clarke energy

Engineer – Install – Maintain

Power Generation

Resilient, low-emission power for continuous and standby operations.

INNIO JENBACHER Waukesha
Distributor New Units & Services

Power Generation

INNIO's Jenbacher gas engines are highly efficient, converting the energy in gas into reliable, low-emission electrical power. These advanced reciprocating engines are engineered for high performance and fuel flexibility, operating on natural gas or alternative renewable gases.

Where sites also require heat, Jenbacher systems can be configured for combined heat and power (CHP), capturing engine heat to increase overall fuel utilisation and reduce energy costs.

Due to their flexibility and robustness gas engines can provide a rapid response to fluctuating demand and can be turned off as demand reduces.

Benefits of Power Generation with Gas Engines

— Reduced fuel consumption per kilowatt-hour generated
— Lower greenhouse gas and pollutant emissions versus less efficient alternatives
— Lower operational costs through improved conversion efficiency
— Flexible operation for both grid-parallel and islanded modes.

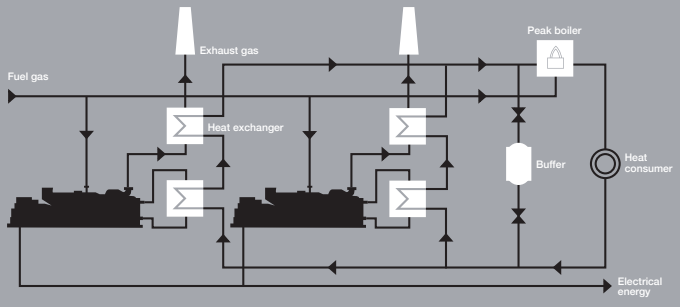
Applications

Base-load generation is useful where there is a stable source of fuel, such as natural, landfill or coal gas to power the generators. Jenbacher gas engines are renowned for their reliability in the field and when challenged with difficult gases. Electrical generation plants come in two main forms:
— Stable base load (continuous) generation
— Electricity peaking

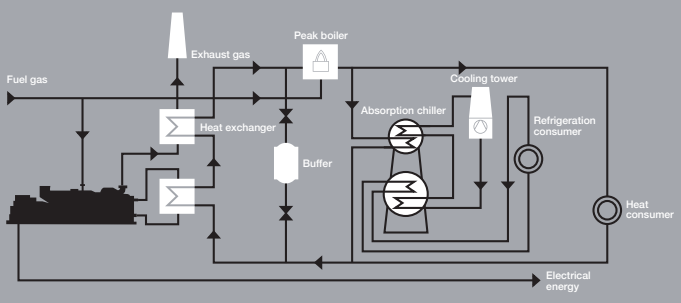
The generation of electricity alone typically takes place where there is no local need for heating and cooling. The power that is produced can either be exported to the local electricity grid, or alternatively be used in island mode operation to power local facilities.

Electricity peaking stations typically operate in standby mode, then when there is a peak in demand for power from the electricity grid; the gas engines receive a signal to commence operation.

Cogeneration Schematic



Trigeneration Schematic



Cogeneration – Combined Heat and Power

Cogeneration or combined heat and power (CHP) systems are configured to produce both electricity and useful heat. Jenbacher CHP systems utilise heat produced during the combustion of the gas in the engine and facilitate process efficiencies of more than 90%. This efficient form of energy conversion achieves primary energy savings of roughly 40% by using a gas engine cogeneration system as opposed to separate electricity and heat generation equipment. Cogeneration plants are typically embedded close to the end user and therefore help reduce transportation and distribution losses.

The heat from the engine is available in two key forms. Firstly low grade heat is recovered from the cooling water circuit of the engine. This is typically available as hot water for recovery via a plate heat exchanger. Secondly high grade heat from the engine exhaust can be utilised. This heat leaves the engine at over 450°C and can be used directly, in a boiler to generate steam or combined with the low grade heat and recovered as hot water.

Trigeneration – Combined Heat, Power and Cooling

Trigeneration or combined heat power and cooling (CHPC) systems take the concept of cogeneration to the next level. Trigeneration systems produce electricity along with useful heat and cooling water. Here the heat recovered from the engine is used in absorption chillers. These heat driven chillers are able to provide cold water for utilisation in air conditioning systems or for process water.

Combining a CHP or cogeneration plant with an absorption refrigeration system allows utilisation of seasonal excess heat for cooling. The hot water from the cooling circuit of the plant serves as drive energy for the absorption chiller. The hot exhaust gas from the gas engine can also be used as an energy source for steam generation, which can then be utilised as an energy source for a highly efficient, double-effect steam chiller. Up to 80% of the thermal output of the cogeneration plant is thereby converted to chilled water. In this way, the year round capacity utilisation and the overall efficiency of the cogeneration plant can be increased significantly.

Quadgeneration – Combined Heat, Power, Cooling with CO_2 recovery

Quadgeneration systems are some of the most advanced gas engine driven power plants in the world. Quadgeneration encompasses the features of a trigeneration system, with electricity, heat and cooling and includes the recovery of carbon dioxide from the exhaust gas.

Carbon dioxide can be used for a number of purposes including encouraging growth in plants or if cleaned to food grade quality can then be used in carbonised drinks industry.

Quadgeneration not only provides the benefits of high efficiency generation, utilising over 90% of the energy contained within the gas, it also utilises carbon dioxide, a byproduct of the combustion process to give the highest levels of performance.

Natural Gas

Efficient, reliable on–site power and heat using pipeline natural gas.

Natural gas is an abundant, clean low–carbon fossil fuel that can be readily utilised for the production of electricity. The high efficiency of the Jenbacher gas engine is well suited to the provision of reliable decentralised electricity utilising natural gas as a fuel.

Natural gas originates from plant and animal matter which decomposed millions of years ago and is now located in reservoirs under the Earth's surface. Natural gas is primarily comprised of methane with other gases in smaller proportions.

When utilised in gas engines, natural gas supports efficient electricity generation and combined heat and power (CHP), offering a reliable solution for sites requiring continuous, resilient energy supply.

Benefits of Natural Gas Power Generation

— Reliable production of electricity at high efficiency
— Financial benefits compared to separate purchase of electricity and heating fuel
— Flexible and can be used to provide heating, cooling and clean carbon dioxide
— Cleanest fossil fuel with lowest relative carbon emissions.

Applications

Natural gas generators can be configured in a number of ways. In addition to the production of electricity, generators can also provide heating as hot water or steam, cooling water and clean carbon dioxide.

— Cogeneration or combined heat and power (CHP)
— Trigeneration of combined heat, power and cooling (CCHP)
— Greenhouse cogeneration / CHP with carbon dioxide recovery
— Quadgeneration or CCHP with carbon dioxide recovery
— Island mode operation – power production isolated from the electricity grid

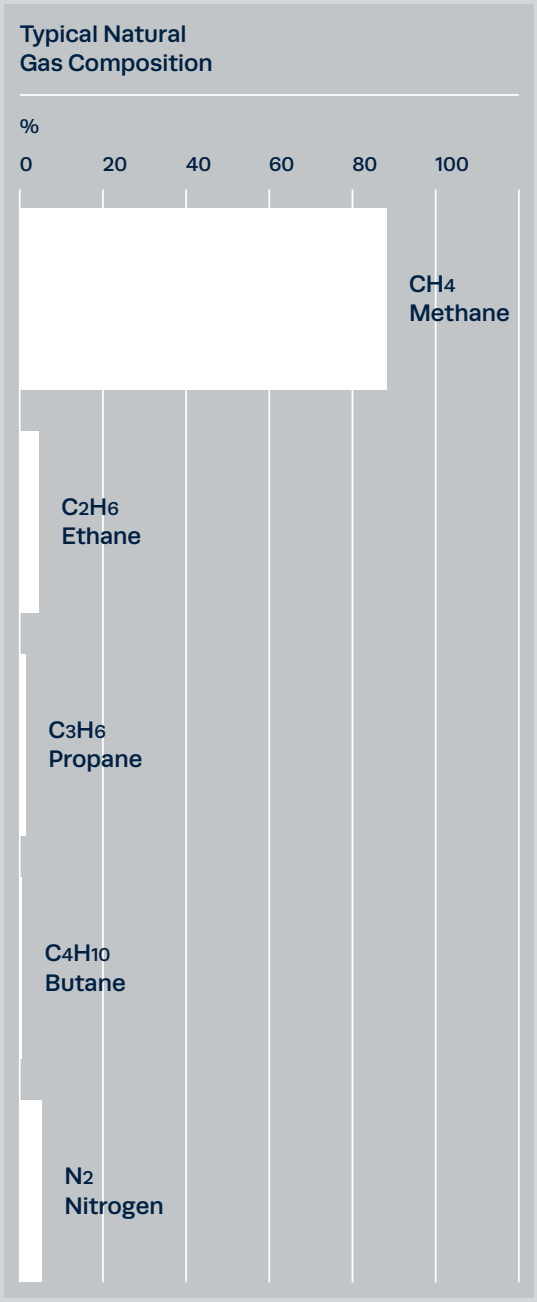
Natural gas generation relies upon a well–developed and stable natural gas supply.

Methane Number

The methane number provides an indication of the knock tendency of the fuel. It is a product of the different constituent gases within the natural gas, particularly the proportions of methane, ethane, propane and butane.

Methane, which has high knock resistance, is given an index value of 100. Hydrogen, which burns quickly relative to methane, has low knock resistance and is given the index value of 0. If a gas mixture has a methane number of 80, its knock resistance is equivalent to that of a gas comprised of 80% methane and 20% hydrogen. There are gas constituents which have a higher methane number than 100 therefore it is also possible for a gas composite to have a higher methane number than 100.

Understanding the methane number of the natural gas fuel is an important factor when determining the appropriate engine version to select.



Power your Sustainability Journey with Natural Gas Power Generation

The concentration of gases contributing to climate change is increased by human activities, particularly by the utilisation of fossil fuels in industrial processes and agriculture. The utilisation of natural gas in gas engines is characterised by the lowest carbon dioxide emission levels of all fossil fuels. Due to the fact natural gas is low in carbon, but has a high hydrogen content, natural gas has the most favourable carbon dioxide balance.

The combustion of natural gas produces around 40–50% less carbon dioxide than when coal is burned to produce the same amount of energy. Notably it also has low emissions of sulphur dioxide (SO_2), oxides of nitrogen (NOx) and particulate matter.

As a fuel, natural gas is set to become a significant source of power in the coming years. Natural gas is projected to become the most significant fossil energy medium in the next fifty years. In countries where the national grid is unreliable and supplies of natural gas are abundant, gas engines provide an excellent source of reliable island mode power.

Associated Petroleum Gas

Unlock the energy potential of APG and flare gas to produce reliable on–site power and heat.

Associated petroleum gas (APG) is also known as flare gas. APG can be converted to power at high efficiency utilising INNIO gas engines which include the Jenbacher and Waukesha product ranges.

This power can be used for the provision of electricity and heating on–site whilst eliminating the cost of diesel deliveries to remote areas.

The utilisation of APG as a fuel for a generator is an excellent way of reducing carbon dioxide emissions that might otherwise result from diesel fuel consumption.

By converting APG into usable electricity and heat, operators can significantly reduce flaring while improving overall energy efficiency.

Benefits of APG as a Fuel Gas

- Reduces operational costs associated with diesel generators
- Utilisation of a gas often treated as a 'waste' product
- Reducing carbon emissions
- A local fuel supply that produces stable electrical and thermal power.

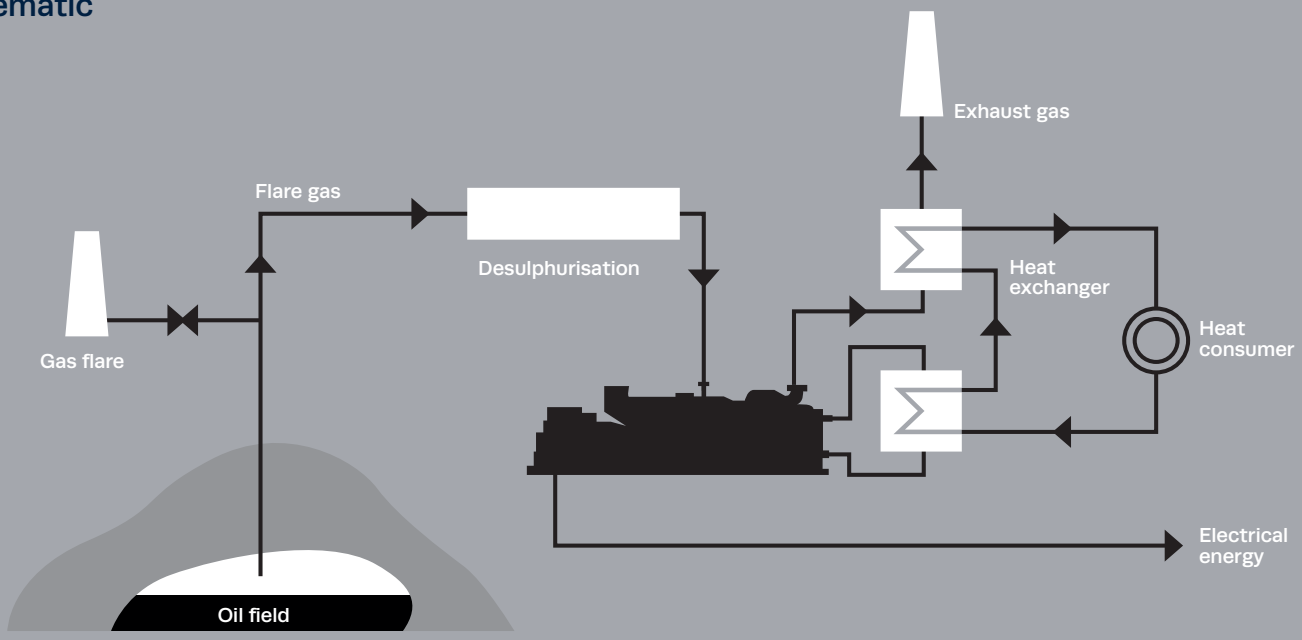
Applications

Modern gas engines are well suited to APG and flare gas applications due to their ability to operate efficiently across a wide range of gas qualities and calorific values. Advanced engine management and combustion control systems enable stable operation despite fluctuations in gas composition over time.

Gas engine systems can be deployed in modular configurations, allowing installations to be scaled to match field development and changing energy demand. Electrical outputs typically range from several hundred kilowatts to multi–megawatt installations.

APG and flare gas power systems are commonly deployed in remote oil and gas fields where grid access is unavailable or unreliable. Gas engines require relatively low inlet gas pressure and offer rapid start–up and load response, making them well suited to dynamic upstream operating environments.

Associated Petroleum Gas Schematic



Creation of Associated Petroleum Gas

Natural gas that comes from oil wells is typically termed 'associated gas'. This gas can exist separate from oil in the formation as free gas or it can be dissolved in the crude oil. Independent from the source of the natural gas, once separated from crude oil it commonly exists in mixtures with other hydrocarbons such as ethane, propane, butane and pentanes In addition, raw natural gas contains water vapour, hydrogen sulphide (H_2S), carbon dioxide (CO_2), nitrogen (N_2) and other compounds. Associated gas that contains such impurities cannot be transported easily and also cannot be used without treatment since it is recovered during the oil production process.

For a long time, oil producers have simply flared this unwanted oil byproduct. But because of the increase in both environmental consciousness and energy demand, flaring is often avoided and is sometimes prohibited.

Technically, several options exist for handling associated gas:

- Preparing it as a fuel in various forms (i.e. dried pipeline gas, LPG and exporting it via a pipeline)
- Gas reinjection for later recovery
- Generation of electricity for transmission or on-site needs
- Processing such as LNG or LPG and exporting via tankers
- Conversion to petrochemical industry feedstock
- Processing gas-to-liquids and gas-to-solids
- Conversion to other forms of energy for such uses as thermal for district heating

The Jenbacher Gas Engine Concept

In most cases, installations of power generation with associated gas are in remote areas. Power supply in such areas – if it exists at all is often poor. Therefore, the common solution in the past was to use diesel gensets. Due to rapidly rising oil and consequently diesel fuel prices, this solution has become increasingly uneconomical. Furthermore, the supply of diesel fuel and the necessary storage also are becoming more expensive.

The composition of associated petroleum gas is often well suited for the combustion in gas engines. However treatment in the form of dehumidification and removal of condensable hydrocarbons from the gas is generally required. Due to the often relatively high content of higher hydrocarbons, a de-rating of the nominal natural gas output may be required. In the case of a high concentration of H_2S, desulphurisation of the gas may also be needed. The gas that is treated in the above-mentioned way is a valuable fuel for the independent power supply with gas engines. The engines are normally installed in containerised units with all peripheral systems (ventilation, silencers, cooling, control room) installed inside or on the roof. These containerised systems also provide the added benefit of being readily transportable if power demands change. Depending on local requirements, the waste heat from the engines can also be used for heating or cooling purposes on site.

Advantages

- Generation of electricity combined with the simultaneous disposal of a problem gas
- Use of waste by-product of the crude oil production process instead of diesel fuel to avoid costs for fuel transportation over long distances
- Independent, on-site power supply
- High profitability with overall efficiency of up to 90%, in the case of combined heat and power, and up to 44% in the case of power generation only
- Smooth operation despite fluctuations in composition and impurities (within given limits) in the gas
- Depending on gas composition, full output of the corresponding natural gas engine version
- Avoidance of liberation of methane into the atmosphere, which has 21 times the global warming potential of CO_2
- Maximum availability and reliability despite high or low ambient temperature
- Small footprint due to compact design (e.g. off-shore)
- Turn-key container solutions allow for fast installation and comfortable operation

Clarke Energy, a Rehlko Company, is a multi-award-winning global business specializing in the engineering, installation and maintenance of distributed energy solutions.

Clarke Energy supplies a range of different energy efficient, resilient, low carbon and renewable power generation and storage technologies. For gas based projects we are able to produce or accept renewable and low carbon fuels including hydrogen, biogas and biomethane / renewable natural gas (RNG).

Our Competence

Clarke Energy has comprehensive multi-national experience in the engineering, installation and maintenance of gas based power generation facilities.

INNIO's Jenbacher engines are known for having the highest levels of electrical efficiency on the market. When coupled with a contractual maintenance agreement with Clarke Energy it will give peace of mind that they will achieve the highest levels of availability and returns for their project.

Benefits of Working with Clarke Energy

- Quality products, balance of plant and installations products mean high technical and environmental performance hence maximum returns for our customers.
- Our installations are backed up by the highest levels of localised aftersales support, meaning maximum reliability of the power generation assets we supply.
- Extensive engineering experience across a range of gases and applications, meaning tailored, optimal power generation solutions for our customers.

To contact Clarke Energy please visit our website:
www.clarke-energy.com