



CHP  
TECHNICAL ASSISTANCE  
PARTNERSHIPS

# Masonic Village

## 390-kW CHP System

### Project Overview

The Masonic Village at Elizabethtown, Pennsylvania is a sprawling continuing-care retirement community, children's home, and community-service organization that opened in 1910. Today, the 1,400-acre complex serves more than 1,700 residents cared for by 1,300 staff. Since its opening, Masonic Village obtained its heat from a coal-fired, high-pressure steam plant that burned approximately 5,000 tons of coal annually. The energy plant's three coal-powered boilers also produced steam for laundry and other purposes. To get away from the emissions-creating, inefficient coal-fired steam system and take advantage of Pennsylvania's deregulation of electric utilities, in 2002 the board of directors decided to install a natural gas-fired distributed energy generation system that would not only supply existing thermal needs, but also create electric power.

### System Design and Operation

The Combined Heat & Power plant consists of six 60 kW Capstone microturbines that produced 390 kW of electricity. They operate in parallel with the power grid to provide supplementary power to the entire facility. The buildings are heated by Bryan low-NOx emission boilers, which operate on natural gas or No. 2 fuel oil. To improve fuel efficiency and lower NOx emissions, the heat generated by the microturbines is used to supplement heating and domestic hot water requirements.

### Quick Facts

**LOCATION:** Elizabethtown, Pennsylvania  
**MARKET SECTOR:** Multi-Family - continuing-care retirement community  
**FACILITY SIZE:** 1,700 Residents and 1,300 Staff  
**FACILITY PEAK LOAD:** 2.5 megawatts (MW)  
**EQUIPMENT:** Six Capstone C65 microturbines  
**FUEL:** Natural Gas  
**USE OF THERMAL ENERGY:** Heating & Domestic Hot Water  
**ANNUAL ELECTRICITY GENERATED:** 3.2 MWhr  
**ENVIRONMENTAL BENEFITS:** equivalent of removing 642 cars off the road or planting 1,000 acres of forest.  
**YEARLY ENERGY SAVINGS:** \$90,000  
**PAYBACK:** 5 years +  
**CHP IN OPERATION SINCE:** 2002, upgraded in 2017  
**RUN TIME:** Over 700,000 total hours



Masonic Village at Elizabethtown, Pennsylvania

## CHP Equipment & Configuration



**Capstone C65 Microturbines with Top Mounted Integrated Heat Recovery Heat Exchangers**

In 2002 E-Finity, the local distributor for Capstone Turbines, installed five C60 low-emission Capstone microturbines, fitted with third party heat exchangers, at the Masonic Village. The five natural gas fired microturbines produced a combined 300kW of electricity. For five years, the microturbines operated in parallel with the grid, providing a portion of the overall campus electric load while simultaneously meeting base-load hot water needs. The system was upgraded in 2007 with the installation of the upgraded C65 ICHP microturbines to replace the five original microturbines. This increased the system capacity to 325 kW. To improve the efficiency of the thermal system, the original third-party heat exchangers were replaced by the Capstone-designed Integrated CHP Heat Recovery Modules (ICHP). To improve overall plant operating efficiency and reduce plant manning requirements, the site installed the Capstone Service Network that allows real-time remote monitoring, alarming, and troubleshooting of the power plant via the Internet. In 2017, the plant was further upgraded with the addition of a sixth C65 ICHP microturbine. The new system produces 390kW (90kW more than the original installation) and over 2MMBtu of hot water. Masonic Village has seen a 47 percent increase in net heat recovered, and an overall system efficiency of approximately 83 percent.

## Lessons To Share

- Needed infrastructure upgrades, particularly the elimination of the use of coal in the power plant, provided the economic opportunity to install a cost-effective CHP system.
- The resultant emissions reductions provided added justification for the system installation and contributed to the facility being an environmental ‘good neighbor’.
- System automation enabled the facility to reduce power plant manning requirements and allow for a cost-effective reallocation of manpower resources.
- The Capstone multiturbine system arrangement enabled cost effective integration of system enhancements and upgrades.

“CHP was an opportunity to get out of the business of burning coal for our hot water heating systems. The CHP installation, which provides electricity and reheats our return loop water, provided enough justification to get away from coal and the emissions issues that go with it.”

Jeff Gromis

Facilities Engineer

Masonic Village

## For More Information

US DOE Mid Atlantic CHP Technical Assistance Partnership  
Dr. Jim Freihaut , Director  
814-863-0083  
[Jdf11@psu.edu](mailto:Jdf11@psu.edu)  
[www.machptap.org](http://www.machptap.org)

E-Finity Distributed Generation, LLC  
161 Pennsylvania Avenue  
Wayne, PA 19087  
610-688-6212  
[www.e-finity.com](http://www.e-finity.com)

Date Produced: 2019