CHP - Combined Heat and Power systems

Reducing your energy costs and enhancing your green credentials
Supplying customised solutions for over 20 years.

• Highly efficient, maximising power output and profitability for our clients
• High reliability, low maintenance, rapid return on capital investment
• World beating delivery times
• World-class project management
• Stringent compliance to customer specifications
  - meet international standards compliance
  - excellent after sales care
• Global reputation of delivering energy efficient solutions
• Reliable, long service life (20+ years)
• Bespoke engineering capability

Peter Brotherhood - powering customer profits worldwide

20+ years of global expertise in the design, manufacture and installation of CHP systems

85% of CHP units manufactured by Peter Brotherhood are still monitored, serviced and maintained by us

60 bespoke CHP units installed across the UK and US

92% average availability of installed CHP units

155,000 operating hours of some of our CHP systems

24/7 customer care, monitoring and servicing globally
CHP systems from Peter Brotherhood reduce on-site energy costs and greenhouse gas emissions.

With more than 20 years’ experience in the global CHP (Cogeneration) marketplace, Peter Brotherhood has developed a strong reputation for delivering energy cost savings and emissions reductions through the design and application of systems for CHP, as well as Combined Cooling, Heat and Power (Trigeneration). As a partner to commercial, industrial and municipal energy users worldwide, we are committed to delivering energy savings through cost-effective energy-efficient investments with pre-designed, factory-tested, fully packaged CHP systems.

We have designed, built and installed over 60 bespoke CHP units, from 119KW small standalone units, to 6.5MW turnkey installations.

Our markets include:
- Agriculture / horticulture
- Automotive industry
- Chemical industry
- Commercial HVAC
- Food industry
- Pharmaceutical industry
- Public sector
- Retail industry
- Waste industry

Applications:
- Bulk chemical processing
- Chemical manufacturing
- Colleges and universities
- Commercial complexes
- Drying processes (eg: ceramics or automotive paintshops)
- Food processing
- Hospitals
- Medical manufacturing
- Mission-critical data centres
- Municipal facilities
- Pharmaceutical manufacturing
- Plastics manufacturing
- R&D laboratories
- Rubber manufacturing
- Textiles manufacturing
- Waste treatment
- Waste water treatment
CHP Operation and Maintenance
Continuous monitoring and appropriate maintenance are essential for the reliable and efficient operation of a CHP system, so Peter Brotherhood offers comprehensive support:

• Remote 24-hour monitoring
• Monthly reports detailing system availability and performance
• Aftermarket support customised to client requirements

Comprehensive maintenance contracts are available that provide full service for both scheduled and unscheduled outages. All necessary engineering and consumable spare parts are included, and the Peter Brotherhood operating and reporting process ensures minimum cost for all maintenance activities.

CHP Refurbishment
Have an older CHP system? Site conditions could have changed since it was designed and implemented, which means the system is not operating at its full potential.

To ensure you’re still getting the maximum possible energy savings from your CHP assets, consider our three-step update service:

1. Health Check
For a small consultation fee, Peter Brotherhood performs a detailed investigation of your CHP system, its current effectiveness and its potential for improvement.

2. Rehabilitation Proposal
If the potential improvements look promising, Peter Brotherhood can complete a more detailed cost and design analysis and provide a fixed price for system upgrades and improvements. There is no charge for this service if the recommendations are implemented.

3. Project Implementation
Our engineering team will upgrade your CHP system and hand over a fully commissioned and performance-tested plant, complete with options for ongoing service and maintenance.

The Peter Brotherhood advantage

DID YOU KNOW CHP HAS EFFICIENCIES OF BETWEEN 85% AND 95%?
The conventional means of generating electricity is through large centralised power stations generating power for the national grid. The generation of process heat is primarily provided through the use of on site boilers.

The plant efficiency of a fossil fuel power station is around 35% to 45%, and conventional boiler systems around 75%.

Environmentally Friendly
Based on the total energy generated, cogeneration plants typically cut NOx and CO2 emissions by almost 50 percent compared to thermal power plant/boiler systems, while complying with the strictest emissions regulations.

Profitable
Cogeneration makes sense for processes where the electricity and most of the heat energy produced by the cogeneration module can be used efficiently. To maximise profitability and to reduce fuel and electric power costs, the performance of the cogeneration module and the availability and quality of maintenance and repair services should all be considered.

Governments of most developed countries recognise that cogeneration is the most efficient and least-polluting way to extract as much of a fuel’s energy as possible, so regulations for these systems are generally favourable.

A CHP system from Peter Brotherhood can produce more heat energy and power while reducing costs
Remote condition monitoring and servicing

Monitoring
All equipment is monitored from our Peterborough facility. The CHP monitoring stations are constantly recording key information to ensure optimum performance and maximum financial benefit to the client.

Outside of normal working hours, critical alarms from the gensets are reported directly to the help desk, where our duty engineers will investigate the fault. A remote diagnostic response will be carried out within 1hr of alarm. Should site attendance be required, our duty engineer will attend. All of our service engineers are able to connect to all of our remote units from anywhere in the world.

Servicing
The Peter Brotherhood Service Team based in Peterborough will facilitate the scheduling and implementation of all resources required to conduct the scope of work within the required timescales and within budget.

All maintenance activities will be managed by a dedicated Gas-Safe registered Site Field Service Engineer, for overhauls a team of engineers will be deployed to expedite the works and reduce the downtime for our customers. Our engineers report directly to the monitoring team and will provide onsite co-ordination with client personnel to ensure fast efficient completion of works with the minimum disruption to the clients process.

BENEFITS OF REMOTE CONDITION MONITORING:

- Total information from one source
- Real time interrogation and fault diagnosis
- More informed operational decisions
- Saves cost and time when diagnosing and resolving issues

Overhauls undertaken are treated as projects and will be broken down into phases with gated reviews at key stages to ensure all required activities required throughout the project lifecycle have been completed. These phases are:

- Pre-shutdown planning and engineering
- Overhaul works
- Close out

Collation, Analysis & Reporting

- vibration, temperature, pressure, speed

We are able to offer upgrades on existing systems to allow real time remote condition monitoring and fault analysis without the need to mobilise to site. Please contact us at chp@peterbrotherhood.com with your system details if you would like us to review whether this will be possible with your control system and provide a quotation.
AirCHP products – cogeneration with heated air production

A unique form of small-scale CHP that directly heats air by using the latent and generated heat from the power generation CHP package. The technology used is similar to that of a modular packaged CHP plant, but the equipment package includes the heated air stream as well as integral heat exchangers and air-handling equipment. At peak performance, this system can achieve 95 percent efficiency. Suitable applications include distribution warehouses, process drying applications, space heating, and other applications where hot air is required on a continuous basis.

Technologies for every CHP application

Trigeneration for air conditioning or process cooling

With seasonal temperature variations and the possibility of process cooling requirements, the heat produced from cogeneration systems may not always be required by a host facility. With the addition of an absorption refrigeration device, it is possible for the cogeneration system to deliver a third output in the form of chilled water or conditioned air. A system with electricity, heating and cooling outputs is known as a trigeneration system. Peter Brotherhood has extensive experience in the design and implementation of customised trigeneration equipment.

Biofuel

Location: London  
Market: Public sector

Located adjacent to the historic Tower Bridge and The Tower of London stands the More London development; a collection of six large office buildings and one hotel.

One of the buildings is a ten-storey, 60,884m² (650,000ft²) office complex for a leading financial services company; their fourth office in the city of London. The key driver was to incorporate the most energy efficient technology available to provide the lowest possible emissions for the building.

A consultant was responsible for designing all the base build engineering services for the building. They approached Peter Brotherhood to assist with the design and integration of a biodiesel fired combined chilling, heat and power (CCHP) system to provide hot water, chilling and power to this highly prestigious office facility.

Peter Brotherhood CHP solution

Peter Brotherhood supplied two completely packaged biodiesel CCHP systems each rated at 385kWe electrical output. The systems are powered by a biodiesel fired engine coupled with a multi-energy chiller mounted directly above the engine enclosure to create a ‘double-decker’ configuration.

The unique challenge presented was designing a dual level system to accommodate the space restrictions of the basement plant room. The integration of the biodiesel engine and multi-effect chiller was one of the first of its type in the UK.

85% system efficiency
74% less CO₂ emissions

The systems were supplied as comprehensive factory-tested packages that can be easily integrated into existing site operations. Items such as synchronizing switch gear, heat recovery equipment, emissions treatment, attenuation, and lube oil systems are included ‘within the box’, dramatically reducing the risk of cost overruns and performance issues associated with traditional site build systems. The 7 More office complex is the first office in London and the third office in England to achieve the Building Research Establishment Environmental Assessment Method (BREEAM) ‘Outstanding’ award. BREEAM determines best practices in sustainable building design and is used to describe a building’s environmental performance.
Cogeneration with hot water production
A cogeneration system produces hot water by recovering heat from the engines’ cooling circuits and exhaust gas systems. Hot water produced by cogeneration can be used for washing and heating in service sector applications such as:
- Hospitals
- Hotels
- Sports centres
- Swimming pools
- And many industrial processes

Cogeneration in greenhouses
Cogeneration reaches its maximum potential when applied to greenhouses, since all of the CHP outputs (heat, CO₂, electricity) can be fully utilised.
Natural gas-operated cogeneration modules are a very profitable investment for greenhouses. The electric energy they generate can be sold to power utilities at a reasonable price, and the heat and carbon dioxide from the exhaust promote plant growth.
Not only that, but new cogeneration laws have made the conditions even more favourable. Our wide range of modules can meet the specific requirements of every greenhouse.

Combined cooling and power (CCP)
Location: Republic of Ireland
Market: Pharmaceutical
A pharmaceutical company, the largest producer of contact lenses in Europe, had some difficult challenges at their site in the Republic of Ireland ranging from the extremely tight deadline for completion of works to the proximity of nearby housing, imposing some stringent noise reduction issues.

Peter Brotherhood CHP solution
Peter Brotherhood designed, manufactured, installed and commissioned a fully packaged, turnkey CCP energy centre for this application.
Designed for installation in three phases, the scope of phase 1 extended from dual mains connections through to HV distribution and included all necessary infrastructure to accommodate phases 2 and 3. Phase 2 introduced the cooling tower packages, which had to take account of the proximity of neighbours and was not allowed to exceed 61 d(A) at the adjacent boundary and the installation of the 15m flue packages. Phase 3 saw the installation of two 1475kWe CCP packages, each package housed a single Jenbacher gas engine, close coupled to a York lithium bromide absorption chiller.
In each package, heat is recovered from the jacket water and exhaust system of the gas engine as hot water at 105°C (221°F) then fed directly to the absorption chiller, each chiller being capable of delivering 1025kWc to the site process. The turnkey project was delivered, on budget, to a very tight schedule which delivered the G10 test and subsequent release to service on time.
Biogas produced from the anaerobic fermentation of organic matter in landfill sites is an ideal fuel for power generation. Peter Brotherhood can help you to maximise the revenue-earning potential of your landfill, turning waste gas into electricity and producing heat that could be piped to nearby facilities.

"It is a real win-win situation and shows the kind of innovation and ambition the UK needs to tackle the twin challenges of climate change and energy security. By selling any surplus electricity back to the Grid, a company has the potential to profit from being greener. I hope this will encourage more UK businesses to realise the benefits of reducing their carbon footprint and switching to alternative forms of energy."

Government Energy spokesperson

**Technologies for every CHP application**

**Cogeneration at landfills**

Biogas produced from the anaerobic fermentation of organic matter in landfill sites is an ideal fuel for power generation. Peter Brotherhood can help you to maximise the revenue-earning potential of your landfill, turning waste gas into electricity and producing heat that could be piped to nearby facilities.

"It is a real win-win situation and shows the kind of innovation and ambition the UK needs to tackle the twin challenges of climate change and energy security. By selling any surplus electricity back to the Grid, a company has the potential to profit from being greener. I hope this will encourage more UK businesses to realise the benefits of reducing their carbon footprint and switching to alternative forms of energy."

Government Energy spokesperson

**Biogas power generation**

**Location: Whittlesey, Peterborough**

**Market: Food Waste**

On the back of a successful initiative to install three 3MW electrical output wind turbines on their Whittlesey, Peterborough site, the energy consumption working group for the potato products manufacturer turned its attention to maximising revenue from their waste treatment process.

The french fries factory produces a wastewater output rich in potato starch which must be cleaned and treated before discharge from the site. A 77,000m³ (2,720,000ft³) covered anaerobic lagoon (CAL) is the first stage in the site’s wastewater treatment process and this CAL produces biogas (which has a high methane content) as a by-product. The opportunity was to maximise the power generation, and therefore revenue potential of the biogas produced from the wastewater treatment process while simultaneously meeting the thermal loads of the french fries manufacturing process.

**Peter Brotherhood CHP solution**

The client invested in an upgrade to their infrastructure by installing a gas scrubber to clean the sulphur from the biogas produced by the CAL and a gas booster plant to bring the gas supply pressure up to the level required for a gas powered CHP unit.

Peter Brotherhood supplied a completely packaged biogas fuelled CHP unit of nominally 1MW electrical output. This system is powered by a high efficiency, spark ignition, reciprocating engine which has been sized to optimise electrical generation from the available gas.

Operation of this system maximises client revenue by displacing imported power and by qualifying for Renewable Obligation Certificates (ROCs) which are tradeable. Classed as ‘advanced anaerobic digestion’ this project qualifies for two ROCs for each MW.hr of electricity generated from renewable resources.

The CHP unit on its own produces in the order of 10 percent of the factory’s power requirements on an annual basis. In addition for each kW.hr of power generated a saving of 0.537kg (1.18lbs) of carbon dioxide as compared to utilising grid supplied electricity can be credited to the site. The capital investment in the gas system upgrade and the CHP installation was offset by the ROCs and displaced imported power cost. The installation paid for itself in little over a year and will continue to provide the site with an annual revenue through the ROCs.
Cogeneration from digester gas

Cogeneration systems can be operated on the gas produced from anaerobic digestion facilities such as sewage treatment plants or agricultural waste digesters.

Anaerobic digestion produces methane-rich biogas that can be treated and used as fuel in special-purpose cogeneration modules to produce electric energy for the facility and hot water for the digesters. In warm climates where the process demand for hot water is lower, the gensets’ exhaust gases can be used for sludge drying. Biogas-fueled engines are also frequently used to directly drive pumps and agitators.

The electricity generated from digester gas will often attract government subsidy or electricity tariff benefits in recognition of its significant environmental contribution.

Generating energy and profit

Location: Broughton, North Wales
Market: Thermal Energy

A manufacturing facility in Broughton, North Wales, has undergone extensive redevelopment over recent years, reflecting the success of the expanding range of passenger aircraft.

The new West Factory, a £350 million ($570 million) building the size of 12 football (soccer) pitches is being used for the assembly of wings for the largest passenger aircraft currently in service and other manufacturing activity. The factory has a significant demand for thermal energy, including that of the wing painting facility.

Faced with a costly mains supply upgrade to accommodate their new production facilities, the client turned to the CHP market for an innovative energy solution that would reduce the site dependence on grid electricity and deliver environmental and commercial benefits.

Peter Brotherhood CHP solution

In partnership with Stiell Facilities, Peter Brotherhood developed an energy centre for the site. For the West factory, three 1020kWe AirCHP units were installed adjacent to the new wing painting facility, generating electricity at 11kV onto the site distribution network. Heated air from each unit is supplied to the inlet of the paint shop Air Replacement Plant which controls the climatic conditions for the painting process.

The paint application cycle requires air at temperatures from 18°C (64°F) for preparation work to 80°C (176°F) for baking, and at different volumes for each part of the process. As the process rarely requires the full output from each AirCHP unit as hot air, the units are configured to provide Medium Temperature Hot Water (MTHW) for heating and process requirements in other areas of the facility. The operational flexibility ensures that the average operating efficiency of each CHP unit is maintained at its highest possible level.
By matching your energy requirements with the most efficient, flexible and effective CHP systems, Peter Brotherhood is able to deliver total energy solutions that optimise operating efficiency and lower total lifecycle costs.

From the selection of the basic approach to the design of the application interface, Peter Brotherhood consistently helps clients gain additional value from their energy assets.

### CHP types

#### Conventional CHP

Conventional CHP, sometimes called Wet based CHP combines the heat available in the engine cooling circuit with the heat in the engine exhaust to produce hot water for the clients needs. While producing electricity from the generator. Giving an overall efficiency of around 85%.

#### Air CHP

Air CHP combines the Wet based CHP system with a conventional Air handling unit. Enabling even greater efficiencies of around 95% to be achieved through the introduction of the low grade heat from the turbo intercooler and radiant heat from the engine block.

#### Trigeneration

Trigeneration takes the Wet based system and combines it with an Absorption Chiller, giving the ability to produce hot and/or chilled water in addition to the electricity generated.
World-class manufacturing and customer support

Engineering Excellence
Peter Brotherhood’s purpose-built world-class facility has first-class design and manufacturing facilities and a highly skilled workforce. Peter Brotherhood offers a complete “one stop shop” from development of an initial concept through to site installation and commissioning, with a service tailored to meet client requirements. Peter Brotherhood works to ISO 9001:2000 quality assurance standard, ISO 14001:2004 Environmental Management standard and OHSAS 18001:2007 Health & Safety management.

Skilled Workforce
We are a highly skilled, multi-disciplinary team of professional engineers dedicated to fulfilling customer needs worldwide. The company’s analytical and design facilities include CAD/CAM, finite element analysis (linear, non-linear and multi-physics), computational fluid dynamics (CFD), and programs for rotor dynamics, heat transfer, control system design and materials science. These are complemented by advanced manufacturing, monitoring and test facilities. Our range of products are the result of continuous, evolutionary development, to maximise efficiency for lower fuel consumption and carbon emissions.

The complete service – from initial concept development to installation and commissioning, as well as after sales support and on-site maintenance.

Installation & Commissioning
World-class project management ensures that globally sourced components arrive on-site, on-time to start a seamless installation and commissioning process. Our team of experienced field service engineers are able to coordinate and conduct activities from the inspection of the turbine foundations to the commissioning and hand-over of the machine to the customer on land and marine based packages.

Servicing & Peace of mind
Peter Brotherhood offer repair and re-rating services for any make of CHP, Reciprocating Gas Compressor or Steam Turbine. A highly skilled team of engineers provide round the clock worldwide services. Often working under extreme conditions, the engineers are dedicated to solving customers’ problems and reducing down time. The engineers are supported by design and technical staff based at Peter Brotherhood’s head office in the UK and if required, can be sent to the customers facility. This, together with an international network of partner companies that offer local support and assistance, ensures we have the right personnel to provide solutions in the shortest time possible.

Continuous R&D
Our ongoing R&D, combined with the feedback from many hundreds of products in the field allows the company to continuously develop designs and manufacturing procedures, improving product capability, reliability and performance. This minimises the time taken to implement new developments and maximises the company’s responsiveness to customers’ needs.

The 11,000m² manufacturing area includes:
- Assembly
- Machining
- Welding and fabrication
- Test bed with live steam
- Heat treatment
- Acid plant
- Pipe fabrication
- Warehouse and stores
- Radiography booth
- NDT - ultrasonic, dye penetrant, magnetic particle

In-house capabilities include:
- Assembly / testing of machines weighing up to 100 tonnes
- Overhead crane capacity of 50 tonnes
- Gas, metal arc, MIG, and TIG welding
- Paint and blasting
- CNC and conventional machining
- Turbine blade manufacture
- Non-destructive testing
- Hydro testing
- Balancing

Manufacturing to quality standards including:
- NEMA SM24
- IEC 45-1
- API 611, API 612
- API 613
- API 614
- ISO 9001:2000
- ISO 14001:2004
- OHSAS 18001:2007
- International Standards
- National Standards, CE Norms, European Directives
- Client and / or Industry Standards
Peter Brotherhood provides a complete range of fully packaged and tested Combined Heat and Power (CHP) systems to commercial, industrial and municipal energy users worldwide. CHP (Cogeneration) systems reduce on-site energy costs and carbon dioxide emissions through the highly efficient delivery of power and heating. Furthermore Combined Cooling, Heat and Power (Trigeneration) systems, provide the high efficiency of CHP, with the added benefit of chilled water output.

To discover how our systems can help reduce your on-site energy costs and greenhouse gas emissions please contact our sales team on: +44 (0)1733 292200 or chp@peterbrotherhood.com