

Low-Emissions Exhaust Quality Control System to Optimize DG/CCHP Systems

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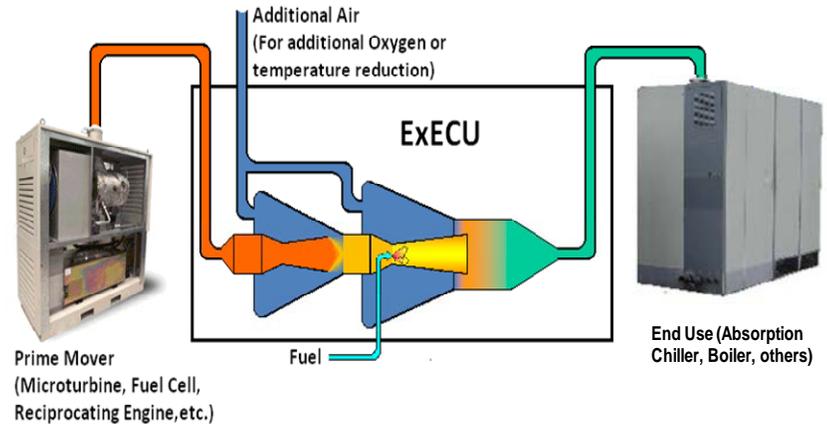
Fact Sheet

The Issue

While the potential benefits of distributed generation (DG) and combined heat and power (CHP) systems or combined cooling heating and power (CCHP) systems have been understood and promoted for many years, the actual deployment has fallen short of the goals and the opportunity. A key weakness in the deployment of many DG/CHP systems is the inability of systems to match the actual load due to the difficulty to optimally match the demand of both electricity and thermal requirements with a single system due to variations in loads with season, site operational changes, and other factors. While examples of temperature increase via supplemental burners are available for small scale systems, a system to control both temperature and overall flow rate is not available.

Project Description

The project will develop a control technology that can optimize the overall system efficiency of various DG/CHP systems when operating on natural gas or a renewable fuel. The system, known as exhaust enthalpy control unit, will have low-emission, fuel-flexible capability and can be used in the 100 kilowatt (kW) to 1 megawatt (MW) size DG/CHP systems. The control technology will be capable of measuring the quality of exhaust from a DG/CHP system and then manage the exhaust temperature and flow rate by injecting fuel and



Exhaust control unit (ExECU) integrated with a prime mover and end-use equipment (Image credit: UC Irvine)

tempering air depending on the exhaust conditions, to match the thermal and electrical load at the site. The control device will be tested to determine the suitable range of fuel and the range of increase in overall efficiency. The project will focus on applying this control technology to microturbines with absorption chillers. The project anticipates an improvement from 60 percent to 70 percent overall efficiency, and an overall capital cost increase of less than 10 percent. Potential adopters of this exhaust control technology include industrial and commercial CHP and CCHP users, equipment manufacturers and system installers.

PIER Program Objectives and Anticipated Benefits for California

The development of an exhaust control technology that complies with the California Air Resources Board (ARB) 2007 emission guidelines will accelerate the deployment of DG/CHP technology into the market place because of its ability to (1) improve overall system efficiency, (2) improve flexibility in deployment of a given suite of prime mover/waste heat recovery options, and (3) facilitate an extended capacity factor. The fuel flexibility – ranging from natural gas to opportunity fuels to hydrogen – will permit placement of the systems in a wider variety of installations. The projected long-term benefits from this technology include:

- Reduced fuel use as compared to current consumption levels for power generation and process needs, with an associated reduction in emissions of carbon dioxide.
- Mitigated deterioration of basin-wide air quality while meeting increased energy demands as compared to deployment of additional central power plants.
- Improved reliability and/or reduced costs from additional choices in acquisition of energy, which can trickle down to reduced costs for consumers.
- Deferred installation of new power generation, transmission and distribution lines, which has been estimated to have a value of over \$350 per kW per year; if applied to the projected 5,400 MW DG/CHP installed capacity statewide, this represents a value of about \$1.9 billion.

Project Specifics

Grant Agreement Number: PIR-09-015
Contractor: University of California, Irvine
City/County: Irvine/Orange County
Assembly District: 70
Senate District: 33
Application: Statewide, Nationwide
Amount: \$666,285
Co-funding: \$71,875 from UC Irvine
Term: April 2010 to September 2013

For more information, please contact:

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