

GE  
Energy

# Energy. It's in our nature.

Cogeneration for your greenhouse  
with the option of CO<sub>2</sub> fertilization.



GE imagination at work

# greenhouse solutions with gas engines make plants grow faster

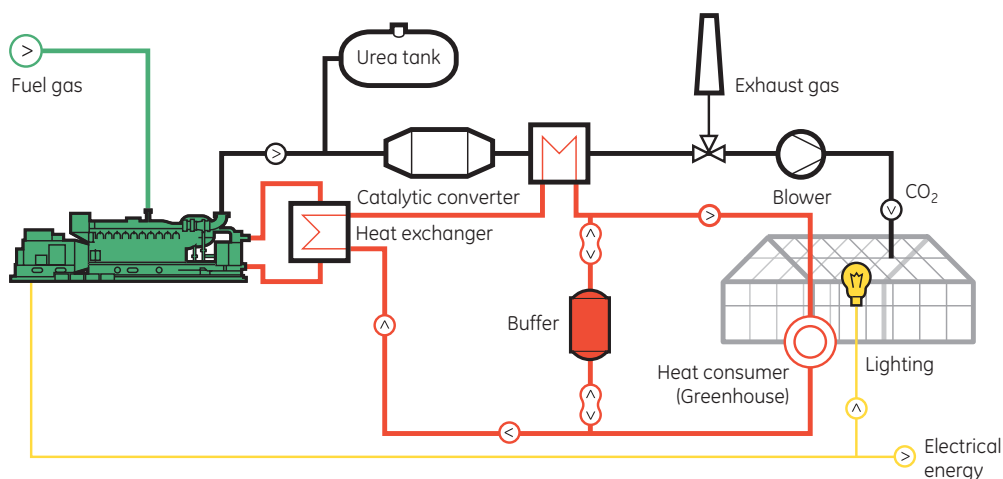
Heat, light and carbon dioxide (CO<sub>2</sub>) promote plant growth. Plants grow by converting CO<sub>2</sub> to carbon through photosynthesis. Air generally contains approximately 350 ppm CO<sub>2</sub>. Optimal CO<sub>2</sub> levels depend on the type of plant and generally lie above 700 ppm. With increased artificial lighting, as present in greenhouses, plants absorb even more CO<sub>2</sub>. If the greenhouse atmosphere is enriched with CO<sub>2</sub>, the temperature kept on a constant level and sufficient lighting provided, plant growth and consequently the harvest yield can be increased significantly.

## the Jenbacher concept

The energy created by gas engine cogeneration systems in greenhouses can be used in various ways. The electricity can provide the power for the artificial lighting and/or be fed into the public grid. The heat efficiently meets the greenhouse's requirements. In addition, the climate-relevant CO<sub>2</sub> of the engine exhaust gas serves as a fertilizer for the plants.

When burning natural gas in gas engines, approximately 0.2 kg of CO<sub>2</sub> is produced per kWh of energy input. This CO<sub>2</sub> is present in the exhaust of gas engines in a concentration of approximately 5 to 6% by volume.

After the purification of the exhaust gas with special catalytic converters (SCR and oxidation catalytic converters), the exhaust gas is cooled down by a heat exchanger to approximately 55°C and supplied to the greenhouse for CO<sub>2</sub> enrichment. A measurement device that constantly measures the exhaust gas levels ensures maximum safety for the vegetation.



#### advantages of Jenbacher CHP systems in greenhouses

- Excellent overall efficiency levels of up to 95%, therefore high contribution to resource conservation
- Time-independent supply of CO<sub>2</sub> and heat through heat storage
- Additional flexibility through the option of supplying electricity into the public grid
- Minimum emissions through the patented LEANOX® lean mixture combustion
- Improved reliability through the additionally integratable light controls using DIA.NE® XT
- Maximum operational safety and availability through the control of the whole system via the patented engine management system, DIA.NE® XT
- Small footprint due to compact design
- Excellent CO<sub>2</sub> quality

#### key figures

- Efficient operation is possible with approximately 1 hectare (ha = 2.47 acres) or larger greenhouse areas
- CO<sub>2</sub> fertilization is suitable for nearly all plant types
- CO<sub>2</sub> fertilization with simultaneous heat supply: dimensioning for 0.5 MWel/ha
- CO<sub>2</sub> fertilization with simultaneous heat supply and illumination: dimensioning for 0.35 MWel/ha
- Illumination suitable for vegetables (e.g., tomatoes or peppers) and for flowers (e.g., chrysanthemums or roses)
- The decisive factors for economical plant operation are the high electrical efficiency, combined with the usage of heat and CO<sub>2</sub> fertilization

#### our competence

We have been working with the Dutch horticulturalists who pioneered CO<sub>2</sub> fertilization in greenhouses. Because of the experience gathered there, we have based our worldwide Center of Excellence for the application in greenhouses in our Dutch office. This new application for cogeneration plants continues to gain worldwide acceptance. Currently more than 280 Jenbacher cogeneration units with CO<sub>2</sub> fertilization have been supplied. Their total electrical output is more than 530 MW.



GE's Jenbacher gas engine division is one of the world's leading manufacturers of gas-fueled reciprocating engines, packaged generator sets and cogeneration units for power generation. It is one of the only companies in the world focusing exclusively on gas engine technology.

GE's Jenbacher gas engines range in power from 0.25 to 3 MW and run on either natural gas or a variety of other gases (e.g., biogas, landfill gas, coal mine gas, sewage gas, combustible industrial waste gases).

A broad range of commercial, industrial, and municipal customers use Jenbacher products for on-site generation of power, heat, and cooling. Patented combustion systems, engine controls, and monitoring enable its power generation plants to meet stringent emission standards, while offering high levels of efficiency, durability, and reliability.

GE's Jenbacher product team has its headquarters, production facilities, and 1,200 of its more than 1,400 worldwide employees in Jenbach, Austria.



GEA-13721A

## for more information on Jenbacher gas engines

### Austria (Headquarters)

Achenseestraße 1-3  
A-6200 Jenbach  
T +43 5244 600-0  
F +43 5244 600-527  
jenbacher.info@ge.com  
www.gejenbacher.com

### Bulgaria

36, Dragan Tsankov Blvd.  
1040 Sofia  
T +359 2 971 4390  
F +359 2 971 4384  
jenbacher.bulgaria@ge.com

### China

8 Floor, The Lee Gardens  
33 Hysan Avenue Causeway Bay  
Hong Kong  
T +852 2100 6976  
F +852 2100 6630  
jenbacher.asiapacific@ge.com

### Denmark

Industrivej 19  
DK-8881 Thorsø  
T +45 86966788  
F +45 86967072  
jenbacher.scandinavia@ge.com

### Germany

Amselstraße 28  
D-68307 Mannheim  
T +49 621 77094-0  
F +49 621 77094-70  
jenbacher.germany@ge.com

### Hungary

Kisret út 1  
H-2112 Veresegyház  
T +36 2858 7376  
F +36 2858 7491  
jenbacher.hungary@ge.com

### Italy

Via Crocioni, 46/H  
I-37012 Bussolengo (VR)  
T +39 045 6760211  
F +39 045 6766322  
jenbacher.italy@ge.com

### North America

5244 North Sam Houston Pkwy E.  
Houston, TX 77032  
T +1 832 2955600  
F +1 281 4429994  
jenbacher.us@ge.com

### Russia

Taganskaya Street, 17-23  
Business Center Mosenka 4  
109147 Moscow  
T +7 495 7755885 1015  
F +7 495 77558 84  
jenbacher.russia@ge.com

### Spain and Portugal

Avda. del Camino de lo Cortao, 34 – Nave 8  
E-28700 San Sebastián de los Reyes (Madrid)  
T +34 916586800  
F +34 916522616  
jenbacher.iberica@ge.com

### The Netherlands

Kelvinring 58  
2952 BG Alblasterdam  
T +31 (0)88 0019700  
F +31 (0)88 0019701  
jenbacher.netherlands@ge.com

### United Arab Emirates

City Tower II, Sheikh Zayed Road  
P.O. Box 11549, Dubai  
T +971 4 3131486  
F +971 4 3131586  
jenbacher.middleeast@ge.com



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