

Propane-Fueled Combined Heat and Power

Green Mountain Coffee Roasters: Improving Productivity, Safety, and the Environment

ombined heat and power (CHP) technologies are increasingly the choice of energy consumers, offering an appreciable mix of high quality and reliability with significant environmental benefits. CHP is a form of distributed generation (DG) in which electric power generating units are installed at consumer facilities to supply on-site energy needs. CHP enhances DG by simultaneously producing thermal and power output, thereby increasing overall fuel efficiency. CHP offers energy and environmental benefits over electric-only and thermal-only systems, is three times more efficient than central power plants, and avoids the transmission and distribution losses associated with purchasing electricity via the central grid.

Propane-fueled DG systems are poised to emerge as the clear choice for a clean, affordable, safe, and reliable solution in residential, industrial, and commercial heat and power applications. However, state laws and utility regulations have constrained the prevalence of propane-fueled DG projects. Therefore, the Propane Education

& Research Council (PERC) funded a research effort, Heat Reclaim Project (Docket 10565), with the following objectives:

- Provide continuous power to Green Mountain Coffee Roasters (GMCR) coffee roasting and packaging operations, hot water, and space heating with a propane-fueled reciprocating engine CHP system
- Compare economics of on-site power production with economics of grid-delivered electricity
- Monitor energy production of on-site CHP system and determine effects on local utility grid
- Analyze existing state laws and utility regulations to increase DG projects in rural Vermont
- Generate a CHP model to promote additional propane DG activities

The *Heat Reclaim Project* represents an extraordinary opportunity for the propane industry to capitalize on positive publicity, promote core competencies of propane, and acquire useful customer data. Increasing public awareness and developing benchmarks of industry performance have been identified as critical to achieving industry goals.

Reciprocating Engines

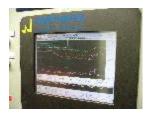
Dramatic increases in fuel efficiency and reduced emissions have made propane-fueled engines a popular choice for distributed generation applications. Over the past three decades, the propane market has seen great expansion in standby, peak shaving, grid support, and CHP applications in which hot water, low-pressure steam, or waste-heat-fired absorption chillers are required. Propane-fueled reciprocating engines offer the following additional benefits:

- Low cost, fast start-up
- Excellent load-following characteristics
- Significant heat recovery
- Proven reliability

GMCR 280kW CHP System







Green Mountain Coffee Roasters

Americans increasingly demand both high quality and social responsibility from the coffee industry. Exemplifying this ideal,

GMCR prides itself on both its gourmet coffee and social activism, donating 5% of pretax profits to good causes. When monthly power disturbances began to interrupt GMCR's coffee roasting process, GMCR turned to Northern Power Systems to develop an environmentally friendly and highly reliable power supply to eliminate costly downtime and product loss.

Unscheduled machinery shutdowns during the roasting process not only ruin coffee beans, they can initiate an exothermic reaction in the roasters which pose a significant fire hazard to employees. Prior to installing the CHP system, a large safety envelope around the roasters and emergency procedures were necessary for dealing with power outages, which occurred frequently due to the plant being located at the end of the power grid.

Project Description

In 1999, Northern Power Systems installed a 95-kilowatt CHP unit in conjunction with GMCR's original roaster line. This CHP system reliably sustained all critical electrical loads, with numerous grid fluctuations resulting in neither downtime nor product loss. The Heat Recovery Project is building on the continuing success of the first CHP project, leading to the installation of a 280-kilowatt CHP plant for the expanded roaster line. Both CHP systems provide highly reliable power and incorporate heat-recovery for potable hot water and space heating.

System Overview

The CHP system consists of one primary 280kW unit and one 95kW unit (currently a standby unit

for phone, computer and lighting). The 280kW unit provides 480 volt 3 phase power and operates full time to critical loads during coffee production. The 95kW unit provides 208 volt 3 phase power to electrical load panels, which are also served by the utility. In the event of an outage or anomaly as short as two cycles or longer, the utility-side circuit

breakers open and the electrical loads are seamlessly sustained by the 95kW unit.

Waste heat from the Enginator® water jacket is sent to super-insulated tanks that preheat



wash water for processing and other building uses. An air/water heat exchanger on the engine exhaust preheats water in the building's hydronic space heating system.

GMCR CHP System Benefits

The CHP system provides the following benefits:

- Increased productivity by eliminating downtime
- Elimination of green bean raw material waste and finished product waste by preventing roaster interruptions
- Improved plant safety by eliminating fire hazards associated with power failures
- Reduced electric bills by allowing "peak shaving"
- Reduced costs by providing additional process hot water
- Demonstration of corporate commitment to socially responsible business practices by using clean burning propane-fueled CHP

Project Status: In Progress

Final report on system performance and economics is underway.

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For More Information:

Propane Education & Research Council Gregory Kerr Director of Research and Development 1140 Connecticut Avenue, Suite 1075 Washington, DC 20036 202-452-8975

www.propanecouncil.org www.usepropane.com



Project Partners:

Green Mountain Coffee Roasters Paul Comey, VP of Environmental Affairs 33 Coffee Lane Waterbury, VT 05676 802-882-2137

Northern Power Systems, Waitsfield VT

Greentech, Meriden, CT

Green Mountain Power, Colchester, VT