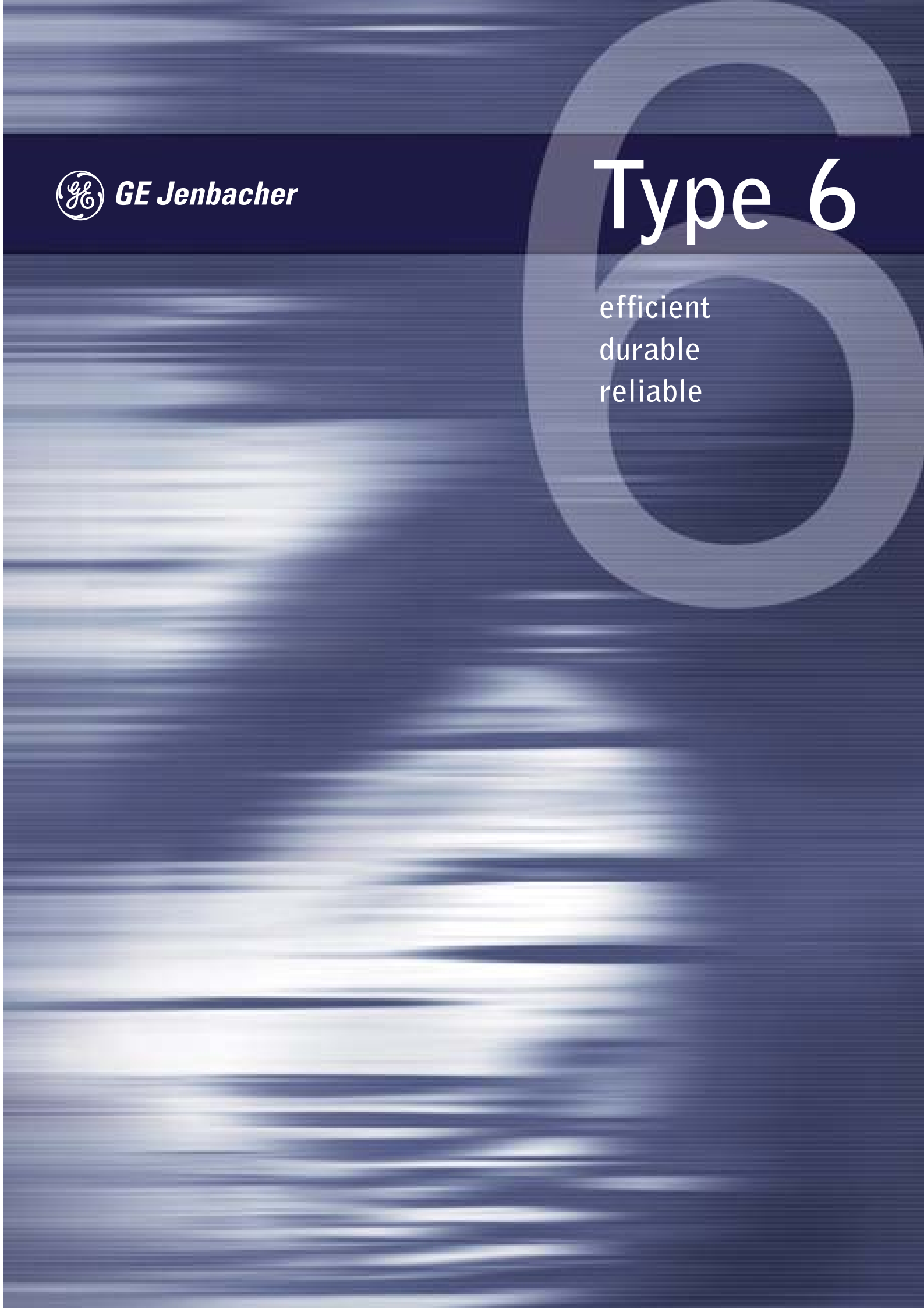
GE Jenbacher

Type 6

efficient
durable
reliable



GE Jenbacher

For more than 45 years we have specialized in developing and producing gas engines for optimized power and heat generation. Drawing on our vast experience, we are able to supply our customers with fully developed products to cover their specific needs. Our high-tech engines in the 0.3 - 3 Megawatt range are designed for stationary, continuous operation and are characterized by extremely high degrees of efficiency, low exhaust gas emissions, durability and a high level of reliability. GE Jenbacher engines can be operated using a broad spectrum of different gases to ensure our customers the best possible availability of fuel for an efficient and safe energy supply. Our comprehensive product and service portfolio includes a full range of equipment from generator sets to complete cogeneration systems and an extensive selection of maintenance and service packages.

efficient

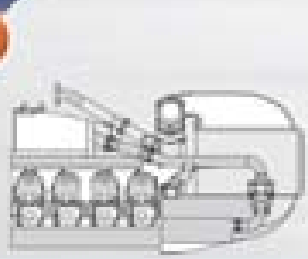
An engine speed of 1,500 rpm results in a high capacity rate and low installation costs. The pre-combustion chamber design enables you to achieve both maximum efficiency and the lowest emission rates.

durable

In the 1.7 MW to 3 MW power range, the perfected design concepts and optimized components of the Type 6 engine ensure a service life of 60,000 operating hours before the first major overhaul.

reliable

Our dedication and commitment to continuous product development combined with our vast experience has resulted in one of the world's most reliable and best designed product lines.



Type 6

Technical Features

1 Four-valve cylinder head The cylinder head, equipped with two intake and two exhaust valves and a centrally located purged pre-combustion chamber, was developed using state-of-the-art calculation and simulation methods (CFD).

• minimized charge-exchange losses • efficient and stable combustion

Crossflow cylinder head Our unique engine design concept utilizes a crossflow of gases through individual cylinder heads.

• separation of cold mixture side and hot exhaust gas side • long cylinder head service life of up to 30,000 operating hours • exhaust gas manifold easily accessible

2 Gas mixer The gas mixer we have developed functions according to the equal-pressure principle and has been optimized over the years to meet the requirements of modern gas engines.

3 Special gas mixer Specific version for special gases with low calorific values.

• optimized geometry and short floating times • low pressure losses and high degree of efficiency at full load • strict adherence to NOx emission values • trouble-free operation with alternative gas types (2-gas operation) • high degree of mixing efficiency • reliable starting behaviour

4 Turbocharger bypass An electronically controlled valve installed behind the compressor enables an efficient mixture return and supports the output control through the throttle valve.

• high dynamism in the output control over the entire control range • high degree of control over the system when in isolated operation, increased reserve for adding and/or shedding load • optimal adaptation to varying ambient conditions (intake temperature, altitude)

5 Dry exhaust gas manifold The uncooled exhaust gas manifold enables a maximum energy supply to the exhaust gas turbocharger.

• high specific output • increased electrical efficiency • increased usable energy content in exhaust gas

• Intake pressure charging Fuel gas and combustion air are mixed before entering the turbocharger.

• except for the pre-combustion gas supply, a low gas pressure is sufficient • mixture homogenized in the turbocharger

• Heat recovery The oil heat exchanger can be specified as a two-stage plate heat exchanger.

• maximum thermal efficiency, even at high and fluctuating return temperatures

• Combustion Optimized combustion is the basis for high engine efficiency at the lowest emission rates. This is one of the core areas of research & development activities at GE Jenbacher.

• maximum degree of efficiency and environmental compatibility

• Scraper ring Integrated into the cylinder liner to prevent carbon deposit on the piston crown.

• stabilized oil consumption • reduced risk of piston seizing • reduced wear • perfect partial load behaviour

• Pre-combustion chamber The ignition energy of the spark plug is amplified in the pre-combustion chamber. This will speed-up and stabilize combustion.

• highest efficiency • lowest NOx emission values • reliable combustion

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Technical Data

Configuration	V 60°		
Bore (mm)	190		
Stroke (mm)	220		
Displacement/cylinder (lit)	6.24		
Speed (rpm)	1,500 (50 Hz); 1,500 with gearbox (60 Hz)		
Mean piston speed (m/s)	11 (1,500 rpm)		
Scope of supply	Generator set, Cogeneration system		
Applicable gas types	Natural gas, flare gas, biogas, landfill gas, sewage gas Special gases as coal mine gas, coke gas, wood gas, pyrolysis gas, ...		
Engine type	J612 GS	J616 GS	J620 GS
No. of cylinders	12	16	20
Total displacement (lit)	74.9	99.8	124.8
Dimensions (l x w x h in mm),			
Generator set	7,200x2,500x2,800	8,300x2,500x2,800	8,900x2,500x2,800
Cogeneration system	7,200x2,500x2,800	8,300x2,500x2,800	8,900x2,500x2,800
Weights empty (kg),			
Generator set	18,600	23,600	27,700
Cogeneration system	19,100	24,100	28,300

1 Dimensions and weights are valid for 50 Hz applications.

Scope of supply

Our scope of supply comprises electrical power generator sets and cogeneration systems for optimized heat and electrical power generation. Depending on customer specifications, various heat sources such as engine cooling water, oil, mixture and exhaust gas can be incorporated, resulting in increased levels of efficiency. Before being shipped to our customers, all modules are performance and load tested at our manufacturing facilities in Jenbach.

Applicable gas types

Increased ecological consciousness and the need to reduce air emissions have lead to an increased use of alternative energy sources. Along with natural gas operation, our technology makes it possible to dispose of environmentally offensive gases (e.g. from landfill sites, agriculture, mining and chemical industries) while simultaneously using these gases for power generation. This helps to reduce industrial emissions and encourage efficient use of natural resources while ensuring the efficiency of a plant. The continuous refinement of our engines and our focus on special gas applications enable the use of a broad spectrum of gases with different calorific values (see table 1).

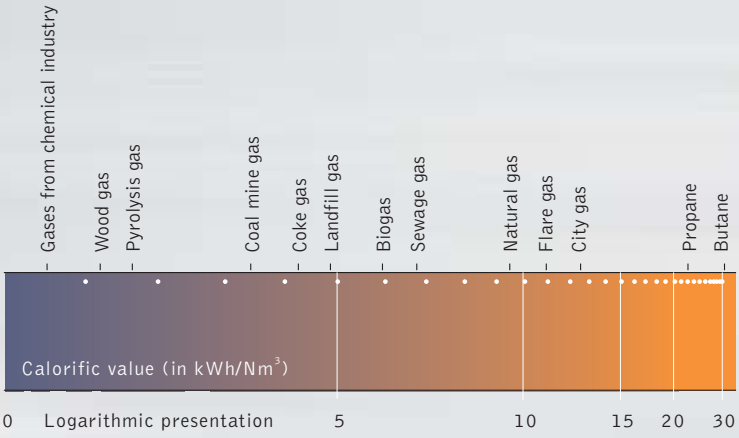

table 1

Type

Outputs and Efficiencies

Natural gas

NOx <	Type	1,500 rpm I 50 Hz					1,500 rpm I 60 Hz				
		Pel (kW)$_1$	ηel (%)	Pth (kW)$_2$	ηth (%)	ηtot (%)	Pel (kW)$_1$	ηel (%)	Pth (kW)$_2$	ηth (%)	ηtot (%)
500 mg/Nm³	612	1,644	42.4	1,730	44.6	87.0	1,622	41.8	1,750	45.1	86.9
	616	2,188	41.9	2,350	45.0	86.9	2,159	41.4	2,374	45.5	86.9
	620	2,740	42.5	2,903	45.0	87.5	2,697	41.8	2,945	45.7	87.5
250 mg/Nm³	612	1,644	41.8	1,762	44.8	86.6	1,622	41.2	1,782	45.3	86.5
	616	2,188	42.1	2,301	44.3	86.4	2,159	41.5	2,325	44.7	86.2
	620	3,047	42.6	3,173	44.4	87.0	2,994	41.9	3,215	45.0	86.9

Biogas

NOx <	Type	1,500 rpm I 50 Hz					1,500 rpm I 60 Hz				
		Pel (kW)$_1$	ηel (%)	Pth (kW)$_2$	ηth (%)	ηtot (%)	Pel (kW)$_1$	ηel (%)	Pth (kW)$_2$	ηth (%)	ηtot (%)
500 mg/Nm³	612	1,458	39.8	1,531	41.8	81.6	1,435	39.2	1,554	42.4	81.6
	616	1,944	39.8	2,041	41.8	81.6	1,908	39.1	2,065	42.3	81.4
	620	2,428	39.8	2,552	41.8	81.6	2,398	39.3	2,594	42.5	81.8
250 mg/Nm³	612	1,458	39.2	1,591	42.7	81.9	1,435	38.5	1,614	43.4	81.9
	616	1,944	39.2	2,121	42.7	81.9	1,908	38.4	2,145	43.2	81.6
	620	2,428	39.1	2,651	42.7	81.8	2,398	38.6	2,693	43.4	82.0

1 electrical output based on ISO standard output and standard reference conditions according to ISO 3046/I-1991 and p.f. = 1.0 according to VDE 0530 REM with respective tolerance; minimum methane number 70 for natural gas

2 total heat output with a tolerance of +/- 8%, exhaust gas outlet temperature 120 °C, for biogas exhaust gas outlet temperature 180 °C

All data according to full load and subject to technical development and modification.

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DIA.NE® – Dialog Network

DIA.NE® XT is the new GE Jenbacher engine management system designed for use with all GE Jenbacher engines. The system comprises powerful central industrial controls that handle master control and feedback control for the engine-plant, as well as visualization. A link with central process control is provided to meet the specific requirements of each customer, via standardized industry buses or using direct signal lines.

The particular focus of the DIA.NE® XT design lies in combining powerful and flexible open- and closed-loop control electronics with a user-friendly operating concept. The novel hardware design employs the most modern components and sets new standards for performance, functionality and operating safety. The visual display uses a color graphics display screen, providing clear and comprehensible presentation of information and measured values while offering the greatest possible ease of use.

Features of our DIA.NE® XT module control system:

• control of all systems relevant to the module (closed-loop LEANOX®, speed, output, knocking and isolated operation control system, ignition system) • 8 additional controllers available • clear visualization of the systems and display of all relevant data • graphical online trends and alarm management

Using the following additional components, DIA.NE® can be customized to individual needs:

• DIA.NE® RMC – Dialog Network for Remote Message Control
• DIA.NE® WIN – Dialog Network for Windows Systems: Analysis and trend identification in the familiar Windows environment
• HERMES – Data remote transmission (via LAN or modem)
• MONIC – Monitoring Ignition Control: Ignition voltage monitoring

LEANOX® Lean mixture combustion This lean mixture combustion control was developed and patented by GE Jenbacher. It ensures the correct air/gas ratio under all operational circumstances in order to simultaneously achieve the lowest exhaust gas emission rates and stable engine operation.

• sensors used in non-critical measurement ranges • permanent monitoring of emission limit values using stable sensor technology • controlled combustion resulting in controlled loading of the components surrounding the combustion chamber (resulting in longer service life for the cylinder head, valves, spark plugs, pistons, ...) • compensation for deviating gas characteristics

Ignition system The microprocessor-controlled ignition system is connected to DIA.NE® XT via CAN (Controlled Area Network) bus. This makes it possible to vary the firing point depending on operating conditions and/or type of fuel gas used.

Knock control system All GE Jenbacher gas engines come standard with a knock control system. The resulting specific firing point, output and mixture temperature control protects the engine from inadmissible loads, resulting in increased reliability and availability.

Type

Reference Installations

1 J612 GS

Plant: Beretta – Industry; Gardone, Italy

Type of gas: Natural gas
Engine type: 1 x JMS 612 GS-N.L
Electrical output: 1,457 kW
Thermal output: 1,704 kW
Start-up: December 1998

2

The generated electricity covers the entire electrical energy requirement of the Beretta factory, while the hot water is fed into the production process. By using our cogeneration system, Beretta was able to reduce the energy supply costs for the factory by 30%.

2 J616 GS

Plant: Springfield Utility – Electric power station; Springfield, Oregon, USA

Type of gas: Natural gas
Engine type: 5 x JGS 616 GS-N.L
Electrical output: 9,525 kW
Start-up: December 2001

Our generator sets with a capacity of approximately 10 MW make the Springfield electric power station a reliable power supply source, which is extremely important during peak utilisation conditions on the US West Coast.

3

3 J616 GS

Plant: Nufri – Producer of fruit juice; Mollerussa, Spain

Type of gas: Natural gas
Engine type: 9 x JMS 616 GS-N.L
Electrical output: 15,255 kW
Thermal output: 17,883 kW
Start-up: 1996/1997

Processing fruit juice and concentrate requires vast amounts of electrical and thermal energy in the form of hot water and steam. Part of this energy requirement is optimally and efficiently covered by our cogeneration system, with the surplus power being supplied to the public electricity grid.

4 J620 GS

Plant: Güssing biomass power plant; Austria

Type of gas: Wood gas
Engine type: 1 x JMS 620 GS-S.L
Electrical output: 1,964 kW
Thermal output: 2,490 kW
(district heating 70/90 °C)
Start-up: April 2002

4

The wood gas produced and cleaned in a fluidized bed/steam reactor is converted into heat and power in the GE Jenbacher cogeneration plant and forms an important component in an innovative project aimed at meeting 100% of the region's energy needs from renewable sources.

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GE Jenbacher 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 Jenbacher's engines range in power from 0.3 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). Patented combustion systems, engine controls, and monitoring enable its products to meet the strictest international emission standards, while offering high levels of efficiency, durability, and reliability.

GE Jenbacher's products are used by a broad range of commercial, industrial, and municipal customers for on-site generation of power, heat, and cooling. In addition, the company offers a comprehensive spectrum of services including full plant operation and maintenance as well as turnkey packages.

GE Jenbacher has its headquarters and production facilities with 1,000 of its more than 1,300 worldwide employees in Jenbach, Austria.

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