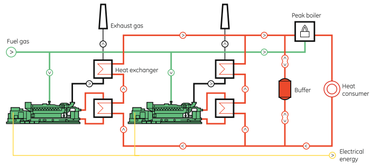
The tailored concept of GE's gas engines

Jenbacher cogeneration plants have an engine/generator unit and heat exchangers that use the produced heat. These plants can create even more customer value by using other heat sources such as the available engine cooling water, lubricating oil, an air/fuel gas mixture, or exhaust gas. To meet peak heating requirements, cogeneration plant modules also can be combined with a boiler system. Connecting a heat storage medium makes the plant even more flexible and efficient; electrical switch and control systems distribute power and can support engine management, while hydraulic equipment ensures heat distribution.

GE's cogeneration plants have numerous advantages:

- Electrical efficiencies up to 48 percent
- Overall efficiencies (electrical and thermal) up to 90 percent
- Wide range of power and heat outputs
- Low emissions through patented LEANOX* lean mixture combustion
- Compact design for a small footprint
- Fuel flexibility to use natural gas, biogas, landfill gas, coal mine gas or coke gas
- Excellent operational safety and availability
- Significant cost savings in areas with moderate to high power prices



Key data

A cogeneration plant with 1,000 kWel and 1,250 kWth meets the following heating demands:

- Short-distance heating network: approximately 135,000 square feet of residential area
- Hospital: approximately 150 beds
- Building supply: approximately 110,000 square feet of usable area

Our competence

The efficient energy generation of combined heat and power is increasingly attractive in an era of growing energy use and costs, along with heightened awareness of climate change. Our innovative Jenbacher cogeneration plants place GE among the world's technological leaders in CHP. More than 9,000 of GE's cogeneration plants have been delivered around the world, and their overall electrical output is approximately 11,000 MW. They annually produce more than 66 million MWh of electricity and more than 60 million MWh of heat. That amount of energy can power about 3.6 million US homes and heat about 5 million US households. This deployed fleet also reduces CO_2 by 4 million tons – the amount of emissions from about 800,000 US cars per year.

Natural gas-driven Jenbacher engines for combined heat and power systems were designated as ecomagination products because of their tremendous cost effectiveness and efficiency and drastically reduced emissions. Ecomagination is the combination of ecology and imagination that GE has applied to innovative technologies that have delivered proven economic and environmental protection benefits.
www.ge.com/ecomagination

* Trademark of the General Electric Company

GE imagination at work

GE Power & Water

GE's Gas Engines business is a recognized leader in the industry for fuel flexibility, low emissions and performance excellence with energy solutions providing efficiencies as high as 98 percent. A specialist in combined heat and power (CHP), mechanical drive, waste heat-to-power and fuel rating technologies, GE's Gas Engines business boasts a combined 170-year legacy of technological innovations crossing three product lines – Jenbacher gas engines, Waukesha gas engines and Heat Recovery Solutions.

GE's Gas Engines business manufactures gas-fueled reciprocating engines, generator sets, CHP modules, ORC systems and auxiliaries for power generation and compression, delivering cleaner, more efficient, and affordable onsite energy with products that generate a wide range of distributed power outputs. Our fuel-flexible engines of up to 10 MW operate on a wide range of natural gas as well as biogas and landfill, coal mine, associated petroleum and sewage gas. The business is supported by lifecycle service solutions such as remote monitoring and diagnostics as well as contractual services and upgrades that increase availability and performance and underscore our global excellence in customer value.

Part of GE Power & Water, GE's Gas Engines business is headquartered in Jenbach, Austria. Its main production facilities are located in Jenbach, Austria, and Waukesha, Wisconsin, United States. It has more than 2,600 employees and over 32,000 engines installed in more than 100 countries.

Further information about gas engines from GE Power & Water:

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GE imagination at work

GE Power & Water

Generating power and heat, where you need it

Cogeneration with Jenbacher gas engines from GE.

GEA-13717/G

GE imagination at work

Cogeneration of heat and power

Combined heat and power (CHP) systems simultaneously generate power and heat. CHP energy conversion saves up to 40 percent of primary energy compared to the separate generation of power and heat, and building CHP systems near the user avoids significant supply and distribution losses. GE's Jenbacher gas engines can generate CHP efficiencies of up to 90 percent.

Efficiency, flexibility and freedom

Cogeneration plants are flexible as well as efficient, so their thermal energy can be used to generate hot water, steam, or process heat, or even to support cooling loads. Similarly, the generated electricity can be used in different ways. In addition, CHP allows you to declare your energy independence. You no longer have to buy electricity from the grid, nor do you have to pay for costly upgrades to coal- and oil-fired burners anymore. Rather than dealing with volatile power prices and supplies, you work with a stable energy source that is immediately deployable. At times, that freedom can be the difference between business survival and failure.

Case in point

Efficiency upgrades from a new CHP plant allowed a major furniture maker in Vermont to cut its energy costs by 10 percent and, therefore, contributed to continued operations in the U.S., thereby preserving 550 local jobs.

Commercial and institutional potential

The great bulk of existing CHP capacity is in applications for thermal energy-intensive industries such as chemicals, paper, food processing, and metals manufacturing. But consider the vast potential CHP has for other business segments: As a distributed energy resource that is located near or in the same space as the end-user, a CHP system essentially gives schools, hospitals, hotels and other commercial and institutional facilities a do-it-yourself power plant and saves them money on the transmission and distribution losses that can happen with power bought through the grid from central stations.

Classic cogeneration: linked to the grid

While a cogeneration system can provide power for the local site, it can also export generated electricity to the grid.

Autonomous operation in remote locations

A cogeneration plant can operate in remote locations with poor infrastructure. All of the generated power and heat feeds the local system, which is unconnected to the public grid.

Playing it safe as a backup generator

In critical operating areas such as hospitals or data centers, an uninterrupted power supply is absolutely essential. While backup generators can immediately supply power in the event of a public grid failure, cogeneration plants equipped with decoupling devices to monitor voltage, frequency and short interruptions can provide an extra level of security.

Greenhouses earn top efficiencies

Cogeneration plants are most effective in large commercial greenhouses, where their overall efficiencies can reach 95 percent. The generated power is used for artificial lighting, the heat maintains a constant temperature in the greenhouse and the purified, CO_2–rich engine exhaust becomes a highly efficient plant fertilizer. In addition, the exhaust can be cooled down below the condensation point so that the water vapor that forms during the combustion of natural gas can be liberated and deployed to the greenhouse.

Cooling down summer with trigeneration

A cogeneration plant that uses an absorption chiller becomes a trigeneration plant that provides heating, cooling and electricity. This is an excellent solution for sites with fluctuating heating and cooling requirements.

Cogeneration plants supply efficient energy supply to:

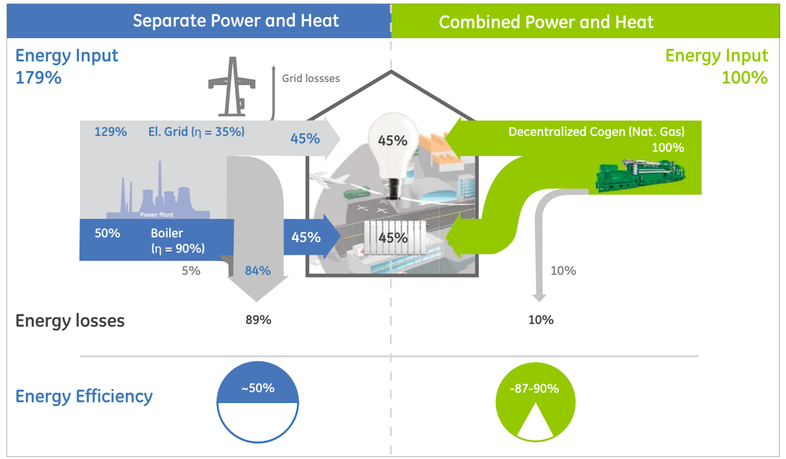
- Residential and commercial buildings
- Hospitals
- Airports
- Public pools, convention centers and stadiums
- Amusement parks
- Universities, schools and kindergartens
- Food and beverage industry facilities
- Greenhouses
- Data centers
- Administrative and other public buildings
- Commercial and industrial facilities

Environmental advantages

Because of their high efficiency levels, natural gas-driven cogeneration plants reduce the use of fossil fuels and significantly lower greenhouse gas (GHG) emissions such as CO_2. That makes CHP systems a vital tool for helping the U.S. reach its government-mandated goal of cogenerating 40 additional GW by 2020. Also the European Union is committed to a strategy that builds a more secure and cleaner energy future. It calls for cutting greenhouse gas emissions and primary energy consumption by 20 percent as well as boosting energy efficiency and the renewable share of the energy mix by 20 percent, too – all by 2020.

Natural gas also is better for the environment than other fossil fuels because it burns nearly particulate-free, generates no sulfur dioxide (SO_2) emissions, and produces much less CO_2. Cogeneration plants also limit nitrogen oxide (NOx) emission.

Fuel savings and emission reductions



Prime energy savings* through CHP: 36%

*naturally occurring energy sources such as e.g. natural gas, crude oil, coal, wood without loss of downstream conversion and transport processes

Cost-saving fuel flexibility

GE's cogeneration plants also can run on various organic and special gases from agriculture, mining, waste management, and other industries. Since the energy potential of these gases would otherwise be wasted and/or removed at great cost, this application makes cogeneration that much more economical than traditional power production.

Offsetting high regional energy costs

CHP can be a cost bargain even when matched against other high-efficiency energy sources and in places where energy is costly. While the energy and CO_2 savings it yields are comparable to those produced by solar photovoltaic, wind and natural gas combined-cycle (NGCC) systems that generate only power, CHP's capital cost is lower than that of solar and wind and as low as that of NGCC.

CHP also lowers your energy costs since its self-generated power and recovered thermal energy are less costly than the purchased electricity and boiler fuel they displace.

In much of the Northeast and Midwest sections of the U.S., as well as in California and Texas, CHP's capture and use of waste energy is a more economical way to supply new power generation capacity, too. Net power costs from large and medium CHP projects in those regions are less than the delivered costs of electricity from central generation stations powered by coal and natural gas, as well as from utility-based renewables.

In places where the grid is overloaded and requires support, utilities that partner with their industrial customers can help relieve financing difficulties because their capital costs are lower and their acceptable payback periods are longer than those of many of their customers.

Downward pressure on commodity prices

Studies show that there is a direct correlation between CHP- and efficiency-induced cuts in natural gas consumption and falling natural gas wholesale prices. Specifically, lowering natural gas consumption in these ways by 5 to 6 percent can drop the wholesale commodity price by 20 percent.

Public-sector incentives

Specific incentive programs in the U.S. from states that include California, New York, North Carolina, New Jersey and Massachusetts are creating another cost advantage for CHP. For instance, Massachusetts' Green Communities Act offers a $750/kWh rebate up to 50 percent of total installed costs for efficient CHP systems, while California has a feed-in tariff for CHP systems below 20 MW that are sized to thermal load and operate at more than 62 percent efficiency.

Lower-cost low carbon energy

CHP also carries one of the lowest costs for emissions control. Within the broad spectrum of CO_2 abatement practices and technologies – everything from consumer product efficiency standards to carbon capture and storage for coal-fired plants – CHP is one of the most cost-effective options, with negative real costs.

Avoiding power failure costs

During natural or manmade disasters, CHP systems can support critical facilities operations when local or regional electric grids fail. An industrial manufacturing facility can lose more than $50,000 during a one-hour outage.