

## Real Benefits from Combined Heat and Power Garryvoe Hotel

### 4 Star Tri-generation Solution

The Garryvoe Hotel in Garryvoe, East Cork, has evolved from a two star 17 bedroom hotel to a four star 84 bedroom hotel with modern conference facilities and fully equipped health club with swimming pools. One focus of this evolution was to develop a suite of best in-class technical solutions to minimise operating costs, focusing on energy management, energy efficiency and implementing an exceptionally advanced energy solution.

The environment, energy efficiency and economic conditions were the driving factors of this transformation, and natural gas was the fuel of choice to replace the hotel's more expensive LPG consumption. The project team investigated a natural gas connection to provide a Combined Heat and Power solution which would minimise operating costs while maximising energy efficiency.

The Hotel Manager, Stephen Belton, knew that replacing existing fuel sources with natural gas would greatly reduce energy costs and the hotel's overall impact on the environment.

The solution developed for this hotel included:

- ◆ Natural gas to fuel the CHP equipment
- ◆ Natural gas for the hotel's extensive kitchens
- ◆ CHP to generate electricity
- ◆ Heat from the CHP for hotel and health club use
- ◆ Heat from the CHP harvested and used through absorption chillers for efficient air conditioning
- ◆ Heat recovery system
- ◆ Building Energy Management System (BEMS)



**Consultant CHP  
Design Engineer:**

Tony Lyons

**CHP Supplied and  
Commissioned by:**

Temp Tech

**CHP Installers:**

MBS

**Absorption Chillers  
Supplied by:**

Comfort Cooling



- ◆ Energy Savings of up to  
€130,000 a Year
- ◆ 2.5 year Payback on Investment

- ◆ Reduced Carbon Emissions
- ◆ Enhanced Security of Supply

## Hotel Goals/Objectives

The addition of 67 new bedrooms, a 1,200 sq ft gym and a 25m indoor heated swimming pool represented a significant increase in thermal demand, and as such the addition of a CHP energy solution was ideal for this hotel's development to minimise energy costs and reduce the environmental impact.

## Approach

The Garryvoe Hotel team worked closely with Bord Gáis Networks to secure a natural gas connection from Ladysbridge, involving the construction of approximately 5km of gas pipeline along the R632 to Garryvoe. Work commenced on the natural gas project in October 2009 and all teams liaised to ensure timely completion of the project in December 2009, enabling the Garryvoe Hotel to commence burning natural gas on schedule in January 2010.

The re-development of the Garryvoe Hotel included relocating the roof-top boiler house. The new CHP system and extra boilers were installed close to the new health club in a custom built thermally insulated and sound proof boiler enclosure on the ground and first floors. Insulated pipework links were installed to the old boiler house location to make use of the existing pipework to rooms, kitchens etc.

## What is CHP?

Combined Heat and Power (CHP) is the simultaneous generation of electricity and heat from the same piece of equipment. Electricity is generated on site by using natural gas to drive an engine which generates electricity through an alternator connected to the engine. The heat from exhaust fumes generated by the engine is harvested to provide heating, hot water, and steam

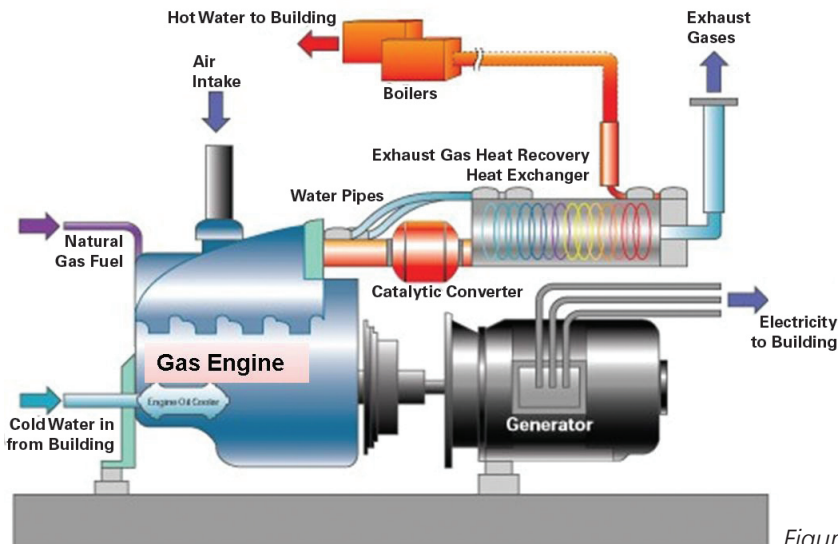


Figure 1: ENER-G Combined Heat and Power Unit



Figure 2: Century Absorption Chillers from Comfort Cooling

for the building, and the energy within the hot water can also be used to provide cooling and air conditioning through absorption chillers.

### Benefits

- ◆ Large reductions in energy costs
- ◆ CO2 emissions reduced
- ◆ Lower carbon tax
- ◆ Security and continuity of power supply
- ◆ Conservation of valuable fuel resources

Figure 3: Inside a Combined Heat and Power Unit

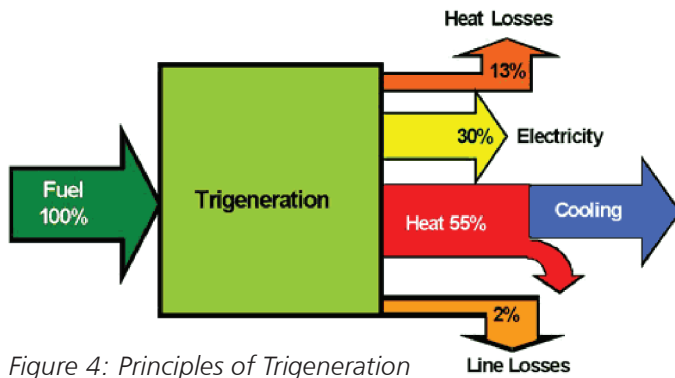


Figure 4: Principles of Trigeneneration

## Why CHP?

Due to inefficiencies in electricity generation, and the resulting cost of electricity from energy suppliers, significant savings can be made by generating your own electrical requirements on your own site. The financial benefits of on-site electricity generation using natural gas to power the electricity generator are evident by comparing daytime electricity prices in Ireland (between 11 and 15 c/kWh based on SEAI July 2012 figures), and natural gas prices (between 4 and 5 c/kWh based on SEAI July 2012 figures).

CHP, also known as “Cogeneration”, is the simultaneous production of electricity and heat usually in the form of hot water or steam from a primary fuel such as natural gas (see Figure 3 Inside a Combined Heat and Power Unit). Combined Heat Power and Cooling (CHPC or Trigeneneration), takes cogeneration one step further. Trigeneneration is the production of three energies: electricity, heat and cooling (see Figure 4 Principles of Trigeneneration). Chilled water is achieved by incorporating an absorption chiller into the process taking the heat generated from the CHP system to create chilled water to cool a building. Adding an absorption chiller into a CHP system means that the user can increase the operational hours of the equipment, maximising the utilisation of the energy, particularly in summer periods, and reducing the reliance on expensive electrical air conditioning. A natural gas fuelled trigeneneration system is in operation in the Garryvoe Hotel.

## Garryvoe Hotel Trigeneneration Technical Details :

### Equipment

CHP consultant Tony Lyons designed the new CHP system and oversaw the overall project. All equipment used for the CHP system in Garryvoe Hotel was supplied and commissioned by Temp Technology and installed by MBS. The CHP system installed was the ENER-G 150 generating 150 kW of electricity and 235 kW of heat. A standard Trigeneneration installation includes the following:

- ◆ Prime Mover
- ◆ Electrical Generator/Alternator
- ◆ Heat Recovery System
- ◆ Absorption Chillers
- ◆ Electrical Safety and Monitoring Controls

### Prime Mover

A Prime Mover is typically a gas reciprocating engine, derived generally from commercially proven diesel engines. Modifications are made to provide the spark ignition for the fuel and to reduce the cylinder compression ratio. Little else is changed resulting in a strong, reliable and resistant engine. In a CHP system the Prime Mover/Engine is used to drive an Electrical Generator or Alternator to generate electricity.

### Electrical Generator/Alternator

An Electrical Generator or Alternator is an electromechanical device used to convert mechanical energy to electrical energy in the form of alternating current (AC). The generator is driven by the Prime Mover engine and generates the required electricity which can be used directly on site, displacing some or all of the electricity purchased from the local supply network.

### Heat Recovery System

A Heat Recovery System is designed into the CHP Unit and takes “waste heat” from the Prime Mover engine, harvesting that heat for use locally in the form of hot water, steam etc. The heat from the engine comes from the exhaust fumes generated by the engine during the internal combustion process and a suitable inbuilt Heat Recovery System ensures that much of the energy contained in this exhaust heat is not lost. Additional heat can also be obtained by fitting an additional heat recovery system externally to the CHP unit as was done in Garryvoe Hotel to provide more hot water from the waste exhaust.

### Absorption Chillers

Absorption Chillers are designed to be fed with steam or hot water and, through a series of chemical reactions, convert the energy in the hot water to produce chilled water. This chilled water is then used for the purpose of space cooling/air conditioning. The addition of absorption chillers into a CHP system results in the generation of cooling indirectly from natural gas and reduces the need for expensive electrically driven air conditioning.

### Electrical Safety and Monitoring Controls

These systems are responsible for monitoring and controlling the energy flow to the site and the operation of the Prime Mover engine. It also

continuously monitors in excess of 70 parameters ensuring safe operation of the equipment. The system allows immediate diagnosis of faults and ensures that the aftercare teams are alerted to any problems with the CHP unit itself, if they occur.

## Results

**Running costs reduced:** Estimated annual savings of approximately €130,000 were achieved by the addition of the CHP/Trigeneration solution and the switch from LPG to natural gas.

**Project Payback:** Payback on this project was in the region of 2.5 years on the CHP installation based on the above savings and an approximate investment of around €325,000.

**Emissions Reduced:** This energy solution also saves 44% Carbon Emissions, (116 tonnes of carbon and

420 tonnes of CO<sub>2</sub>) – equivalent to removing the emissions from 150 cars from the roads every year.

**Continuity of Energy Supply:** The hotel is no longer reliant on securing the majority of its electrical demands from the electricity grid, and therefore has the added security of electricity supply in the event of power outages in the region. In addition, as this project also involved changing from LPG to natural gas, missed deliveries of this fuel, due to errors or extreme weather conditions, are also no longer an issue for the hotel.

**Enhanced offerings from the hotel:** The hotel achieved Platinum Award from the Green Hospitality Association of Ireland as a result of the energy conservation solutions developed as part of this expansion project.

## Owners perspective

*"Garryvoe Hotel, over the last four years, has invested circa €325,000 on our CHP/Trigeneration energy system throughout our hotel and health club. The efficiency of the machinery and processes involved in Combined Heat and Power was one of the main reasons why we invested in this energy project. With the ever increasing prospect of increased fuel costs over the next 10-15 years, it has to make commercial sense to look to improving all the processes in energy usage throughout any building. We have data showing the saving running to €130,000 a year, the payback is commercially obvious. We still feel it was definitely the correct decision to install a CHP plant, combined with absorption chiller technology, and run it on natural gas and we look forward to continuing to enjoy the saving in the years to come".*

**Stephen Belton Managing Director.**

## Technical Team

<i>Consultant CHP Design Engineer</i>	<i>CHP System Suppliers</i>	<i>Absorption Chillers Suppliers</i>
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This information is only a guideline to the different products available for use with natural gas in new development construction. Users should ensure that products are suitable for the specific circumstances in which they seek to apply them. Contact the supplier or manufacturer directly for specific information on building requirements and materials needed for installation. Professional advice specific to the project should always be sought. The current Irish Gas Standards and Technical Guidance Documents (Building Regulations) override all contents. Users should ensure they always have the most up to date information.