Combined Heat & Power

See inside for information from;

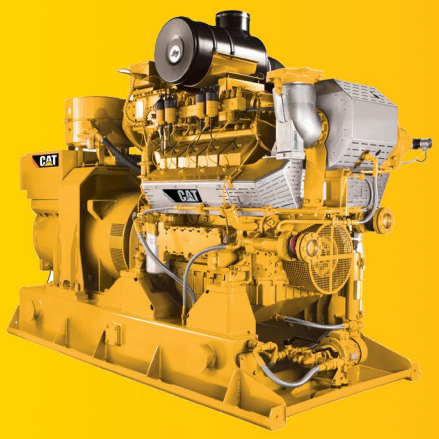
- CHPA (Combined Heat & Power Association)
- Finning (UK) Ltd
- Veolia Environmental Services

SMARTER ENERGY SOLUTIONS.

Many commercial facilities can reduce operating costs by implementing a combined heat and power system.

The Cat® CG range of gas generators is designed for maximum efficiency in extended-duty distributed generation and cogeneration applications. With outputs from 400 to 4,300 kWe, the sets offer superior value by using the very latest gas engine technology, and can operate on natural gas or biogas.

Coupled with Finning's experience, engineering expertise and ongoing support you will benefit from an integrated system that will help reduce energy consumption and improve operational efficiencies.



Contact Finning to learn more, call +44(0)1753 497300 or email psmail@finning.co.uk

BUILT FOR IT.

www.finning.co.uk/power

FINNING CAT

Introduction to Finning capabilities

Our CHP experience

Finning has a global reputation for developing combined heat and power (CHP) solutions that are durable, economic and reliable. We use highly efficient heat exchangers to harvest heat from the engine block water jacket, oil coolers and exhaust gases to produce hot water or steam. This can then be used for heating, absorption chilling or other processes.

District heating

District heating schemes, where heat is supplied from a central source directly to homes and businesses through a network of pipes carrying hot water are gaining in popularity as a highly efficient means of generating heat.

Cogeneration is often added in parallel with the boilers to generate heat and electricity simultaneously, typically providing up to 90% of the heat required.

We have experience of designing, packaging and commissioning CHP packages for numerous district heating schemes, combining highly efficient Cat® gas engines with our own engineering expertise, to deliver energy efficiencies as high as 80%.

Making the case for CHP

CHP is a well-established technology employed in numerous industrial plants and applications across the UK. On-site power generation reduces the amount of electricity the host site purchases from the grid while a variety of systems can be used to capture and transfer useable heat that may otherwise be wasted.

CHP technologies are certainly gaining momentum and according to the Carbon Trust, are particularly suitable for the industrial, public and commercial sectors.

CHP explained

A CHP system consists of a prime mover, such as an internal combustion gas engine to provide motive power, an electrical generator and a means of recovering heat, typically from the engine water jacket and exhaust. Industrial sites will often use this heat generated to provide hot water or to heat the building, but in process applications, this heat can also be used during the manufacturing cycle.

Uses of the heat could include steam generation, medium pressure and low temperature hot water and even cooling water, reducing the need for separate boilers or other heat related equipment.

The business case

According to the Carbon Trust, CHP is a viable option for sites that have ‘a high and constant demand for heat of at least 4,500 hours per year.’

It states that it is a more efficient use of primary fuel for producing heat and power than separate methods. Per 100 units of fuel, a packaged CHP can produce 40 units of electricity and 45 of heat, whereas a conventional power station and boiler would need around 139 units of fuel.

"As a general rule, operators should expect payback within three to four years, depending on the difference between their gas and electricity supply prices. The higher the demand for power and heat, the greater the achievable savings."

For example, a 1200kWe CHP operating 24 hours a day and producing 1189kW of heat could save £125,000 per year. This is based on a 3.5 pence per unit cost for gas and a 10 pence per unit cost for electricity and, after comprehensive maintenance costs have been factored in.

CHP units from Finning in the 400-800kWe range operate at 42.0-42.4% electrical efficiency and in the 1200-2000kWe at 43.3-44% efficiency.

"There are a number of factors that will affect return on investment, including the cost of bought-in gas and electricity from the utility provider, the demand for heat and whether this is continuous or cyclical."

The distance that the heat will have to travel to reach the process should also be accounted for, as any heat losses will mean that CHP station efficiency will be lowered.

The site survey

Before commissioning a CHP package, energy managers should first carry out a site survey to ensure suitability and to make any necessary modifications to site infrastructure. Finning offers a comprehensive feasibility service, which includes checking the gas supply and assessing the electrical connection for the CHP power element among others.

CHP installations should normally be sized to meet the base load consumption. It is important that this is based on the demand profile during a full production year to account for peaks and troughs in output and that it includes an assessment of yearly gas and electricity bills, based on half-hourly measurements of heat and power consumption.

This will enable a heat-to-power ratio to be calculated. For example, a processing site may require 500 kW of heat and 500 kW of electricity to operate to maximum production output. In a conventional installation, the heat will be provided by a series of gas boilers and the electricity purchased directly from the grid.

In contrast, a CHP installation may produce 400 KWe of heat and electricity respectively from one natural gas fuel source, meaning that the operator can significantly reduce its utility costs, importing only the additional power it needs above the 400kWe base.

In some instances, to achieve the power-to-heat ratio necessary, it can be more economic to oversize the package from a power perspective to meet the site's heat demand and sell any excess electricity back to the grid at a profit. In other applications, it can be more profitable to size to the building's lowest average heat demand, with the CHP system acting as the lead boiler and backup boilers picking up additional heat requirements.

- **Almost 80% of the UK's CHP electrical capacity is generated by just three industrial sectors; chemicals, oil refineries and paper, publishing and printing**
- **Technology is used widely in a range of large-scale community heating schemes in hospitals and universities**
- **Smaller, packaged CHP applications in hotels, leisure centres, hospitals and small community heating schemes are also gaining popularity**

Helping to cut carbon at Janssen Pharmaceuticals (IRE)

At Janssen Pharmaceuticals (IRE), part of the Johnson and Johnson group of companies, the company specified a CHP solution from Finning. Featuring a containerised Cat® G3512E gas engine with an electrical output of 1.0 MWe, the CHP solution supplied by Finning includes an exhaust gas boiler producing up to 625kg/hr of steam and a hot water recovery system generating up to 569kWt.

Finning also supplied and installed a purpose built boiler house, as well as a transformer to step-up power from 400V to 11kV.

Commenting on the success of the project, Janssen Pharmaceuticals said: "We are continually seeking ways to improve our environmental performance and this move to on site generation of power is a key element in our strategy for carbon reduction. The increased efficiency will also significantly reduce our ongoing utility costs."

Biogas and CHP; a perfect partnership

The wastewater treatment industry was one of the earliest adopters of CHP technologies, recognising its value in the process of generating electricity from reclaimed biogas.

Southern Water has been working with Finning for more than a decade for the generation of 'green' electricity from biogas; a model which incorporates a 15-year operations' and maintenance framework centered around the implementation and asset management of modular, CHP stations together with the latest gas treatment technologies.

A decade of experience

Finning first began working with Southern Water on an initial CHP framework agreement covering five sites. With engine sizes ranging from 370 kW to 750 kW, these smaller installations proved an ideal test bed for a second and much larger agreement that was to follow, commencing with the Budds Farm Wastewater treatment works in Havant.

"CHP stations take the biogas produced during the digestion process and use it as a fuel to drive a suitable gas engine/generator package with the by-product heat captured and transferred for process heating around the works."

As part of their plant mix, CHP operators can thus expect larger savings by substituting grid electricity with their own supply, shorter payback periods to other categories of green technologies and reduced reliance on heat-generating sources, such as gas boilers.

Budds Farm was originally using biogas from the digester as fuel to run a sludge dryer only. Finning calculated that by using the biogas to power a Cat® G3520C gas generator CHP package, the site would generate 1.95MWe of electrical power, sufficient to power the plant alongside heat that was available from other site processes.

Together with a commercially guaranteed 15-year operation and maintenance contract to optimise the generator's output, ensure maximum heat recovery from the available fuel and guarantee 93 per cent engine availability. This approach has continued to be replicated at other sites across the Southern Water estate.

These include the Millbrook wastewater treatment works at Western Docks in Southampton, where in 2007 a 1.15Mwe modular CHP station, including all civil engineering works was developed. This was followed by the Ashford treatment works in Kent, where a larger 1.95MWe CHP unit with full heat recovery was installed until more recently, the commissioning of a comprehensive CHP package at Southern Water's showcase Peacehaven site, 11 km to the east of Brighton.

A modular approach

Installing a CHP system on a working site can involve considerable disruption, so Finning employs a modular approach, where much of the engineering and design is completed off site before delivery and installation.

At Budds Farm, for example, package elements were divided in to four modules. The first of these was a packaged **continued page 10**

CHPA and Veolia Environmental Services

Both committed to CHP

The Combined Heat and Power Association (CHPA) is the leading advocate of an integrated approach to delivering energy services using combined heat and power district heating.

The Association has more than 100 members active across a range of technologies and markets and is widely recognised as one of the leading industry bodies in the sustainable energy sector.

The CHPA works to promote a greater awareness and understanding of combined heat and power (CHP) and district heating to create a strong, dynamic and sustainable environment for its members and the communities, businesses and households they serve.

Prior to the Government's Heat Strategy being released, CHPA launched a report to set out a pathway for the decarbonisation of heat.

'The Heat Revolution: Meeting Consumers' Needs in a Decarbonised Economy,' focuses on the needs of all heat users and lays out the CHPA's vision for reducing heat's contribution to the UK carbon emissions securely, efficiently and competitively, while also facilitating the decarbonisation of wider energy use.

Heat provision currently accounts for over half of the UK's energy demand and without a robust plan for heat decarbonisation, abating the UK's overall emissions is likely to prove more costly for energy users at all scales.

The Government's Heat Strategy identified pathways for the transition of the UK's heat supply to low- and zero-carbon energy sources.

The strategy points the way to a major expansion of new district heating networks in the nation's towns and cities, driving a multi-billion pound investment programme in green infrastructure and creating an additional 40,000 jobs in construction and engineering.

Ambitious new targets announced in March will see Scotland deliver five times more heat through district heating to help Scottish householders and businesses lower their energy bills.

CHPA welcomed the Scottish Government's heat generation policy document, which puts district heating at the centre of its strategy for delivering affordable, low carbon heat by 2020.
The proposals commit the Scottish Government to connect up to 40,000 more homes to heat networks by 2020 and double the money available for the District Heating Loan Fund to £8M.
CHPA Director, Dr Tim Rotheray, said: ***"District heating is one of the most cost effective methods for tackling fuel poverty, making it an important tool to help the nearly one-third of Scottish households classed as 'fuel-poor'.***
"These ambitious targets will be vital for attracting the additional investment needed to benefit the thousands of families across Scotland that struggle to pay their heating bills.
"To make sure that this ambition is delivered, it is essential industry continues to take the lead in strengthening consumer confidence through strong standards and independent customer protection.
"We look forward to working with the Scottish Government to ensure industry can help deliver Scotland's ambition for affordable, low carbon heat."
CHPA congratulated the 26 local authorities that were awarded funding in January to support the development of their heat network projects.
In addition to the £1.9M of funding, the Heat Networks Delivery Unit will also provide these local authorities with commercial and technical expertise to help develop attractive investment propositions for the supply of cost effective, low carbon heat to homes and businesses.
Dr Rotheray commented: ***"The success of these applications is a great first step towards realising the Government's ambitions for district heating.***
"By delivering heat to homes more efficiently, each of these schemes has the potential to benefit their local community and curb rising energy costs for thousands of people across the UK.
"We look forward to working closely with Government and industry to ensure that local authorities have the capacity to turn these projects from lines on a page to pipes in the ground."
The final passage of the Energy Act was also warmly received by CHPA.
The Act, which received Royal Assent in December 2013, offers an opportunity to begin transitioning to a more efficient, consumer-led energy system.
It brings in new measures to incentivise energy efficient renewable CHP, reduce electricity demand and ensure consumers can be active participants in providing capacity to the energy system through demand side response.
Dr Rotheray said CHPA is committed to meeting the challenges about the cost of energy, and the Act will create a system with 'the consumer at its heart'.
"At a time when consumers are increasingly asking questions about the cost of energy, we need to make sure we are meeting the challenge in the most cost effective way," he said.
"The Energy Act could help to create a smarter, more efficient energy system, with the consumer at its heart. We do not yet have all the policies in place to reach that goal, but some of this Act's key measures will help to move us in the right direction.
"Support for highly efficient renewable CHP will ensure we are using renewable energy efficiently to decarbonise UK industry.
"The inclusion of demand-side measures in the capacity market could give consumers the opportunity to engage with and benefit from a more secure and efficient energy system."

Veolia

Veolia Environmental Services, employing around 12,000 people, is the UK's leading recycling and waste management company, enjoying a UK presence since 1990.
Conscious of its environmental and social responsibilities, the Company promotes the use of sustainable waste treatment methods to recover valuable raw materials and more than £1Bn has been invested by Veolia in the UK's recycling and waste infrastructure.
Over a third of the UK's population benefit from the Company's services,

including refuse, recycling, street cleansing and grounds maintenance, all provided through more than 100 local authorities across the UK.

Veolia's commercial and industrial customers can take advantage of recycling and waste collection, treatment, recovery and disposal services for dry, liquid and hazardous waste.

On-site industrial services, decommissioning and emergency responses are also provided as well as a range of compliance services.

Veolia is at the forefront of new technology and committed to staying ahead of the latest legislation with more than 150 dedicated staff based in its unique European research and development facilities.

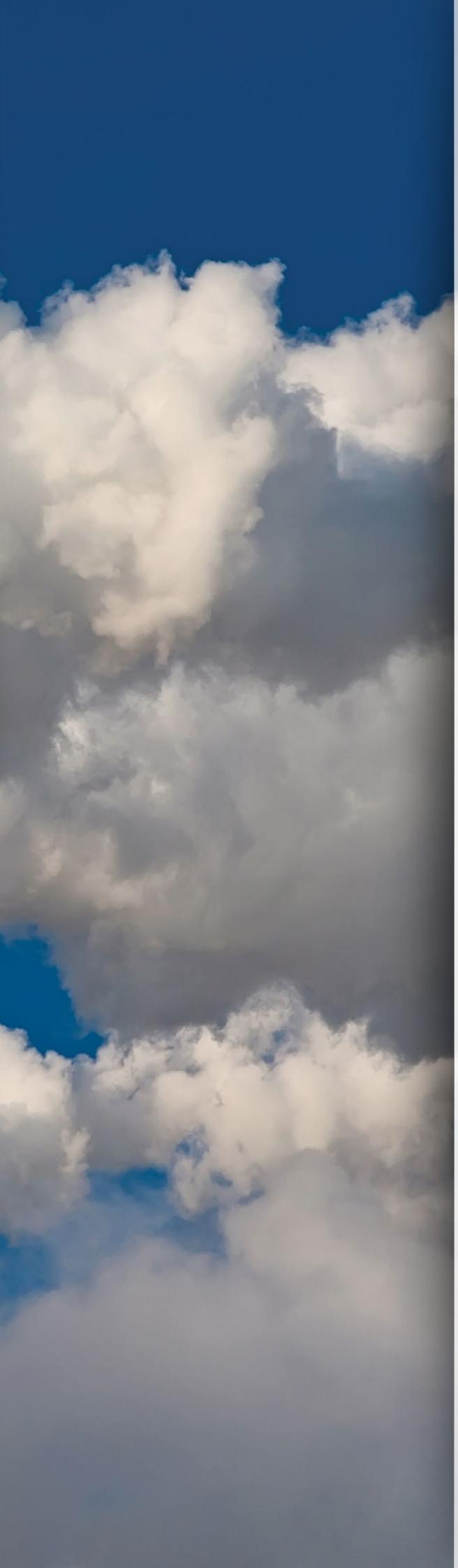
More importantly, the Company views its role as pivotal in securing a positive future for the environment and a benchmark for the industry, which always ensures it maintains the highest standards of practice.

The Company is the waste management arm of Veolia Environment, one of the world leaders in environmental services.

Veolia Environment generated revenues of €29.4Bn in 2012 by providing tailor-made solutions in water management, energy services and waste management. It is listed in the main socially responsible investment indices, including the Ethical Sustainability Index and FTSE4Good. It is also a member of the World Business Council for Sustainable Development and the UN Global Compact.

Veolia Environmental Services believes that utilising large quantities of waste heat in CHP applications is vital to the future energy diversity and stability of the UK economy.

February saw the Department for Environment, Food and Rural Affairs (Defra) publish its updated 'Energy from Waste: a guide to the debate' outlining a desire to see more high efficiency EfW plants producing both energy and heat.



Veolia already operate two CHP facilities in Sheffield and London, and its proposed facility in Hertfordshire – awaiting planning approval – could provide a further 20MWth of heat.

This would be enough for 60,000MWh per year to heat the equivalent of 4,000 local homes.

Local businesses can also profit with options for 4-5MW of electricity and heat supplies underpinning local jobs by making industry more sustainable.

Benefits of these schemes are wide and decentralise energy supplies, providing cost effective power and heat to local communities and business.

Clear industry evidence identifies that there is a lack in current waste to energy infrastructure, and a real need to invest now for the future.

If approved, the Recycling and Energy Recovery Facility (RERF) in Hertfordshire will generate sufficient power to the National Grid through the energy recovery process to power approximately 50,000 Hertfordshire homes and save the local authority around £667M.

However, the delay in approval is causing savings to be lost. Waste continues to be sent to disposal or recovery facilities outside the county, and there is an inability to use the waste as a source to heat local homes.

Veolia's Executive Director, Robert Hunt, said: ***"The current planning system appears neither business nor community friendly since it is not delivering the infrastructure we need to ensure the UK prospers with an economy that will add value to the majority.***

"However, the good news is that we do have a solution available now through projects such as the Hertfordshire RERF and in terms of energy provision it is certainly more cost effective than what we do today.

"Sheffield is a good example of a successful CHP project from an innovative and proactive company such as Veolia.

"Local schemes across Sheffield now utilise 40MW of waste heat from Veolia's Energy Recovery Facility to heat the city, cool the sports centre and reduce reliance on the use of fossil fuels."

In November last year, Southwark Council and Veolia launched London's first EfW district heating network.

It will result in almost 8,000 tonnes of carbon emissions each year being cut – the equivalent of taking 2,700 cars off its roads.

Energy generated from the South East London Combined Heat and Power (SELCHP) facility in Deptford will be used to provide heat to 2,500 homes in Bermondsey, Southwark.

The commitment to heat from waste technology was announced at the official launch ceremony in November, attended by representatives from local authorities, government officials and leading energy experts.

Matthew Pencharz, senior advisor on energy and environment to the Mayor of London, attended the event as a guest speaker and put forward his vision for EfW technology across the capital.

The pioneering scheme presents a viable alternative to traditional gas fired boilers and will provide sustainable and secure heating for the five estates of Bermondsey.

In addition, the scheme promises to deliver long-term energy cost savings to residents.

Estelle Brachilanoff, Veolia Environment Executive Vice President, UK and Northern Ireland, said: "This scheme is a great example to other local authorities of how local waste can be reused to create energy and heat for local homes.

"It's the circular economy made real and represents an important source of renewable energy that will help keep homes warm and improve energy security and diversity of supply.

"Combining district heating and energy from waste means residents can secure their heating bills for the next 20 years."

Set up to transform tonnes of rubbish into heat and hot water over the winter of 2013, the scheme will run for 20 years, after which the Council will decide whether to retain the scheme or revert back to the traditional supply of gas.

Since its inception, the SELCHP facility has only generated electricity, which feeds into the National Grid.

This will be the first time that heat will be created as part of the energy process.

generator set housed in an acoustic container that includes the Cat G3520C gas generator and the company's LIMA control system. This covers all of the synchronisation, G59 and remote monitoring requirements and connects to the site's high voltage switchgear via a 2500kVa step up transformer.

The second module was the heat recovery system, configured initially to capture 716kWt of heat from the engine jacket water circuit due to additional heat being available from other site processes. This was added to earlier in 2013 with the retrofitting of an exhaust gas heat exchanger due to changes in site set up.

Module three was a gas collection and compression station that also removes some of the solids and vapour from the biogas.

Finally, the fourth module was a gas clean up skid that removes other contaminants such as siloxanes and hydrogen sulphide. This fourth module uses new regenerative filtration instead of activated carbon filters to remove the siloxanes, lasting up to five years and eliminating the problem of waste carbon disposal.

In addition, at the Peacehaven site, the CHP package has a dual gas train allowing it to run on either biogas or natural gas. This was an important consideration for Southern Water as, without power, vital processes in the plant cannot operate. The package is therefore configured to run in island mode should the site suffer a mains power failure, enabling processes such as the supply of heat to the digesters, to remain at full capacity.

A final gas management package was supplied, including gas boosters to raise the fuel gas pressure from 15mBar to the 150mBar required by the generator sets, gas meters to meet CHPQA requirements for 'good quality' CHP and online gas analysis to measure the methane, oxygen and hydrogen sulphide content of the fuel gas.

This modular approach has several benefits. First, all of the modules are subject to a strict factory-based quality control regime, enabling Finning to use more of its in-house engineering resource to ensure that each bespoke solution meets Southern Water's needs. Most importantly, it halves the installation time by minimising site works and the associated disruption.

District Heating

Powering Cofely District Energy

Finning Power Systems supplied Cofely District Energy with seven Cat® generator sets for its schemes in Leicester and Birmingham.

The Cat gensets support low carbon CHP and tri-generation technology across the two sites, covering thousands of homes as well as other council-owned buildings.

Leicester District Energy scheme

Cofely District Energy, a GDF SUEZ company, completed the construction of the Leicester District Energy scheme in late 2012. A £15m partnership between Cofely District Energy, Leicester City Council and the University of Leicester, the scheme spans six estates and is one of the largest projects of its kind to be installed in the UK.

Finning supplied two 1600kWe, Cat G3516E generator sets, along with design support and commissioning for the new, gas-fired CHP installation at the University of Leicester. A G3516E unit was also supplied for the upgrade of the existing district heating scheme on the city's St Marks estate.

The scheme will help to provide heat and power to more than 3,000 council homes, many city council buildings and the entire University of Leicester campus, with other buildings already planning to connect. The scheme is expected to reduce Leicester's carbon emissions by around 8,400 tonnes per annum.

Birmingham District Energy scheme

Four Cat gensets from Finning, including a G3516C with control panel and exhaust gas heat exchanger, along with a 2000kWe G3520E, 1600kWe G3516E and 725kWe G3512LE were supplied to the district energy scheme in Birmingham.

Owned and operated by Cofely District Energy in partnership with Birmingham City Council, the scheme features tri-generation - producing heat, electricity and chilled water.

The scheme makes extensive use of large-scale CHP technologies, along with conventional boilers, and is playing a pivotal role in the city council's climate change strategy, which aims to reduce carbon emissions by 60% by 2025.

Finning provided design support and commissioning for all four units. Commenting on the company's relationship with Finning Power Systems, Simon Woodward, CEO at Cofely District Energy said: "We purchased the first Cat generator from Finning for the Birmingham District Energy scheme back in 2007. It's testament to the quality, reliability and performance of the Cat products that we have continued to use them to support our schemes in both Leicester and Birmingham over recent years."

COMBINED HEAT & POWER POWER PROFILE.

Customer
Janssen Pharmaceutical

Location
Cork, Ireland

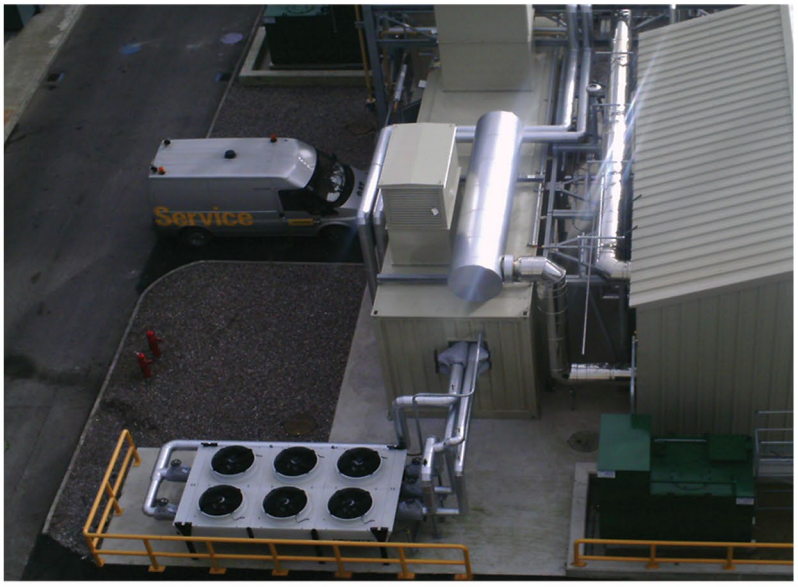
Customer requirement
Combined Heat & Power (CHP) plant

Services

Feasibility studies	☑
Detailed design	☑
Financing	☐
Mechanical engineering	☑
Civil engineering	☐
Equipment supply	☑
Ancillary equipment	☑
Project management	☑
Installation	☑
Commissioning	☑
Ongoing operation	☐
Maintenance	☑
Genuine parts supply	☑

For more information:
T: 01753 497300,
E: psmail@finning.co.uk

BUILT FOR IT.



Power Need

Janssen is a world leading pharmaceutical company. Their site in Cork produces Active Pharmaceutical Ingredients (API) which are shipped to other sites for incorporation in end products. The company required a CHP plant to generate on site power, steam and Low Temperature Hot Water (LTHW) for various site processes. With ever increasing energy bills, the aim was to reduce on-site energy costs.

Solutions

Following a proposal resulting from careful analysis of the site and sizing requirements, a containerised Caterpillar G3512E gas generator, with an electrical output of 1.0MWe was specified. The solution includes an exhaust gas boiler producing up to 625kg/hr of steam and a LTHW recovery system generating up to 569kWt. The CHP solution uses two ways of generating heat for the site. Exhaust gases are used to evaporate condensate return water to generate steam, whilst heat exchangers harvest heat from the engine water jacket circuit to produce LTHW. The steam and LTHW is then used within various production processes within the plant. The inclusion of a step-up transformer allows the production of continuous power at 10 kV and integration of the CHP system with the existing site High Voltage (HV) ring infrastructure. The scope of works included a purpose designed building to house the exhaust gas boiler, hot well and blowdown vessel.

Results

Finning was selected as the sole CHP supplier based on previous experience and local coverage. Finning will provide ongoing maintenance for the plant including preventative maintenance, servicing, genuine spare parts and remote monitoring of the site. Says Finning's Gas Projects Sales Manager Keith Stocker: "This project demonstrates our ability to work with a customer from system design through to implementation and ongoing maintenance. It conveys our knowledge and expertise of CHP applications in the pharmaceutical sector."

www.finning.co.uk/power

FINNING CAT

Finning Power Generation
688-689 Stirling Road
Slough, Berkshire
SL1 4ST

Telephone: +44 (0)1753 497300
Email: psmail@finning.co.uk
www.finningpower.co.uk