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Case Study

Trigeneration Technology helps Rochestown Park Hotel to do it again

Located in Douglas, Cork, the Rochestown Park Hotel offers 149 guest bedrooms, a health club, swimming pools, 12 conference and banqueting suites with the capacity to cater for 700 guests. In the mid-90's this hotel invested in Combined Heat and Power (CHP) technology to reduce their operating costs.

Following the 2008 investment of €18 million to refurbish the hotel, management's focus was to get even further returns from their best-in-class technical energy solution which had proven to be extremely cost effective over the previous 13 years.

By adding 50 new bedrooms, a new bar, restaurant and a larger reception area, energy requirements increased significantly. With knowledge and experience of the savings that could be earned from CHP technology, management's strategy was to invest in a larger CHP system, coupled with an absorption chiller providing air-conditioning, to cater for the increase in energy requirements, and gain further energy efficiencies and financial savings.

Since the hotel's original investment in CHP technology, Rochestown Park Hotel has enjoyed annual energy cost savings of over 40%, significantly lower carbon emissions, a reliable energy solution with the security of a natural gas supply and independent on-site generation of electricity. This encouraged management of the hotel to look again towards CHP technology to meet their future energy needs.

Results

Annual energy savings of circa €115,000

Approximately 2 year payback on investment

Enhanced security of energy supply

Reduced Carbon Emissions of 278 tonnes CO2 per annum

Increased competitiveness through additional facilities and cost savings.

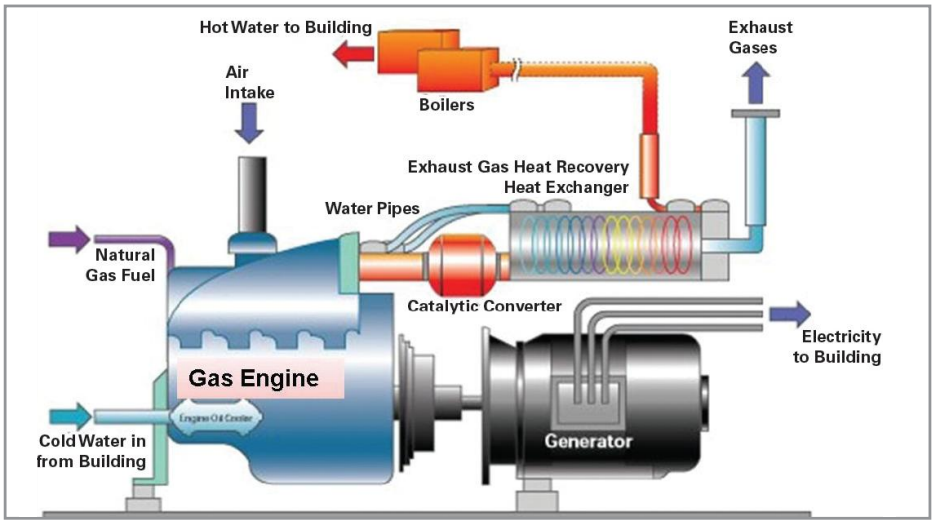

Figure 1. Inside a Combined Heat and Power Unit

Figure 2. ENER-G Combined Heat and Power Unit

The solution developed included:

- Natural gas to fuel the CHP equipment
- CHP to generate electricity
- Heat from CHP harnessed for hotel and leisure centre
- Additional heat from CHP used through absorption chillers for efficient air conditioning
- Heat recovery system
- Building Energy Management System (BEMS).

Hotel Goals/Objectives

With the refurbishment, the hotel's energy requirements increased accordingly. Positive experience with CHP warranted further investment in this technology and an absorption chiller was introduced to provide air conditioning during the summer months. Due to its low cost and greater efficiency, natural gas was chosen to fuel the appliance again.

What is CHP?

CHP, also known as "Co-Generation" 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 1 – Inside a Combined Heat and Power Unit). Electricity is generated on site by using natural gas to drive an alternator connected to the engine. The heat from exhaust fumes generated by the engine is harvested to provide heating and hot water for the building, while some of the energy within the hot water can also be used to provide cooling and air conditioning by using absorption chillers.

Benefits

Significant reduction in energy costs

CO2 emissions reduced

Lower carbon tax

Security and continuity of power supply

Conservation of valuable fuel resources

Why CHP?

Due to potential inefficiencies in electricity generation and the resulting cost of electricity from energy suppliers, significant savings can be made by generating electricity to meet requirements on your own site.

The financial benefits of onsite electricity generation (using natural gas to power the electricity generator) are evident by comparing daytime electricity prices in Ireland of circa 13.9 cent/kWh with market natural gas prices of circa 4.5cent/kWh (SEAI figures, July 2013).

Trigeneration

Trigeneration takes cogeneration one step further. Trigeneration is the simultaneous production of electricity and heat with the additional transfer of thermal energy to provide cooling for practical use (see Fig 3 – Principles of Natural Gas Trigeneration).

Heat generated from the CHP system is converted using an absorption chiller to provide cold water to cool the building. By adding the absorption chiller into a CHP system the user can increase the equipment's operational hours, maximising the utilisation of the energy, which is of particular benefit in summer periods, thus reducing dependence on the more costly electrical air conditioning.

Rochestown Park Hotel have enjoyed these benefits since introducing a natural gas trigeneration system.

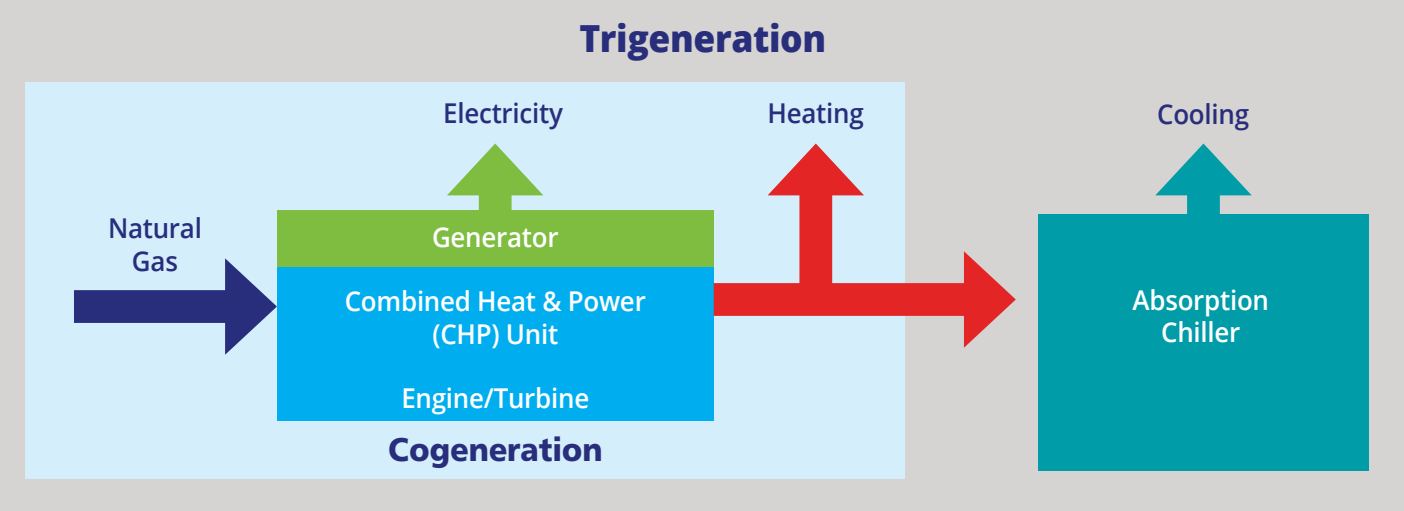

Figure 3. Principles of Natural Gas Trigeneration

Rochestown Park Hotel trigeneration technical details:

Equipment: CHP consultant Tony Lyons designed the new energy system and oversaw the entire project. All equipment used was supplied and commissioned by Temp Technology and installed by MBS. The CHP system installed was the ENER-G 310 generating 306kWh of electricity and 357kWh of heat (see Fig 2).

A standard Trigeneration installation includes:

- Prime mover
- Electrical generator / alternator
- Heat recovery system
- Absorption chillers
- Electrical Safety and monitoring controls

Prime Mover: A prime mover is a gas reciprocating engine, derived from commercially proven diesel engines. Modifications are made to provide the spark ignition for the fuel and to reduce the cylinder compression ratio 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: This 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. A suitable inbuilt heat recovery system ensures that much of the energy contained in this exhaust heat is not lost. The Rochestown Park Hotel recovered further heat by fitting an additional external heat recovery system to the CHP unit, to provide hot water from the waste exhaust.

Absorption Chillers: Absorption chillers are designed to be supplied with steam or hot water. Through a series of chemical reactions, the energy in hot water is converted to produce chilled water which is used for 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 costly electric air conditioning (see Fig 4 – CHP and Chillers).

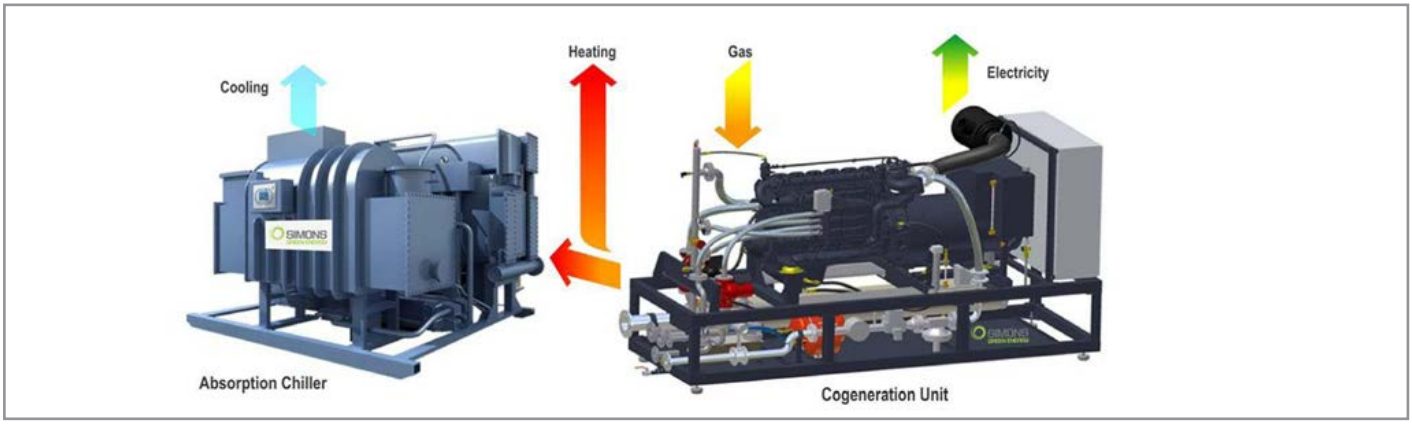

Figure 4. CHP and Chillers

Management Perspective

"Having seen the significant savings achieved by generating electricity on-site using CHP Technology, it was obvious that further investment to achieve even greater savings was the only solution to meet our hotel's greater energy requirements. The ability to independently generate electricity onsite, at a cost almost 70% less than grid market costs, gives our business a significantly lower cost base to help us drive profitability".

John Donovan, *Financial Controller*

Trigeneration Technology and Rochestown Park Hotel Results

Running costs reduced

Estimated Annual energy cost savings of circa €115,000 were achieved through the use of the Trigeneration solution.

Project payback

Payback on this project was approximately 2 years on the CHP installation based on the above savings and an approximate investment of around €240,000.

Emissions reduced

A reduction of 33% on the hotel's emissions resulted in a decrease of 77 tonnes of carbon and 278 tonnes of CO2 being emitted to atmosphere – equivalent to removing 150 cars from the nation's roads every year.

Continuity of energy supply

Because the Rochestown Park Hotel generates a large portion of its electrical demand on site, it is assured of a constant supply of electricity, even in the event of grid power outages in the region.

Technical Team

Consultant CHP Design Engineer

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