The flexure-based design achieves the same function as a piston-cylinder set by simply changing the volume of the working spaces, as opposed to sliding a piston along the interior of a cylinder. The removal of pistons from the design eliminates the need for sliding seals such as piston rings or air/gas bearings, resulting in lower engine friction and fluid flow losses. It also potentially lowers the fabrication cost compared to other heat engines. The proposed kinematic engine design provides easy coupling to existing rotary alternator design, which allows the use of robust and mature off-the-shelf alternator technologies and controllers.

Internal Combustion Engines

Air Squared, Inc. – Broomfield, CO

A High Efficiency SACI 1kW Generator with Organic Rankine Cycle Waste Heat Recovery - $2,745,000

Air Squared Inc. will lead a team of partners to develop an advanced internal combustion engine (ICE) integrated with an Organic Rankine Cycle (ORC) for waste heat recovery. The ICE will use Spark-Assisted Compression Ignition (SACI), a Turbulent Jet Ignition (TJI) fueling system, high compression ratio, and aggressive exhaust gas recirculation (EGR) to deliver a higher thermal efficiency with low emissions. The ORC design uses the same components of a traditional steam-based Rankine Cycle, but with an ammonia/water mixture as the working fluid. Combined with a novel oil-free scroll expander, this ORC system is projected to cost one third of existing systems.

Microturbines

Mohawk Innovative Technology, Inc. – Albany, NY

High-Speed Microturbine with Air Foil Bearings for Residential CHP - $2,500,000

Mohawk Innovative Technology, Inc. (MiTi) and its partners will develop a 1 kW microturbine based on their Hyperlaminar Flow Engine design. Key innovations of their design include viscous shear-driven turbomachinery, flameless combustion, and lubricant-free air foil bearings. Traditional aerodynamic-based devices derive their work production from inertia effects, while the Hyperlaminar Flow Engine is characterized by the use of turbomachinery that derives most of its work production from viscous shear. The system also uses a flameless combustor to attain high combustion efficiency and low emissions. Furthermore, MiTi's advanced air foil bearings use no lubricants, have low power loss, can operate at very high speeds and extreme temperatures, and require minimal maintenance.