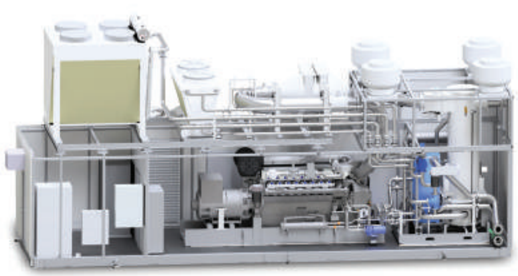
MARTIN ENERGY GROUP

Generating Clean Energy.



Guide to Small Scale

Combined Heat & Power (CHP) Systems

CONTENTS

Complete solutions provider for Generator Packages, Combined Heat and Power (CHP) Systems, MicroGrids, and Anaerobic Digester Design & Construction

Our company has the capacity to supply and service the full range of power generation products, including generator sets, switchgear, gas handling skids, waste heat recovery systems, absorption chilling systems, carbon credit monitoring systems, and much more.

In-house electrical and mechanical engineering solutions

Our experience covers a wide variety of applications: greenhouses, hospitals, universities, landfills, waste water treatment plants, agricultural establishments, mining operations, oil fields, and more.

We have installed hundreds of CHP units throughout the United States, Canada, Central and South America, Africa, Europe, Asia, the Middle East, and Australia.

Our commitment to customer satisfaction is second-to-none. We evaluate each project and engineer solutions that meet or exceed your expectations. We can install our custom, sound-attenuated enclosures in sub-basements and on roofs.

Professional manufacturing, careful assembly, and comprehensive testing are performed by trained technicians, in our own facilities.

WHAT IS COMBINED HEAT AND POWER?

Introduction to Combined Heat & Power

Combined Heat & Power (CHP) converts a single fuel into both electricity and heat in a single process at the point of use. CHP is highly energy efficient and as well as supplying heat and power, it can deliver a number of positive financial, operational and environmental benefits.

CHP is a well-proven technology, recognized worldwide as a viable alternative to traditional centralized generation.

With CHP, an engine which is normally fueled by natural gas, is linked to an alternator to produce electricity. CHP maximizes the fuel and converts it into electricity at around 33% efficiency and heat at around 52%. Heat is recovered from the engine by removal from the exhaust, water jacket and oil cooling circuits.

Typically a good CHP scheme can deliver an efficiency increase of anything up to 25% compared to the separate energy systems it replaces.

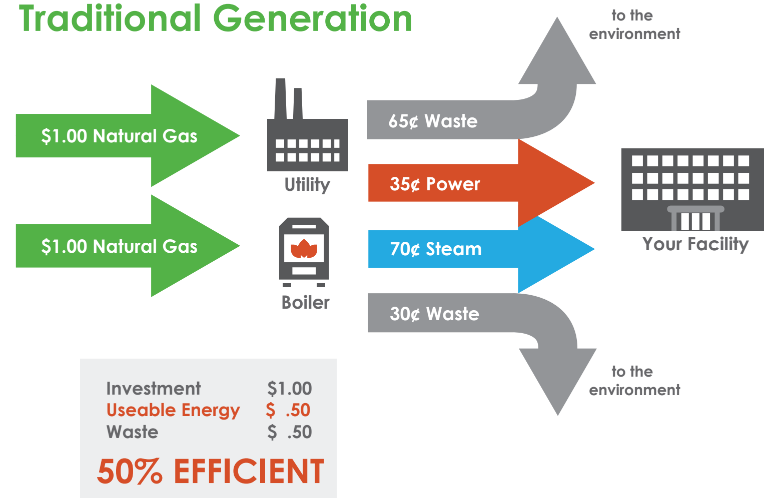
CHP should always be considered when:

- Designing a new building
- Installing or replacing a new boiler plant
- Replacing or refurbishing an existing plant
- Reviewing electricity supply
- Reviewing standby electricity generation or plant
- Considering energy efficiency in general
- Exploring options towards building regulation compliance
- Reducing CO2 emissions

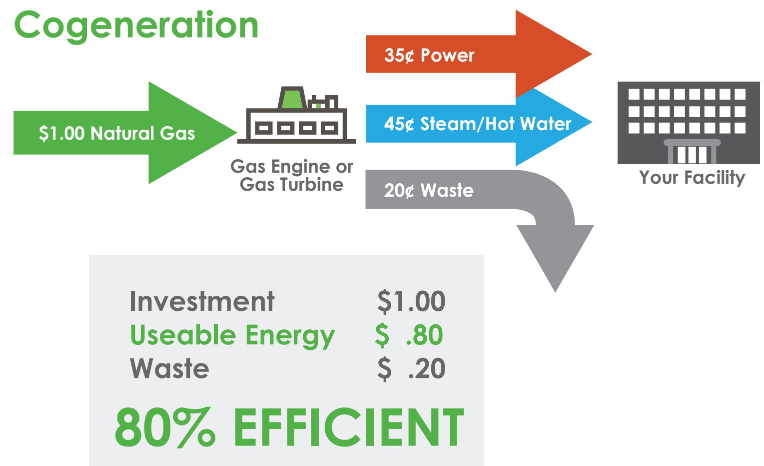
Combined Heat & Power Applications

- Leisure centers
- Hotels
- Hospitals
- Universities
- Military bases
- Prisons
- Manufacturers
- Commercial premises
- Horticulture
- Airports
- Waste water treatment works
- Municipal buildings
- District heating schemes i.e. offices, residential
- Pharmaceutical
- Anaerobic Digestion i.e. dairy, on-farm.

Traditional Generation



Cogeneration



WHAT IS COMBINED HEAT AND POWER?

Fuel Options

The most common fuel option for a Martin Energy Group CHP is natural gas. This is widely available in many countries through the mains gas network and offers straight forward and sustainable access to Combined Heat and Power.

Alternatives to natural gas include biogases, bioliquids and biofuels. Using alternative fuels has its advantages. Payback on anaerobic digestion (AD) and other biogas CHP projects, such as wastewater applications, can be rapid. Wastewater CHP projects can provide rapid payback on investment – usually within 10 to 18 months. Considering that the lifespan of a typical CHP system is 10-15 years, this can provide a significant cash surplus, as well as improving environmental performance.

Developers can choose to fund capital costs of projects claiming Feed-in Tariffs (FiTs) on electricity generated from CHP engines and exported to the grid as well as benefiting from enhanced capital allowances. There is also potential for additional income via the Renewable Heat Incentive (RHI).

Biomass and biogas CHP is eligible for Renewable Heat Incentive (RHI) support. Any new application for RHI with a biomass boiler (including CHP systems) or a biogas CHP (such as part of an anaerobic digestion plant or at a waste water treatment works) must have either an RHI emission certificate or an environmental permit certifying that Particulate Matter (PM) and NOx emissions from the site do not exceed maximum permitted levels.

Biomass boilers and biogas applications that do not have a RHI emission certificate or an environmental permit will not be eligible for the RHI.

Martin Energy Group can offer pre-treatment technology required to clean and dry biogas from digestion processes, such as effluent and AD this would include Siloxane and H2S treatment, and a chiller to clean/treat gas prior to the engine, depending on the gas quality and feedstock.

Benefits of Combined Heat and Power

Reduces Running Costs

- Reduces sites actual energy costs
- Avoidance of Climate Change Levy
- Claimable Enhanced Capital Allowances
- Stabilizes energy costs over a period of time

Reduces CO_2 Emissions

- Points for BREEAM assessment
- Meet CSR requirement
- Legislative compliance with part L2 of building regulations

Security of Supply

- Acts as back-up generator
- Back-up heat supply
- Reduces grid dependency

Financial Benefits

CHP represents a highly efficient use of fuel, which means lower energy costs for the user. In the USA, taxation benefits can be obtained through avoidance of Climate Change Levy (Good Quality CHP) and the possibility of Enhanced Capital Allowances for eligible organizations. In other countries, a range of fiscal support measures also enhance the financial benefit of CHP. Third party or supplier funding options for CHP means an organization has the option of outsourcing the CHP system without capital outlay giving an immediate payback.

Emissions Benefits

In the USA, the recent amendments to the Building Regulations, Part L2A and Part L2B seek to reduce both energy consumption and CO2 emissions by up to 28% compared to the 2002 regulations. All CHP schemes produce reduced emissions compared to the separate supply of mains electricity and traditional means of site heat production. A well designed and operated CHP plant can contribute significantly towards Part L compliance. Impacts can be readily assessed through SBEM or other energy performance modeling software packages.

Co2 savings are calculated using the following formula:
Grid electricity CO2 abated + Boiler fuel CO2 abated - CHP fuel CO2 released = Net CO2 saving
The figures to use in this calculation are found in the Building Regulations 2000, Part L2A (2006 Edition) which are:
• 0.184kg Co2/kWh for combusted natural gas
• 0.483kg Co2/kWh mains electricity displaced

ECONOMICS OF COMBINED HEAT AND POWER

There are generally three stages to completing the economic viability for CHP once the project has been scoped:

- Data Collection
- Initial Feasibility Study – desktop calculation
- On-site Review – to determine installation options and cost.

Data Collection

Before a CHP unit can be correctly sized and the associated savings accurately calculated, the appropriate site data needs to be collected and validated. The minimum data requirement centers around the utility consumption of the site (grid electricity and natural gas) and the associated tariffs. Natural gas consumption doesn't have a graded tariff system. The most common source of this data is simply found on the site utility bills.

Over the last few years, the availability of half-hourly utility data is becoming more and more common. Availability of such data can improve the accuracy of a feasibility study since it can provide a greater insight into the operation of the site.

Whilst the utility consumption and tariffs are the most important pieces of data in a CHP desktop feasibility analysis, other site conditions can have a major effect on the CHP savings. Examples include the distribution of the consumed natural gas and the boiler efficiency. The thermal energy recovered by a CHP unit can only displace thermal energy generated by the boilers, therefore if any gas is used in any direct gas-fired plant (e.g. ovens) then this gas needs to be deducted. The boiler efficiency is used to convert the natural gas consumed by the boilers into useful thermal energy.

Initial Feasibility Study

Having collected and validated the data, a simple evaluation of whether a CHP scheme is likely to be feasible or not can be conducted. This is calculated by working out the "spark spread" - the difference between the grid electricity tariff and the natural gas tariff. If the grid electricity tariff is 9p/kWh and the natural gas tariff is 3p/kWh, then the spark spread is 3.0.

$$\frac{\text{Grid Electricity Tariff}}{\text{Natural Gas Tariff}} = \frac{\$0.12 \text{ per kWh}}{\$0.80 \text{ per therm}} = 3.0$$

As a rule of thumb a spark-spread of at least 2.5 is required to make a CHP scheme viable, however this is not a strict figure. Within the table below, an example set of data is used to help determine a CHP unit size.

When determining the best CHP unit for a site, both the electrical and thermal utilization of the CHP outputs need to be maximized in order to deliver the best return on investment. If the selected CHP unit is too small then the maximum savings aren't being delivered. If the selected CHP unit is too large then the CHP unit will be operating inefficiently at part-load, have fewer run hours and lower utilization figures.

With smaller projects, it is likely that the site energy demands are lower during the night-time than the daytime. Therefore consid-eration is required to either select a CHP based on the lower night-time baseloads so it can run 24 hours per day or to size a larger CHP to run during the daytime operational hours only.

	Day kWh Electricity	Night kWh Electricity	Natural Gas Therm		Mean Day kW_e	Mean Night Therm	Mean LTHW Therm
January	101,569	21,657	483,832		192.7	99.8	520.2
February	93,524	19,081	415,009		196.5	97.4	494.1
March	101,437	20,873	388,279		192.5	96.2	417.5
April	101,006	20,189	331,167		198.1	96.1	368.0
May	104,762	21,233	265,264		198.8	97.9	285.2
June	101,939	20,897	229,530		199.9	99.5	255.0
July	100,425	21,442	187,109		190.6	98.8	201.2
August	100,789	21,064	206,916		191.3	97.1	222.5
September	99,802	20,297	239,345		195.7	96.7	265.9
October	100,868	21,238	300,171		191.4	97.9	322.8
November	101,556	20,441	366,487		199.1	97.3	407.2
December	100,457	20,767	450,435		190.6	95.7	484.3
Total	**1,208,133**	**249,179**	**3,863,544**	**Mean**	**194.8**	**97.5**	**353.7**

CHP Sizing

The utilization of the recovered thermal energy drives the economics of a CHP project. However this doesn't mean that sizing the CHP to match the summer thermal baseload will always provide the best overall solution. Depending on the individual site circumstances it may be more cost-effective to operate the CHP with some of the thermal energy being dissipated rather than to switch the CHP unit off.

Additionally the scheme will become eligible for ITC (Investment Tax Credits) and MACRS (accelerated depreciation).

ECONOMICS OF COMBINED HEAT AND POWER

CHP Selection

CHP selection will be exemplified using the table below.

If the requirement for the CHP unit was to operate for 24 hours per day, then a 90kWe and 161kWth unit (MEG 90) would be an ideal selection. This is because the night-time load of the unit is approximately 95kWe.

The other key advantage is the much lower chance of any rejection of recovered thermal energy so the CHPQI figure will be healthier. However if the requirement is for the CHP unit to offset as much of the more expensive daytime electricity as possible then the a 185kWe and 309kWth unit (MEG 185) would be a better selection. This selection is based on the daytime load of the unit being approximately 190kWe.

It is likely that there will be some rejection of thermal energy during the summer baseload period so a CHPQI calculation will need to be conducted to ensure this is a 'Good Quality' CHP scheme.

If the unit was selected based on the thermal baseload of the site then a 125kWe and 200kWth unit (MEG 125) would be a more prudent selection.

This will be the biggest unit that could be installed with no heat rejection, however, the unit would only be able to operate correctly during the daytime period as it is slightly too large for the night-time electrical load.

The savings for all three units selections are presented in the following table.

Ref	Parameter	Equation	MEG 90	MEG 185	MEG 128
A	Electrical (kWe)	-	90	185	125
B	Thermal (MMBTU)	-	161	309	200
C	Fuel (Therms)	-	308	603	399
D	Day Hours Run	17h/day * 365day/yr * 90%	5,585	5,585	5,585
E	Night Hours Run	7h/day * 365day/yr * 90%	2,300	-	-
F	Day Elec Util.	-	100%	100%	100%
G	Night Elec Util.	-	100%	-	-
H	Thermal Util.	-	100%	91%	100%
I	Day Electricity (kWhe)	A * D * F	502,605	1,033,133	698,063
J	Night Electricity (kWhe)	A * E * G	206,955	-	-
K	Thermal Utilized (kWhth)	B * (D + E) * H	1,269,324	1,577,208	1,116,900
L	Gas Consumed (kWh)	C * (D + E)	2,428,272	3,367,454	2,228,216

Ref	Parameter	Equation	MEG 90	MEG 185	MEG 128
M	Day Elec Tariff (p/kWhe)	-		9.000	
N	Night Elec Tariff (cents/kWh)	-		6.000	
O	Electricity CCL (CCL = SBC)	-		0.541	
P	Gas Tariff ($/Therm)	-		3.000	
Q	Natural Gas CCL ($/Therm)	-		0.182	
R	Boiler Efficiency	-		80%	
S	Day Electricity Savings	I * M	$45,234	$92,982	$62,826
T	Night Electricity Savings	J * N	$12,417	$-	$-
U	Boiler Gas Savings	K * (P + Q) / R	$50,487	$62,733	$44,425
V	CHP Fuel Cost	L * -(P + Q)	($77,268)	($107,152)	($70,902)
W	Total Utility Savings	S + T + U + V	$30,871	$48,563	$36,349
X	Total GROSS Savings	W + Y	$39,130	$60,281	$44,180

Based on the 'Total GROSS Savings' alone, the MEG 185 offers a substantial increase in savings over the two smaller options, even though the unit is rejecting some of the recovered heat during the summer period. However in order to make the final decision over the suitability of the CHP unit for the site, the installation costs and the annual maintenance costs need to be considered.

The table also shows that the previous assertion regarding the balance between the gas costs and the electricity savings are broadly applicable in this case. For the MEG 185 and the MEG 125 the 'Boiler Gas Savings' (Ref U) and the 'Total GROSS Savings' (Ref Z) are approximately equal. This means that if there is poor utilization of heat then the savings will be less than anticipated.

Site Review to Determine Actual Installation Costs

If the desktop calculation modeling demonstrates a saving, it is imperative to understand the site to ensure suitability regarding interfacing the CHP, to establish the connective loads are achievable.

Installation costs can vary dramatically from site to site depending on several key factors:

- Location of CHP plant
- Gas availability
- Space allocation
- Planning implications
- Noise issues
- Local regulations
- Maintenance restrictions
- Electrical connections i.e. LV, HV, network restrictions
- Thermal integration.

Once these are established, another more detailed feasibility review is required to ensure suitability and compliance. Martin Energy Group can support this by providing applications engineering guidance and budget costings.

Plant Optimization

In order to optimize the CHP system, sizing the unit is critical to the success of the project. The aim of the process is to maximize the potential financial savings and ensure compliance with current legislation.

The most suitable sites for CHP generally have year round demand for heat or cooling, where the unit will be run as "lead boiler".

Viability further improves if you consider the CHP unit as a standby generator for noncritical loads or boiler replacement is considered. For units sized just above baseload, thermal modulation is possible where the unit is run at reduced output for short periods.

The baseload electrical demand of the site is the level that the sites electrical demand never falls below. It is generally the norm to provide a CHP unit that meets this criteria so that all the electricity generated by the CHP will be utilized by the site and any top-up will be provided from the grid.

There are instances where it maybe beneficial to export electricity onto the grid, provided the full economics behind the scheme are identified and addressed. Electrical modulation is also a possibility to reduce the electrical output of the CHP of periods of low demand on-site.

Other Factors

Other local influences that need to be established are site occupancy and the operational hours for the proposed plant, existing boiler efficiencies and future energy requirements that could be provided for.

FINANCING THE CHP PROJECT

There are a number of financing options that can be specifically tailored to the individual requirements of each project regardless of project size, cost or complexity.

Power Purchase Agreement (PPA)

Martin Energy Group can offer to fund either all of, or any proportion thereof, the costs associated with the implementation of the CHP project. This includes the design, supply, delivery, installation, commissioning and on-going operation of the scheme. Martin Energy Group would recover both the initial capital costs and the ongoing maintenance charges over a contractually agreed period, usually 10 years, by charging a p/kWh rate for the electricity generated by the CHP plant. PPA benefits include:

- No capital outlay/lower risk
- No ongoing maintenance costs
- Faster implementation/immediate savings
- Long term, capped energy costs
- Energy Services Contract.

Capital Purchase

Martin Energy Group can provide a fixed cost for the complete turnkey package, including project design, supply, delivery, installation and commissioning. In addition to this, a service package can be offered that will operate and maintain the system throughout its lifetime. The main advantages of the capital purchase route are that the greater savings will be achievable over the product lifetime and greater operational flexibility is available.

If the capital purchase option is being considered and the customer is making a taxable profit (paid to HMRC), the project will likely be eligible for an Enhanced Capital Allowance. This mechanism allows businesses to claim a 100% first year capital allowance on investments on energy efficiency investments (such as CHP) against taxable profits during the period of investment.

Capital Purchase benefits include:

- Customers receive the full financial benefit of the energy savings
- The equipment is owned by the customer
- Unit can be used as a standby generator
- Run profile can be more easily modified to suit customer needs.

Energy Savings Agreements (ESA)

This process would begin with an Investment Grade Audit (IGA) of a customer's site, and identify potential opportunities covering the following aspects:

- **Demand Side Measures (also known as Energy Conservation Measures) -** These center on opportunities that reduce the energy demand on site, e.g. new lighting, pumps, pipework insulation etc.
- **Plant Upgrades -** These opportunities look at generating the same energy demand but by using less fuel, e.g. new boilers, chillers etc.
- **CHP -** Once the new site demand and plant has been considered a CHP opportunity be evaluated.

Following the audit, a comprehensive report and savings calculation is presented to the customer.

Typical contract length of this agreement is 10 years. An agreed fixed monthly fee is paid by the customer to Martin Energy Group, and this fee is actually covered via the savings generated from the introduction of the upgraded equipment. As a result, the net cost to the customer is typically zero.

ESA benefits include:

- Guaranteed savings and levels of service delivery
- Zero capital outlay
- Proven method to reduce a sites energy consumption
- EUETS (EU Emissions Trading Scheme) and carbon reductions
- Incorporate additional low/zero carbon technology.

INTEGRATING CHP INTO THE BUILDING

Low Temperature Hot Water (LTHW) Systems

The most common and simplest form of heat recovery from a CHP unit is in the form of LTHW (typically 90oC/80oC). This enables heat recovery from the oil cooler, engine jacket and the exhaust gas heat exchanger, in a common primary water circuit.

CHP units can also be designed to operate at lower return temperature. There are a number of potential configuration options where the CHP can be integrated within the LTHW system, such as in-series or in-parallel.

An in-series configuration ensures that the CHP heat is utilized to its maximum capacity. This offers a number of additional benefits such as; reduction of on-site boiler dependency, which in turn, reduces boiler maintenance costs, and any potential backlog maintenance issues which potentially extends the life of the incumbent boiler set.

In some circumstances, it can be possible to use the CHP heat for domestic hot water use. This can be to supplement times then there is no or little LTHW load, such as summer months.

The thermal integration of any CHP unit should be carefully considered and investigated in order to achieve the maximum possible savings.

Steam Systems

If the user requires a heat source in the form of steam then the exhaust gases (800 Deg F to 1200Deg F) from the CHP can be diverted directly into a waste heat recovery boiler.

Steam generation from CHP is best suited for units greater than 500kWe as the quantity of recovered energy below this value is small. The CHP provider would usually work with the boiler manufacturer to design the boiler using the details of the exhaust gas flow rates, temperature and pressure conditions of the required heat output.

Absorption Cooling Systems

(Trigeneration Systems) Absorption cooling is a technology that allows cooling to be produced from waste heat rather than traditional methods such as a vapour condensing chiller that uses electricity. Some sites that consider using this method will have a large continuous cooling demand, for example air-conditioning or process cooling. Typically these systems require a system temperature of 40Deg F to 60 Deg F which is particularly suitable for absorption chillers.

Absorption chillers can also be successfully incorporated into schemes that have a large electrical demand but may only have a relatively small thermal demand.

The size of the CHP unit could be maximized to meet the sites electrical load profile with the thermal energy being used to drive an absorption chiller. This would lower the sites electrical load by displacing the electrical demand of a conventional chiller.

The additional heat load would allow the plant to operate more efficiently, removing the seasonal variation element and improve the operational hours of the scheme. Most standard absorption chillers operate on either LTHW, MTHW or steam. Absorption chillers utilize excess thermal energy to produce chilled water rather than allowing the excess thermal energy to go to waste.

CHP TECHNOLOGY

The Equipment

Gas Reciprocating Engine

The most common form of smallscale CHP contains spark-ignition gas reciprocating engines. These prime movers are suited to smaller, simpler cogeneration systems of up to typically 2.5MWe in size, although multiple units can be used to deliver greater capacity.

There are two types of spark-ignition engines; naturally aspirated and turbocharged. Naturally aspirated engines are a simpler technology where the combustion air delivered to the engine is at atmospheric pressure. This is most commonly found on units under 250kWe due to the lower costs but at the expense of electrical efficiency which is around 30% (based on HHV).

Due to the lower electrical efficiency, more thermal energy can be recovered from these units.

Larger units above 250kWe tend to be turbocharged units which compress the combustion air before going into the cylinders. Turbocharged engines offer improved electrical efficiencies which can be as high as 40%.

Typically heat is recovered in the form of Low Temperature Hot Water (LTHW) with a flow temperature of up to 90˚C. This is achieved through the recovery of heat from the engine block itself and an Exhaust Gas Heat Exchanger (EGHE) which recovers heat through the cooling of the exhaust gases. On large-scale systems the exhaust is sometimes diverted directly into a waste heat boiler to generate steam.

Gas Turbine

The most common alternative prime mover is a gas turbine. Within the small scale CHP sector, gas turbines are a niche product due to their much higher heat-to-power ratios (about 3:1) and are relatively expensive at this size.

Gas Engine and Alternator

The engine and alternator are assembled as a unit with the drive from the engine transmitted to the alternator through a flexible power coupling. This assembly is attached to a steel sub-frame by flexible mounts with flexible connections to other mechanical equipment installed within the enclosure.

Heat Recovery System

The closed primary water circuit recovers heat from the engine jacket, oil cooler and the exhaust gas heat exchanger. A thermostatic valve controls the temperature of the primary cooling system. This valve manages the warm up and cool down of the engine avoiding any thermal shocks.

CHP heat is transferred to the customer’s secondary water systems through a high efficiency plate heat exchanger. This plate heat exchanger hydraulically separates the primary and secondary water circuits.

This hydraulic separation prevents either primary or secondary circuit contamination from the other water circuit and permits ease of maintenance and security of heat supply.

The Base Frame and Enclosure

The CHP enclosure comprises a steel frame with sound insulated closure panels and doors. Removable/openable enclosure doors allow easy access for repair and maintenance.

Ventilation air is drawn through a sound attenuator in the air inlet and pulled through the enclosure by an enclosure mounted fan. Combustion air is drawn independently into the engine through a dedicated combustion air attenuator located on the top of the enclosure.

Control and Protection

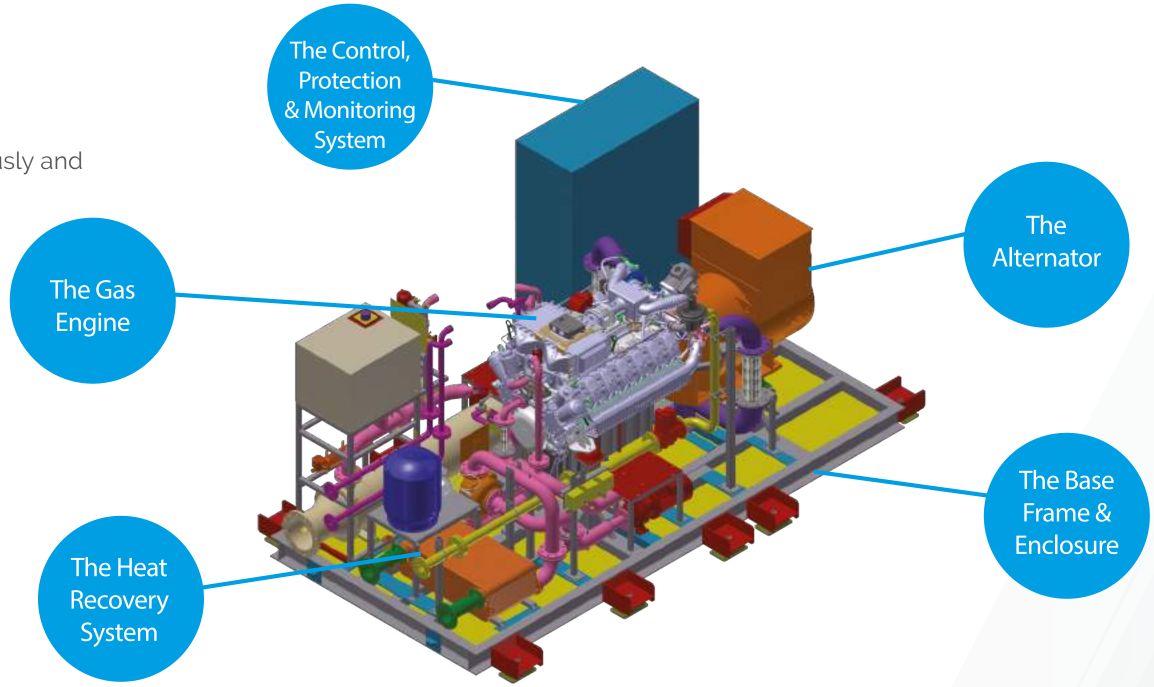
The unit is primarily designed to operate as a 'stand-alone' package with automatic control that requires minimal or no supervision. In exceptional cases, manual intervention or supervision can be advantageous.

The unit control and electrical system is installed in a cabinet that forms part of the enclosure. It is specially designed to control and protect the CHP unit.

Principal areas of control are:

- Electric output
- Heat
- Import and export interface with grid
- Electrical isolation.

A Remote Monitoring System collects data continuously and would be connected to a central control desk. This allows remote operation and adjustment of settings when needed. The unit is usually controlled and protected by a remote monitoring and control system called Martin Energy Control system.



CHP TECHNOLOGY

Martin Energy Control system

MEG control system is a unique controller specifically designed for CHP and its related plant. It allows you to monitor over 200 parameters on your CHP system and many more on your energy plant.

The flexible integrated controller offers improved safety, always-on Internet connectivity, high quality touch screen and graphics.

MEG control system is different from other Genset system controllers as it is specifically designed with optimum functionality including:

- Sophisticated data logging:
  - Trip counter
  - Restart counts
  - Immediate fault detection
  - Easy root cause analysis
  - Ignition energy
  - Knock levels
  - Spark advance
  - Enhanced synchronising
- Designed for data collection, integration and metering
- Assists in reducing on-site costs
- Two integrated safety circuits ensuring total peace of mind
- Touchscreen Human Machine Interface (HMI)
- Always optimized heat production and utilization.

The MEG control system can easily expand into:

- Boiler controls; ensuring your boilers are fully optimized and integrate with your CHP
- MBus metering

HMI – Human Monitoring interface

HMI is the platform that collects, collates and reports all the energy generated from the CHP system and any connected related plant.

It is a fully integrated platform that allows the control of multiple energy systems located at one single site or at multiple sites.

- Built-in customer access
- Excel based reporting
- Online reporting and analysis
- Secure Cloud based servers
- Worldwide access
- Enables wider building control
- Assists in reducing on-site costs
- Shows demonstrable savings
  - Carbon Reduction
  - Financial
- Monitoring of boiler and chiller heat usage
- Optimization of thermal store – controlling the flow and return
- Controls the modulation and firing of boiler/heating plant

In the USA, CHP units should be designed and constructed to the following standards and regulations:	
IEEE 1547	Electrical regulations
UL 2200	Underwriters laboratory for stationary gas engines
NFPA37	National fire protection code for gas fuel supply systems
ASME	American Society for mechanical engineers for Boilers/Heat exchanger

GLOSSARY OF TERMS

Absorption Chiller - Absorption chillers use heat instead of mechanical energy to provide cooling. Therefore they can be combined with a Cogeneration (CHP) unit to provide Trigeneration.

AEC - Alternative energy Credits - Scheme designed to improve energy efficiency in organizations.

BEMS - Building Energy Management Systems.

Biogas - Biogas is generated when bacteria degrades biological material in the absence of oxygen, in a process known as anaerobic digestion. Since biogas is a mixture of methane (also known as marsh gas or natural gas) and carbon dioxide it is classed as a renewable fuel.

Building Management Systems - Controls associated with space heating, air conditioning, hot water service and lighting in buildings.

Calorific Value - Amount of heat generated by a given mass of fuel when it is completely burned. It is measured in joules per kilogram.

Catalyst - A catalyst provides a means to further reduce exhaust emissions for NOx and CO_2.

Carbon Dioxide (CO_2) – odorless gas which is harmful to the environment.

Cogeneration - Also referred to as Combined Heat and Power or CHP - on-site generation of electricity, heat and/or cooling for the public and private sector.

Combined Heat and Power (CHP) - See Cogeneration.

COP - Coefficient of Performance (COP = chiller load/ heat input).

DECC - The Department of Energy & Climate Change works to make sure the USA has secure, clean, affordable energy supplies and promote international action to mitigate climate change.

Electrical Efficiency - Electrical output in relation to fuel input.

ESPC - See Energy Services Performance Contracting.

Feasibility Studies - Carried out free of charge by the Martin Energy Group to determine the viability of our technologies in a particular application.

HHV - Higher Heat Value.

HVAC - Heating, Ventilation and Air-conditioning.

Investment Tax Credits - Federal Tax incentive to support AEC projects and Distributed Generation assets.

Island Mode / Standby Cogeneration - Ability of the Cogeneration unit to operate independently from the grid.

ITC - See Investment Tax Credits.

kWh - Kilo Watt Hour.

LTHW - Low Temperature Hot Water.

MEG Control system - Control and monitoring system dedicated for use in Martin Energy Group PLC Gensets/CHP Units.

GLOSSARY OF TERMS

MTHW - Medium Temperature Hot Water.

MWh - Mega Watt Hour.

NOx - Nitrogen oxides (NOx) act as indirect greenhouse gases by producing the tropospheric greenhouse gas 'ozone' during their breakdown in the atmosphere.

Operation & Maintenance - Services & aftercare of CHP Units.

Parallel Grid Mode - This is where the Cogeneration unit runs in parallel with the grid.

PPA - Cogeneration technology supplied, installed and maintained by the Martin Energy Group with no capital cost incurred to the client. The energy produced from the unit is then sold at a discounted rate to the client.

SEIR - standard electrical interconnect - Recommendations for the connection of embedded generating plant to the DNO's distribution systems and the provision of standby generators.

Sound pressure level (dB(A)) - A weighted sound pressure level at a certain distance from the source.

Spark Spread - The difference between electricity price and gas price—can affect the viability of the cogeneration system.

Standard Reference Conditions - Standard conditions for ambient air, ambient air pressure, relative humidity, cooling water temperature referred to when defining engine output, fuel consumption etc.

Thermal Efficiency - Quantity of heat produced in relation to fuel input.

Total Efficiency - Sum of the electrical and thermal efficiency in relation to the fuel consumed.

Trigeneration - The absorption chilling unit uses waste heat available from the CHP system in the summer months to provide chilled water.

Utility - Distribution Network Operator.

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