Low-Cost Packaged Combined Heat and Power System

Increasing the Market Acceptance of Smaller CHP Systems

This project will develop a flexible, packaged CHP system that produces 330 kilowatts (kW) of electrical power output and 410 kW of thermal output while increasing efficiency and reducing total cost of ownership.

Introduction

Many combined heat and power (CHP) systems less than 1 megawatt (MW) use reciprocating internal combustion engines. Unfortunately, reductions in the size of these engines are associated with reduced efficiency and increased maintenance costs.

This project will leverage core technologies developed under the U.S. Department of Energy's (DOE) Advanced Reciprocating Engine Systems (ARES) program to lower costs while increasing efficiency.

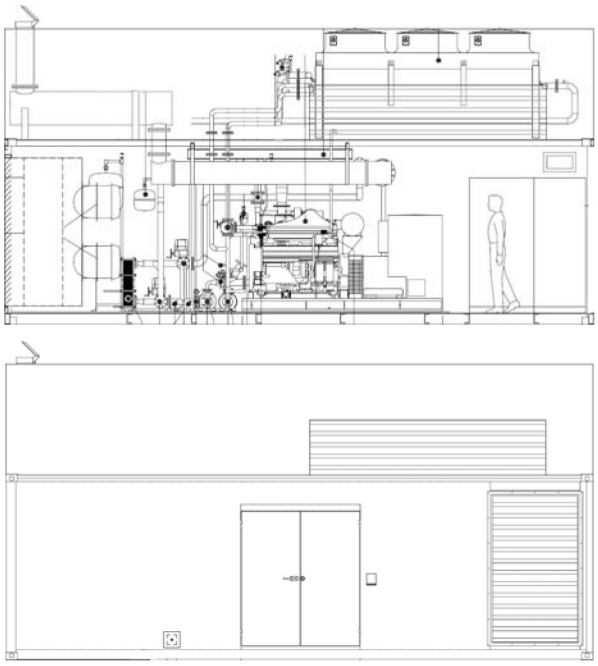
The project will result in one of the highest-efficiency systems for a CHP project less than 1 MW in size.

Benefits for Our Industry and Our Nation

This project's CHP package will improve the economics of ownership and contribute to a reduction in domestic energy intensity.

Potential benefits of this CHP package include:

- Significant energy savings, equating to an estimated 37% reduction in the end-user's fuel consumption compared to separate generation of electricity and heat
- EPA emission levels of nitrogen oxide (NO_x), carbon monoxide (CO), and volatile organic compounds (VOCs)
- Yearly reduction of carbon dioxide emissions by 950 tons compared to separate generation of electricity and heat, given 8,000 hours running time
- Lower total cost of ownership including maintenance and installation
- Estimated simple payback of 6 years, using average U.S. industrial prices for natural gas and electricity in March 2009



Concept drawing of a 330 kilowatt combined heat and power (CHP) system that simplifies installation and ownership. The simple and low-cost design is intended to increase the adoption rate for high-efficiency CHP systems.

Illustration courtesy of Cummins Power Generation.

Applications in Our Nation's Industry

This project will target small applications (100–500 kW power range) in numerous industries, institutions, and other facilities, including:

- Schools
- Office buildings
- Health clubs/spas
- Extended service restaurants

Project Description

The objective of this project is to develop a flexible, 330 kW packaged CHP system that can be deployed to small industrial and commercial applications at a lower cost than other CHP solutions. The project will leverage prior engine efficiency developments established under the DOE-ARES program, and a lean-burn combustion configuration will provide enhanced reliability and emissions that meet EPA standards. Remote monitoring and control utilizing predictive service and advanced diagnostics will additionally minimize maintenance costs and system down time, facilitating mass adoption. Overall, lower initial capital investments and improved system capabilities will increase the market acceptance of this small CHP packaged system.

Barriers

- Integrating standard components into a flexible, packaged system, thus reducing initial capital cost
- Developing comprehensive predictive service and advanced diagnostic algorithms and statistical models
- Simultaneously maintaining NO_x, CO, and VOC emissions while increasing efficiency
- Lowering system sound levels to meet commercial customer requirements

Pathways

Cummins Power Generation (CPG) and Cummins Engine Business Unit (EBU), both entities of Cummins Inc., are the primary partners for this project. To ensure that customer needs are met, CPG will perform a "voice of the customer" analysis. CPG will interview potential customers to determine the CHP characteristics most likely to lead to widespread adoption. These "voices" then translate directly into specific product prototype requirements.

As a sub-contractor to CPG, the EBU will design the advanced engine within the Cummins Technical Center (CTC). CPG will additionally manage the controls design and thermo-mechanical integration.

Once the heat recovery system, 330 kW Genset, and control system are complete, CPG will package the prototype CHP system. CPG will then integrate the prototype system into a customer site to test and measure system performance.

Milestones

- Design and development of heat recovery system
- Design and development of CHP controls and switch gear requirements
- Design and development of advanced engine, controls and sensors, and support hardware
- Design, development, and validation of CHP package
- Validation of installation and operability at a customer site

Commercialization

CPG will integrate custom and off-the-shelf components from the CHP prototype to create a new production-intent CHP product. CPG will use its Value Package Introduction (VPI) process to further decrease the cost of manufacturing and improve product reliability and robustness.

The initial product will be marketed to mainstream end-users via the Cummins Energy Solutions Business (ESB), with commercialization eventually transitioning to the extensive Cummins distributor network.

Project Partners

Cummins Power Generation
Fridley, MN
Principal Investigator: John Pendray
E-mail: john.pendray@cummins.com

Cummins Engine Business Unit
Columbus, IN

For additional information, please contact

Bob Gemmer
Technology Manager
U.S. Department of Energy
Industrial Technologies Program
Phone: (202) 586-5885
E-mail: Bob.Gemmer@ee.doe.gov

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

EERE Information Center
1-877-EERE-INFO (1-877-337-3463)
eere.energy.gov/informationcenter

DOE/EE-0437 • March 2012
Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.