

Guide

Combined Heat  
and Power Schemes

## CHP in hotels

– a guide for hotel owners and managers

- Lower overall energy expenditure
- Reduce business environmental impact
- Tackle climate change



*'I became an enthusiastic advocate of small-scale CHP well before the conclusion of the first hotel field trial in the Manchester Posthouse. The savings resulting from the more efficient use of fuel to generate heat and electricity were there for all to see from the very beginning.'*

*John Forte*

# Introduction

This guide provides owners and managers of hotels with an overview of the benefits to be gained from introducing combined heat and power (CHP) in hotels. It outlines an introductory description of what CHP is, how the equipment works, and provides case study examples of hotels that have successfully adopted CHP.

This document is not intended as a technical guide: those seeking detailed technical engineering information are recommended to obtain further free publications from Action Energy, CHP Club and other organisations. (See page 15).

## The Benefits Of CHP In Hotels

The main benefit of CHP to a hotel is that overall annual energy costs can be reduced. On site generation of electricity reduces the amount of electricity that has to be purchased from the grid. Although the hotel's total fossil fuel consumption (typically gas) will increase, any rise in gas costs will be more than offset by the savings in electricity costs. Inherently gas is cheaper than electricity. In certain applications there may be further savings from reduced electrical maximum demand charges. In addition, 'Good Quality' CHP (see page 4) is exempt from the Climate Change Levy (CCL).

A further benefit is that, through greater efficiency in fuel use, CHP reduces environmental impact because it helps to cut emissions of greenhouse gases which are linked to climate change. Using CHP demonstrates a commitment to the environment – a fact that can be used to promote your hotel as being environmentally friendly.

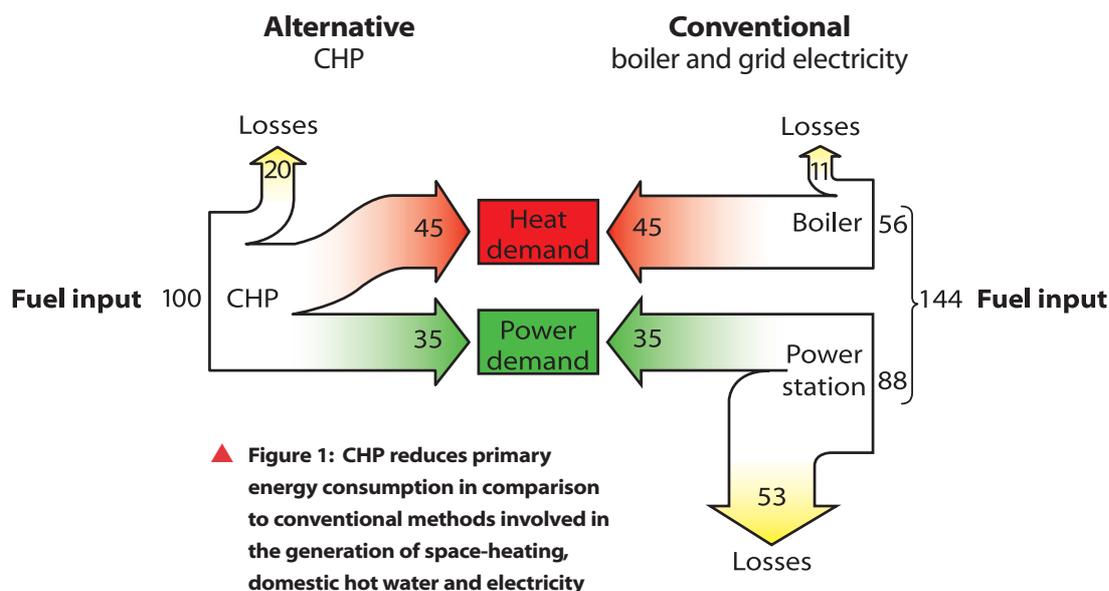
Other benefits include:

- CHP units can act as standby generation equipment.
- Hotels connected to community heating networks can receive instantly available hot water; there may also be opportunities for chilled water for air conditioning use (often community heating networks utilise CHP) with space usually taken up by building services equipment becoming available for hotel use.

### What is CHP?

CHP is the simultaneous generation of heat and electricity in a single process.

CHP equipment usually burns fossil fuel such as natural gas or diesel oil to generate electricity on site. At a power station, the heat generated when electricity is produced has to be dissipated via cooling towers. With CHP, the heat is recovered on site, and used for space-heating, domestic hot water, or heating a swimming pool. This means that, overall, the process is more efficient, so less fuel is used. (See figure 1).



## Small-scale Packaged CHP

To gain the most benefit from CHP, the equipment needs to maximise its operation for as many hours of the year as possible. With their year-round requirements for electricity and hot water, hotels are ideally suited to using 'small-scale packaged CHP' (particularly if they have a swimming pool).

Small-scale packaged CHP was first introduced into hotels 20 years ago. Since then there have been numerous advances in the CHP equipment technology, to both its level of reliability and its control systems. Today, it represents a reliable and efficient solution for supplying heat and power to a hotel.

When considering CHP it is important to assess its application/feasibility carefully. Successful projects will require detailed evaluation of the engineering, economics, reliability and operation of the systems. Space will also be required for the equipment. To justify the cost of investment, the aim should be to maximise the use of all the heat and hot water the system can produce. Every hotel is different and therefore a detailed whole life cost calculation is essential. This is discussed on page 4. This assessment should be made only after other simpler energy efficiency measures have been installed. Financing options are discussed on page 5.

Most small-scale packaged units are not designed to meet the site's full demand. Additional heating will be required in winter and this will have to be provided by conventional boilers. As electrical demand varies during the day, any power requirement in excess of that provided by the CHP equipment can be drawn from the local electricity network.

Should the CHP electrical output be sized to exceed the hotel's requirements, it is possible (in principle) for the surplus to be exported to the local electricity network. Embedded generation is becoming more common within the built environment.

The case studies in this document illustrate the application of CHP to hotels, and demonstrate:

- a corporate approach to CHP
- the benefits of small-scale packaged CHP
- provide an example of hotels connected to community heating networks with CHP.

## Climate Change And Energy Efficiency

Most of the energy used today originates from fossil fuel sources (gas, oil and coal). The burning of these fuels – whether at power stations, in boiler rooms in our buildings, in industry, or in vehicles – releases combustion gases which are damaging to the environment. These include:

- carbon dioxide (CO<sub>2</sub>)
- carbon monoxide (CO)
- sulphur dioxide (SO<sub>2</sub>)
- nitrogen oxides (NO<sub>x</sub>)
- unburnt hydrocarbons

As greenhouse gases build up in the atmosphere, more of the sun's heat is trapped – 'the greenhouse effect'. This is resulting in climate change – increasing the risk of adverse weather conditions. The UK Government has set a demanding domestic goal to cut UK carbon dioxide emissions to 20% below 1990 levels by 2010. A practical way of reducing CO<sub>2</sub> is to specify 'Good Quality' CHP.

## Hospitable Climates

Hospitable Climates is a partnership programme set up between the Hotel and Catering International Management Association (HCIMA) and the Carbon Trust Action Energy programme. This scheme offers a free advisory service to help reduce energy consumption in the hospitality industry and covers hotels, pubs, caterers and the licensed retail trade.

At the heart of 'Hospitable Climates' is a series of 'Energy Measures Fact Files' – designed to take hospitality and leisure managers from the first step of appointing an energy champion through all the areas of potential waste and savings. The majority of the measures advocated in the fact files will cost nothing, or very little, to implement, concentrating on reducing the huge amount of wasted energy in the Industry.

Please see the Hospitable Climates website for a full description of this free scheme and examples of the services and information provided. (See page 15).

## Whole Life Cost

A Whole Life cost analysis will help managers determine the full benefits of their investment: first cost only appraisals only tell half the story. When appraising the feasibility of CHP and comparing it to the conventional provision of heat and power by boilers and electricity purchased from the local electricity network, it is important to take into account not only capital expenditure but also all operating and fuel costs in a Whole Life cost approach.

Although the capital cost of CHP equipment is significantly higher than for conventional boiler plant, the equipment often has the lowest Whole Life cost. The Whole Life costing approach involves considering the annual expenditure required to operate and maintain heating, ventilation and air conditioning equipment, considering a number of options regarding equipment and fuel costs.

## The Importance Of Detailed Appraisal

A detailed financial and technical appraisal is essential as part of the decision whether to invest in CHP. Careful specification of CHP can yield savings in overall running costs and provide attractive economic returns on investment. It is important for the detailed appraisal of CHP (its viability, feasibility, assessment to a particular building) be completed by a qualified consultant engineer. Where appropriate, any economic appraisal should consider the marginal capital cost of CHP plant over and above any avoided costs of additional boiler or standby generation equipment.

Alternative methods of financial appraisal – simple payback, discounted cashflow, net present value (NPV) and internal rate

of return (IRR) - are covered in depth in the CHP Club's Manager's Guide to Packaged CHP equipment. (See References and Further Information on page 15). Alongside financial and technical appraisals it is important that a project consultant completes an environmental impact assessment.

## Maintenance Contracts For CHP Equipment

Consideration should always be given to the availability of a suitable long-term maintenance contract when selecting a CHP package. The best time to negotiate a long-term maintenance package is at the time of purchase. Contractors are often less willing to take on the maintenance of old and unfamiliar equipment.

Various levels of maintenance agreement may be available, and the choice should be considered in conjunction with the risks and responsibilities. Typical options include the following:

- Remote monitoring of plant parameters to provide a diagnosis of equipment condition.
- Call-outs to unplanned outages or breakdowns within a guaranteed response time.
- Comprehensive maintenance cover, to include all parts and labour costs associated with both planned and unplanned maintenance requirements.
- Installation of exchange or replacement unit to cover periods of prolonged outage associated with failure or servicing requirements.

Ideally, equipment availability will be guaranteed for 90% of the required operating time or above, and an emergency service will be provided to ensure that equipment down time is kept to a minimum.

### Incentives For 'Good Quality' CHP

Several government incentives are available to 'Good Quality' CHP equipment, as certified under the CHP Quality Assurance (CHPQA) programme. These include:

- Exemption from the CCL for the gas purchased as fuel for CHP (and electrically generated)
- Eligibility for Enhanced Capital Allowances (ECAs) whereby capital costs for CHP may be written off against taxable profits in the year they are incurred
- Exemption from business rates of the electricity generating plant and machinery.

All these factors improve the competitiveness of CHP. It is, however, vital to select the optimum size of CHP equipment to meet the hotel's needs. The detailed requirements of CHPQA are set out in a series of guidance notes available on the programme's web-site. (See page 15).

### CHP-SIZER V2 Software

A preliminary evaluation of the viability of introducing CHP should be undertaken initially. Action Energy has developed software for this purpose. CHP-SIZER is a simple software programme for carrying out a preliminary evaluation of the viability of CHP in hotels and other building types. Based on energy profile data collected from a sample of hotels, the software allows the user to gain an initial indication of the likely CHP size range and the associated costs and savings including an estimated payback period. Where CHP is shown to be a feasible option, a more detailed examination using site-specific data is recommended, and the software lists the next steps that should be taken.

Version 2 of CHP-SIZER enables an existing or new build hotel to carry out a preliminary viability calculation on the application of CHP in hotels. It is available on CD free of charge from Action Energy. (See page 15).

## Financing Options for CHP

There are two main financing options for CHP in Hotels – ‘capital purchase’ and ‘equipment supplier finance’. In the first of these, the hotel purchases and owns the equipment. In the second, the hotel provides space for the equipment – which is financed by the supplier – and purchases the electricity and heat generated.

### Capital Purchase Finance – ‘On-Balance-Sheet’

Here the hotel purchases the CHP equipment, but usually contracts out the maintenance and monitoring to the equipment supplier. Capital purchase of CHP equipment appears on the organisation’s balance sheet as a fixed asset. Funding may be from internal sources or external finance, or a mixture of both.

With capital purchase, the hotel bears all the costs of the CHP package, but stands to gain all the benefits. However, it also bears the technical and financial operating risk.

The financial case for CHP is improved by the government’s programme of Enhanced Capital Allowances (ECAs). To qualify, the CHP equipment must meet the threshold criteria for good quality CHP set out in the CHP Quality Assurance (CHPQA) programme standard.

For every hotel, hospitality rather than power generation is their core business. Management may know little of running and managing a mini power station. In such cases, either equipment supplier finance or an energy supply contract may be the better option.

### Equipment Supplier Finance – ‘Off-Balance-Sheet’

Here the CHP equipment is purchased by a third party which also has responsibility for operating and maintaining the equipment. Under the most popular method:

- 1 The CHP equipment supplier designs and installs CHP in the hotel, including the necessary mechanical and electrical ancillary works.
- 2 The supplier also finances, operates and maintains the system.
- 3 The hotel purchases the fuel for the CHP equipment from a utility in the usual way.
- 4 The CHP equipment supplier provides the hotel with ‘free’ heat and also sells electricity to the hotel at a cost at or below that available from an electricity utility.

In this way, the hotel benefits from reduced energy costs for no capital outlay. The financial advantage to the hotel owner is less than with capital purchase, but so are the risks, which are usually shared between the two parties.

Equipment suppliers may offer differing proposals depending on their own objectives and the hotel’s needs. Among the key issues to be agreed are:

- Unit prices for electricity (p/kWh, pence per kilowatt hour) and how these will change over the contract period.
- Who will operate the equipment on a day-to-day basis?
- Who will be responsible for ensuring availability of heat and electricity at an agreed level – and who will bear the performance risk?
- Who will maintain the equipment?
- Who will own the equipment at the end of the initial agreement period (typically 10-15 years) and at what on-going cost?

### Energy supply contract

This is similar to equipment supplier finance. The contractor designs and finances the installation of the CHP equipment and the necessary ancillary works, and is contracted to provide the building’s energy supply for a fixed period of time. The hotel purchases electricity and heat from the contractor at set tariffs, normally in the form of a standing charge and unit rate for each service. The hotel saves from the tariff being lower than buying mains electricity supplies conventionally, while the contractor recoups the cost of the investment from the profit on the unit prices and the standing charges.

# Installing and Operating CHP

## Packaged units

Most hotel CHP equipment is supplied as complete packaged units on a common chassis and within an enclosure. They require a suitable structural support, but are otherwise ready to be connected to power, fuel and heating services. The enclosure simplifies site installation, and often includes anti-vibration mountings and provision for noise attenuation as part of the unit; it also provides safety, prevents unauthorised access and gives full or partial weatherproofing. Any design requires to carefully assess and consider noise and vibration from the unit.

## Power generation

Most packaged CHP equipment use reciprocating internal combustion engines similar to the diesel engines used in transport vehicles, but they are adapted to run on natural gas. Given suitable operation and maintenance they are reliable and efficient with a life expectancy of up to 15 years or more.

## Island mode operation

Most small-scale CHP equipment is connected 'in parallel' with the mains electricity grid system, and power requirements in excess of that provided by the equipment are automatically drawn from the grid.

While it is possible to export power to the mains electricity grid, careful consideration must be given to export metering and the price achieved for the electricity.

CHP equipment can, for an extra cost, be designed to continue operating in the event of a grid failure. Known as 'island mode' operation, its requirements that:

- the site electrical system must disconnect from the grid and maintain frequency
- the site electrical system must shed load so that it matches the capacity of the CHP equipment
- the CHP equipment must have heat dump radiators or other means of dissipating the heat
- when grid supplies are restored, there must be controlled synchronisation, parallel operation and reconnection.

Island mode operation should be considered if existing standby generators require replacement in the future.

## Mechanical and electrical services connections

The CHP package requires a number of connections to the hotel's services, including gas supply, heating system, and the electrical distribution system. Gas engine CHP equipment recovers heat from the hot exhaust gases and the engine's cooling system. Hot water flows from heat exchangers within the CHP package to the distribution pipework of the hotel, with cooler return water passed back to the unit.

The location and space requirements for the CHP equipment need careful consideration. An adequate air supply is required for combustion and ventilation. Heat rejection equipment is necessary to prevent the engine overheating at times when full electrical output is needed but not all of the heat produced can be utilised. Space will be needed for this. A flue is required to remove the products of combustion from the engine, and exhaust them safely to the atmosphere.

## Commissioning the CHP equipment

Once CHP equipment has been properly installed and is ready to run, it is vital that it is properly commissioned to ensure maximum savings. Commissioning is normally undertaken by the installer/manufacturer. Proper commissioning should ensure that the CHP equipment:

- is running within normal parameters
- is controlled to provide the maximum possible savings
- is integrated with existing mechanical and electrical services to ensure they work together and operate with maximum efficiency.

## Cooling and air-conditioning

Absorption cooling allows coolth (usually in the form of chilled water) to be produced from a thermal source. This can be of economic and environmental benefit should there be a significant cooling load at the site itself or required by buildings nearby. An option study/evaluation should be undertaken of the potential for using absorption cooling during summer months. Potentially this can extend profitable CHP running time, and turn a marginal CHP study into a viable option. The location, size and capital cost of required heat rejection equipment needs to be considered carefully.

# Operating and Performance Monitoring

## Controlling CHP

Once installed and commissioned, a CHP package needs to be operated and maintained correctly if it is to provide the anticipated levels of financial saving. Typically control of the unit is automatic, with no need for active control by site staff under normal circumstances. If conditions change beyond certain defined limits, the remote monitoring system will contact the service centre to report the occurrence and, if there is a risk of damage to the equipment, the unit will shut down automatically.

At night the cost of purchasing electricity from the grid can be quite low and it may be uneconomic to operate the CHP equipment. Should electricity be required without demand for heat, heat generated must be rejected. It may at certain times be more economic to run the unit at lower output or shut it down and purchase electricity from the grid. Operating decisions of this kind should be considered at the design stage, and also be incorporated within the operational control strategy.

## Staff training

While, typically, there is no requirement for site staff to know how to maintain or operate CHP equipment, there is a need for familiarisation and training. Staff should understand the purpose of the package (and its place within a hotel energy strategy) and the importance of condition and performance monitoring. They need to be aware that the CHP equipment operates as the lead boiler, so they do not inadvertently re-set the boiler controls to defeat this. Ideally staff should be present for the final stages of CHP installation when the plant is commissioned and tested by the installers. New and existing staff should be briefed about the equipment's operation, its requirements and any health and safety issues.

## Operation of CHP with M&E systems

Because the CHP package normally supplies heat via the hotel's existing space heating and hot water distribution system and electricity via lighting and power supply distribution, it is important that the hotel's mechanical and electrical (M&E) systems are properly operated and maintained. This includes any system interface between the CHP equipment and the building's distribution networks.

## Plant controls

CHP equipment has automatic controls. These are normally linked to 24-hour monitoring services supplied under a maintenance contract. Links between the CHP equipment and an existing Building Energy Management System (BEMS) can provide useful monitoring facilities on site, as shown here.

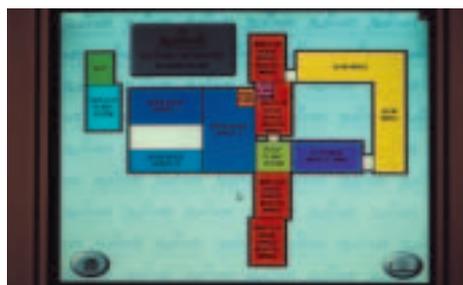
▼ The Building Energy Management System (BEMS) touch screen interface



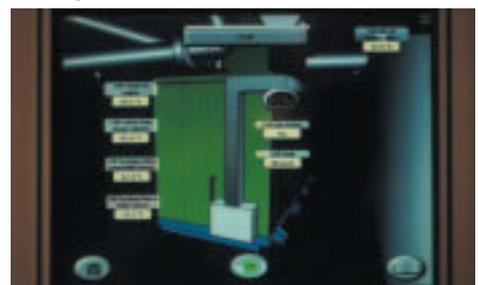
▼ The BEMS interface showing operation of conventional boilers



▼ The BEMS interface showing a schematic of the floor plan



▼ The CHP is monitored through the BEMS interface - including operating status and flow and return temperatures



## Marriott Hotels – A Corporate Policy

Whitbread holds the franchise for 59 Marriott Hotels in the UK and is embracing environmental management practices across the estate. Installing CHP is part of their strategy for improving the environmental performance of Marriott Hotels. The company is committed to installing CHP equipment in its hotels. 20 systems are already operating with a further 18 planned.

In December 2001, Marriott became the first UK hotel company to be awarded Energy Efficiency Accreditation by the Institute of Energy. The company had to demonstrate that it had reduced its consumption of electricity by 5% in 2000 and had a strategy for doing so again in 2001. It had to show management commitment, and a programme of investment in energy efficiency. Besides CHP, the Marriott chain is investing £500,000 to install low energy lighting in guest bedrooms, assisting to meet a target of reducing electricity use by 75%.

## Whitbread Hotel Company Environmental Policy Statement

“ The Whitbread Hotel Company is committed to minimising the impact of its operations on the environment by means of an improvement plan based on the principles of sustainable development. This means the company will:

- At all times comply with all applicable laws and regulations relating to the environment.
- Aim to apply the principles of reduction, re-use and recycling to the management of our products and their packaging.
- Seek to avoid the use of any material derived from endangered species.
- Reduce, where practicable, the level of harmful emissions.
- Design energy efficiency into new services, buildings and products.
- Work with our suppliers to minimise the impact of their operations on the environment.
- Monitor progress and report to our stakeholders on an annual basis. ”

## Heathrow Marriott

The Heathrow Marriott is a large luxury hotel with 390 guestrooms, a heated indoor swimming pool, and a gymnasium. In 2001, 400 kW<sub>e</sub> CHP equipment was installed in the car park, interfacing with the hotel's services including the building energy management system. In its first 11 months of operation, the unit generated 2.0 million kWh of electricity (at an average output of 398 kW), and 2.8 million kWh of heat. The unit ran for 17 hours per day and the average availability was 97.5%.

▼ The CHP equipment is located discretely in a secure housing in the hotel car park

▼ Heathrow Marriott Hotel



▲ Swimming pool at the Heathrow Marriott – heated by CHP

## Fact File

|                      |                     |
|----------------------|---------------------|
| Output - electricity | 400 kW <sub>e</sub> |
| Output - heat        | 609 kW <sub>t</sub> |
| Fuel input (gas)     | 1197 kW             |
| Average availability | 97.5%               |

Annual savings (2001-2002)

|                       |                                    |
|-----------------------|------------------------------------|
| Cost saving           | £51,000                            |
| Environmental savings | 1,020 (tonnes of CO <sub>2</sub> ) |

Date of commissioning – 2001

Location – externally in car park

Finance – capital purchase

# Case Studies – CHP In Hotels

## Slough Windsor Marriott

A full refurbishment programme of the Slough Windsor Marriott Hotel was completed in September 2001 at a cost of £6.5m. The hotel offers 382 guestrooms on five floors, plus 11 suites and 21 meeting rooms. As part of the refurbishment, a 300 kW CHP equipment was installed next to the car park. Its heat supplies space heating and domestic hot water, and serves the hotel swimming pool. It is fully interfaced to the hotel's Building Energy Management System (BEMS) and monitored at the hotel through the BEMS touch screen interface.

In its first year of operation, its output was 1.5 million kWh of electricity and 2.4 million kWh of heat. The daily electrical output averaged 297 kW, and the availability was 96%. The system received a Commendation from the Combined Heat and Power Association (CHPA) in 2000.

### Fact File

|                      |         |
|----------------------|---------|
| Output - electricity | 300 kWe |
| Output - heat        | 430 kWt |
| Fuel input           | 863 kW  |
| Average availability | 96%     |

#### Annual savings (2001-2002)

|                       |                                  |
|-----------------------|----------------------------------|
| Cost saving           | £40,000                          |
| Environmental savings | 772 (tonnes of CO <sub>2</sub> ) |

Date of commissioning - 2000

Finance - capital purchase

#### ▼ Slough Windsor Marriott Hotel



#### ▼ The CHP unit is located in a secure housing adjoining the chiller plant next to the car park



#### ▲ The CHP equipment needs no attention from the hotel's maintenance engineer, other than sounds and monitoring it via the BEMS

## Cardiff Marriott

The four-star Cardiff Marriott hotel has 182 bedrooms on ten floors, together with four suites and eight meeting rooms. Its leisure facilities include a large indoor pool, whirlpool, and gym, and the hotel is fully air-conditioned.

210 kW CHP equipment was installed during 2001 and commissioned in November. In its first four months of operation its electrical output was 409,000 kWh, at a daily average of 207 kW. Its thermal output was 597,000 kWh over the same period. Its availability over the four months was 96.4%. Comparisons of energy costs made by the hotel engineer show net annual savings of over £40,000 being achieved by the unit in its first full year of operation.

### Fact File

|                      |         |
|----------------------|---------|
| Output - electricity | 210 kW  |
| Output - heat        | 317 kWt |
| Fuel input (gas)     | 617 kW  |
| Average availability | 96.4%   |

#### Annual savings (2001-2002)

|                       |                                  |
|-----------------------|----------------------------------|
| Cost saving           | £40,000                          |
| Environmental savings | 581 (tonnes of CO <sub>2</sub> ) |

Date of commissioning - 2001

Finance - capital purchase

## Glasgow Marriott

The four-star Glasgow Marriott hotel features 300 bedrooms on 13 floors, including 20 guest rooms specifically designed for the business traveller. It also has a business centre, four suites and 13 meeting rooms. There is a leisure club with swimming pool, sauna, solarium, steam room, a fully air conditioned gymnasium, a cardio-theatre for fitness entertainment, a fitness studio, and a health and beauty spa.

210 kW CHP equipment was installed during 2000 and commissioned in October. In its first year of operation, its electrical output was 1.3 million kWh, at a daily average of 209 kW. Its thermal output was 1.9 million kWh over the same period. Its availability over the three months was 98.3%.

### Fact File

|                      |         |
|----------------------|---------|
| Output - electricity | 210 kW  |
| Output - heat        | 317 kWt |
| Fuel input           | 617 kW  |
| Average availability | 98.3%   |

#### Annual savings (2001-2002)

|                       |                                  |
|-----------------------|----------------------------------|
| Cost saving           | £31,000                          |
| Environmental savings | 607 (tonnes of CO <sub>2</sub> ) |

Date of commissioning - 2000

Finance - capital purchase

## Calculating Financial Savings In The Case Study Fact Files

Financial savings are calculated as a result of considering:

The value of savings in electricity which do not have to be purchased from the grid because it is generated on site

LESS

The cost of the additional gas purchased to run the CHP equipment and the cost of CHP equipment maintenance

“ Whitbread hotels are always looking for opportunities to increase the efficiency with which we provide our hotel guests with comfortable conditions and luxury facilities. CHP units are an environmentally friendly means of generating electricity and heat that reduce emissions of greenhouse gases while also achieving financial savings.

We have already successfully installed CHP units in over half of our Marriott hotels, and are committed to installing them in others where they are financially viable. ”

**John Conlon, Director Whitbread Hotels**

## Shrigley Hall

Shrigley Hall Hotel benefits from CHP equipment that has enabled it to provide additional facilities that exceed the supply capacity of the local grid network substation and electricity supply line. By using equipment supplier finance, the hotel has gained operating benefits without capital outlay, as well as achieving overall annual savings.

Shrigley Hall was built in 1825 as a country mansion. In 1986 it was restored, extended and converted into a 150-bedroom luxury hotel, golf and country club that opened in 1989. Although the hotel is connected to the national grid and mains gas, there was insufficient capacity to meet the hotel's full needs. When the hotel was first converted, two diesel engine generators were installed to provide electricity. In 2000, with the generators beginning to wear and electricity demands rising, a feasibility study was undertaken to explore the possibility of generating electricity by gas-fired plant, retaining the two diesel engines for use as standby emergency generators.

Packaged CHP equipment was installed in August 2001. The CHP supplier operates the plant and sells electricity to the hotel. This proved a much cheaper alternative for the hotel than having the electricity supply upgraded. Also it offers greater security of supply, since part of the electricity supply line is above ground and is liable to damage by the strong winds that affect this part of the Peak District. The hotel has conventional gas-fired boiler plant which is used for heating and domestic hot water.

### Fact File

|                      |             |
|----------------------|-------------|
| Output - electricity | 580 kWe     |
| Output - heat        | 820 kWt     |
| Fuel                 | Natural gas |

#### Annual savings (2001-2002)

|                       |                                  |
|-----------------------|----------------------------------|
| Cost saving           | £12,900                          |
| Environmental savings | 297 (tonnes of CO <sub>2</sub> ) |

Date of installation 2001

Finance: energy supply contract

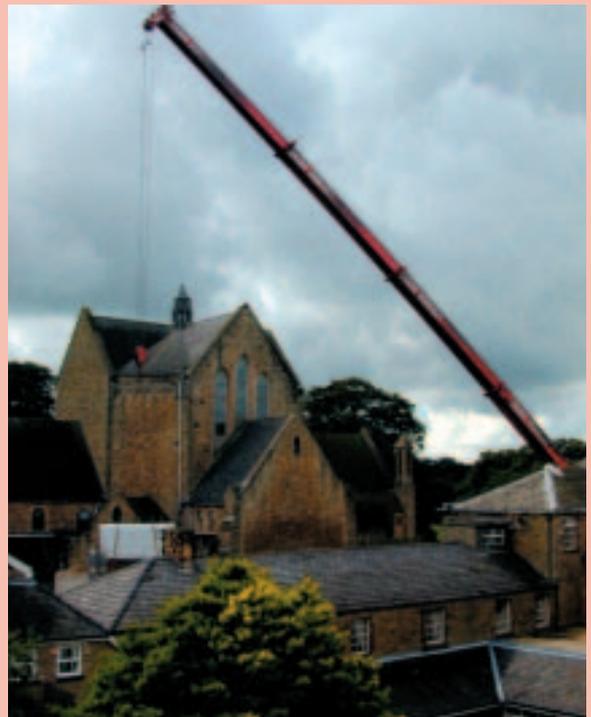
▼ Shrigley Hall Hotel



▼ Standby diesel generators



▼ Craning in the CHP equipment, August 2001



# Hotels connected to community heating systems with CHP

## Cutlers Hotel, Sheffield

Cutlers Hotel in Sheffield – a 50-bedroom hotel in the heart of the city – is one of more than 75 buildings connected to Sheffield's Community Heating system. The system is based around an incineration plant that burns household waste. Hot water, at temperatures up to 120°C and pressures up to 16 bar, is distributed around the city through a network of underground pre-insulated steel pipes. A stainless steel plate heat exchanger in each of the connected premises provides low temperature hot water, with a heat meter on the high temperature side measuring consumption.

For the hotel, the advantages of connection to the heating scheme are:

- Reduced capital costs: Plate Heat Exchangers (PHEs) are cheaper to install than conventional plant and are silent in operation.
- Savings in space for plant: PHEs are more compact than conventional gas boiler plant, and require no flues or ventilation.
- Savings in maintenance: PHEs require less maintenance than conventional plant.
- Overall savings in heating costs: although delivered costs of heat are higher per kWh than delivered gas, the efficiency of the PHEs is higher than gas boiler efficiency and there is no CCL to pay.

## De Vere Grand Harbour Hotel, Southampton

The De Vere Grand Harbour Hotel opened in 1994. It provides 172 guest bedrooms, two restaurants, and extensive conference and banqueting facilities. The leisure club offers two swimming pools, a fitness suite, sauna, steam room, and jacuzzi, and there is also a beauty salon.

The hotel was designed and built without heating or cooling plant. It takes heat and chilled water from Southampton's CHP-fired district heating and cooling scheme. The CHP scheme's origins lie in the exploitation, twenty years ago by the City Council, of a geothermal heat source beneath Southampton. But CHP was added to the system and now accounts for 85% of the heat output. A network of pipes delivers hot water and cooled water to the hotel.

The benefits to a hotel of connection to a district heating scheme are:

- Savings in utility costs
- Reduced environmental impact from exploiting 'green energy'
- Savings in capital cost of boiler, air conditioning equipment
- Savings in maintenance costs
- Security of supply.

## Holiday Inn, Woking

In 2000 Woking Borough Council set up a joint venture energy services company. The company's first project was a town centre CHP community heating and cooling system which includes a 1.35 MWe lean-burn gas-fired CHP equipment, together with heat-fired absorption cooling, stand-by boilers and thermal storage. These supply commercial and residential customers – including the 161-bedroom Holiday Inn - with heating, cooling and power.

The benefits to the Holiday Inn include:

- Costs savings by avoiding the need to finance, operate and maintain heating and cooling plant
- Saving on plant room floor space within the hotel
- Competitive prices for electricity, heat and chilled water
- Avoidance of the CCL
- Security of supply should the national grid fail; in the event of a power cut in the public distribution network, the system continues to operate in 'island mode' (see page 6).

Further details of Woking's community heating and cooling systems are given in Good Practice Case Study (GPCS434) See References and Further Information section at the back of this document.

## Contractual

**Capital purchase** A funding option where the hotel buys CHP equipment using its own funds or own structured loan.

**Climate Change Levy (CCL)** An environmental tax on energy supplies applicable to businesses and introduced in April 2001. It is intended to help the UK meet its commitment to reduce greenhouse gas emissions.

**Contract Energy Management (CEM)** A service providing technical, financial and management resources to implement an energy saving project. Remuneration for the service is often by retention of a proportion of the savings. The CEM contractor can also bear a higher proportion of the financial risk of any investment. (Further details are given in CIBSE Applications Manual AM12 – see References and Further Information).

**Energy services contract** As CEM, but the supplier is contracted to maintain pre-determined conditions in buildings, and accepts responsibility for the entire heating system up to the point of delivery. Energy Services contracts maybe worded to define the outcome of the service provided, temperatures and light levels, rather than how much energy is to be supplied. Further details are given in CIBSE Applications Manual AM12 – see References and Further Information.

**Energy services company** Companies offering a total energy supply service who take responsibility for provision, financing, operation and maintenance of energy facilities. Further details are given in CIBSE Applications Manual AM12 – see References and Further Information.

**Enhanced Capital Allowances (ECA's)** A government scheme to encourage businesses to invest in low carbon technologies. The scheme enables businesses to claim 100% first year capital allowances on investments in energy saving technologies and products. Hotels can write off the whole cost of their investment against their taxable profits of the period during which they make the investment.

**Equipment supplier finance** A funding option whereby the CHP equipment supplier designs, installs, finances, operates and maintains the CHP equipment; supplies the hotel with free heat; and sells the electricity generated to the hotel. Typically the hotel purchases the gas for the CHP, and additional electricity from the grid, in the usual way.

**Export electricity** Electricity generated in excess of hotel demand which can be sold to the electricity supply company if suitable metering and contract conditions exist.

**Good quality CHP** CHP which meets the threshold criteria in the Combined Heat and Power Quality Assurance (CHPQA) programme standard. The standard is intended to ensure that the energy efficiency and environmental performance of a CHP scheme are superior to the generation of the same amounts of heat and power by separate conventional means.

## Technical

**Absorption chiller** Equipment that uses heat energy to produce chilled water in air conditioning. Often uses spare CHP heat in the summer when buildings require cooling.

**Building energy management system (BEMS)** An electronic control system for building services usually linked to a central computer system.

**Combined heat and power (CHP)** Simultaneous generation of electricity and production of heat using a source of mechanical and thermal energy (eg reciprocating engine, gas turbine or steam turbine).

**Compression ignition** Ignition of the fuel in an engine using compression on the principle of a diesel car engine.

**Domestic hot water** Hot water used in a hotel for day to day purposes, such as for catering, baths and showers, cleaning, etc.

**CHP Engine** Type of CHP engine, spark ignition or compression ignition reciprocating engine fuelled by gas or oil.

**Gas turbine** A type of CHP, with an operating principle similar to a jet engine, fuelled by natural gas.

**Heat dump** A means by which excess heat from CHP equipment can be transferred to the atmosphere when not required for utilisation in the hotel, usually in the form of a radiator with powered fan to drive external air over it.

**Heat recovery** Recovery of heat from the exhaust gases and cooling system of CHP equipment.

**Low temperature hot water (LTHW)** Water, typically at 70°C to 80°C and which may or may not be pressurised. Low pressure hot water (LPHW) is the term sometimes used when water is not under pressure.

**Medium temperature hot water (MTHW)** Water at temperatures between 120°C and 133°C and pressure between 200 kPa and 300 kPa.

**MWe** Megawatt of electricity, equivalent to 1000 kilo watts (kW) of electricity.

**Packaged CHP** Self-contained CHP equipment with all necessary equipment, often in a sound-insulated casing.

**Remote monitoring** A CHP control system which reports performance and problems automatically via telephone to the maintenance contractor.

**Spark ignition** Ignition of the fuel in an engine, using spark plugs on the principle of a petrol car engine.

## General

**Availability** The percentage of time that CHP equipment can be used. Reduced below 100% by maintenance and breakdown.

**Building services** The utilities/services required for operation of a building. Building services include cold water, space heating, domestic hot water, air-conditioning, lighting, small power and electricity.

**Island mode operation** Operation of CHP despite a failure of mains electricity from the grid. May be used in conjunction with standby generation to maintain full operating service.

**Reliability** The percentage of time that CHP equipment can be used when required to do so (eg outside scheduled down-time).

**Stack or Flue** Chimney or flue through which waste gases are exhausted from CHP equipment or conventional boiler.

**Standby** Generation capacity on site which provides electricity (or other building services during supply failure).

**Utilisation** The percentage of time that the CHP equipment is operated at full output (or equivalent).

## Action Energy

### CHP Club

The Action Energy programme has a wealth of free information and advice on CHP. These services are channelled through the CHP Club which provides:

- published Guides and Case Studies
- up-to-date web-based information
- site specific advice
- access to CHP sector champions
- opportunities to share best practice with other CHP users

Helpline: 0800 58 57 94

Web site: [www.chpclub.com](http://www.chpclub.com)

### CHP Publications

The following associated Action Energy publications and software are available from the Energy Helpline

Helpline: 0800 58 57 94

Web site: [www.actionenergy.org.uk](http://www.actionenergy.org.uk)

### General Information Reports

GIR082 The Manager's Guide to custom built CHP

GIR083 The Manager's Guide to packaged CHP systems

These guides cover all aspects of the CHP development process including details of technologies, financing and operation and maintenance.

### Good Practice Guides

GPG234 Guide to community heating and CHP

GPG256 An introduction to absorption cooling

### Good Practice Case Study

GPCS298 Long-term operation of combined heat and power in a leisure centre

### Energy Consumption Guide

ECG036 Energy Efficiency in Hotels – a Guide for Owners and Managers

### CHP Software

CHP sizer V2 (CHP002) – a tool to conduct a preliminary evaluation of CHP in new and existing hotels, available on CD-ROM from Action Energy. (The software also covers three other sectors: hospitals, university residences and leisure centres)

## Other Organisations

### Hospitable Climates (HCIMA)

For the latest information and advice regarding energy management for Hospitality businesses, readers should sign up to the free Hospitable Climates programme.

Hospitable Climates is a partnership programme set up between the Hotel and Catering International Management Association (HCIMA) and the Carbon Trust Action Energy programme. This scheme offers a free advisory service to help reduce energy consumption in the hospitality industry and covers hotels, pubs, caterers and the licensed retail trade.

At the heart of 'Hospitable Climates' is a series of 'Energy Measures Fact Files' – designed to take hospitality and leisure managers from the first step of appointing an energy champion through all the areas of potential waste and savings. The majority of the measures advocated in the fact files will cost nothing, or very little, to implement, concentrating on reducing the huge amount of wasted energy in the Industry.

Please see the Hospitable Climates website for a full description of the scheme and examples of the services and information provided. Contact HCIMA using the details provided below. HCIMA Helpline: 020 8772 7407

Web site: [www.hospitableclimates.org.uk](http://www.hospitableclimates.org.uk)

### CHP Quality Assurance Programme (CHPQA)

Helpline: 0870 190 6196

Web site: [www.chpqa.com](http://www.chpqa.com)

### Enhanced Capital Allowances (ECAs)

Helpline: 0800 58 57 94

Web site: [www.eca.gov.uk](http://www.eca.gov.uk)

### Chartered Institution of Building Services Engineers (CIBSE)

See publication: CIBSE Applications Manual AM12: 1999, 'Small-scale combined heat and power for buildings'

Telephone: 020 8675 5211

Web site: [www.cibse.org](http://www.cibse.org) (for register of consultants)

### Combined Heat and Power Association (CHPA)

Telephone: 020 7828 4077

Web site: [www.chpa.co.uk](http://www.chpa.co.uk)

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CHP Club is an initiative of the Action Energy programme. Further help and advice is available online through [www.chpclub.com](http://www.chpclub.com) or by telephone through the Action Energy Helpline on 0800 58 57 94.