ТЕМПЕРИЛОДЖИСТИКСЕООД
TEMPERI LOGISTICS LTD

# Manufacturers of gas turbine units in the EU and Asia

## Part 1

2024

**Gas turbine plants in the modern world**

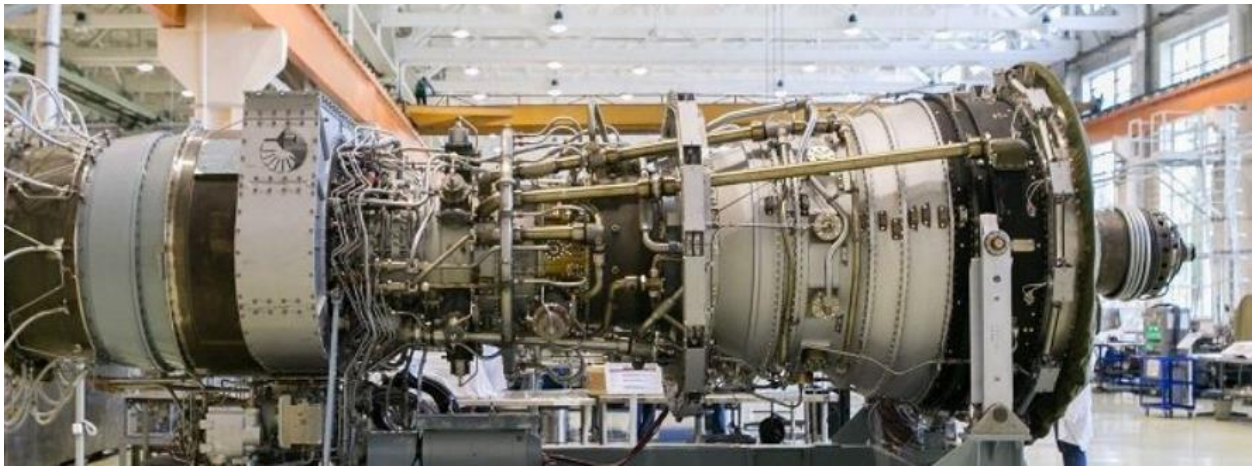
In the modern world, gas turbine units are becoming more and more widely used in various industries. They can run on fossil fuels, which allows them to be used in stationary and transport applications, such as thermal power plants, marine vessels and rail transport.

Every day the share of small-scale energy installations with a cogeneration cycle* is increasing, which allows optimizing the production of heat and electricity in social and industrial infrastructure to ensure effective energy saving. For example, in the UK the share of cogeneration in small-scale power generation reaches 80%, in the Netherlands – 70%, in Germany – 50%. This process is actively supported by the state both through legislative regulation and through budget financing.

* Cogeneration cycle is a method of generating electricity that uses heat released into the environment.

The basis for the economic efficiency of gas turbine cogeneration power plants is their high electrical and thermal efficiency, achieved through the basic mode of their operation on thermal consumption (heating, hot water supply, heat supply for production needs).

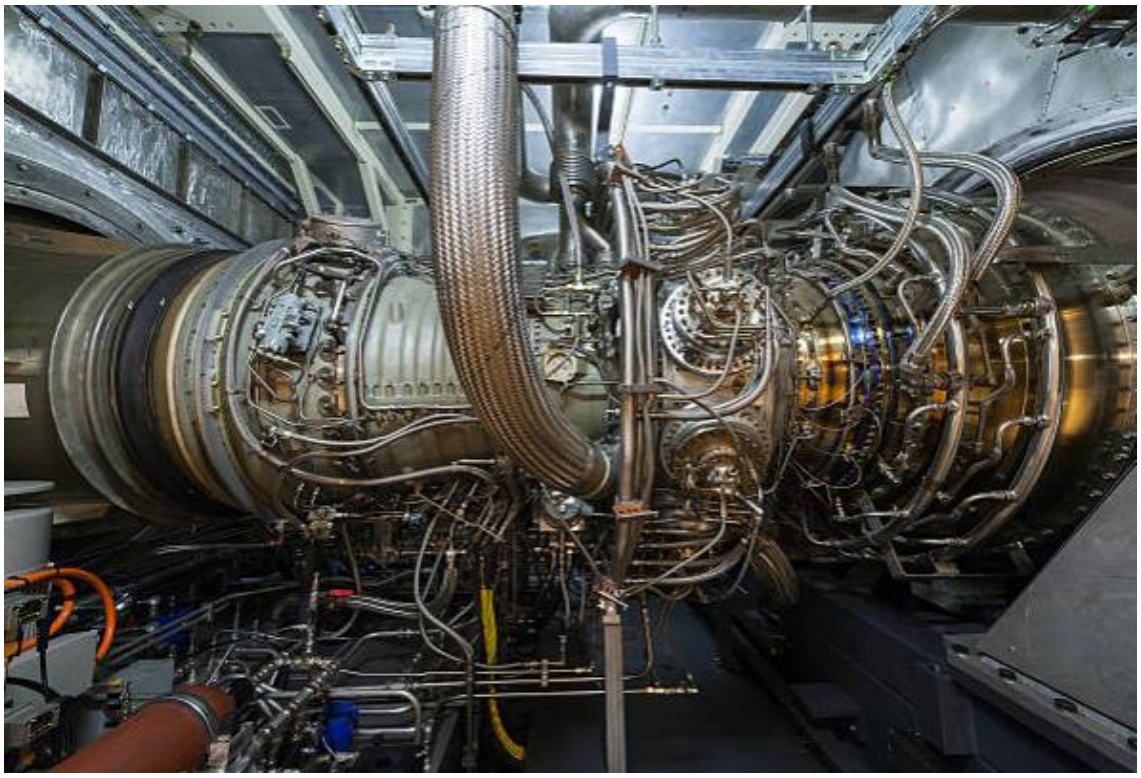
Gas turbine units (GTUs) have received recognition in the energy sector as fully developed, reliable equipment. The performance indicators of gas turbine units in power plants are at the same level as traditional power equipment. They are characterized by readiness for operation within 90% of the calendar time, a 2 - 3 year repair cycle, and a failure-free start-up rate of 95 - 97%. Low specific weight, compactness, ease of transportation and ease of installation are some of the main advantages of gas turbine units, the most attractive from the point of view of their use. The advantages of gas turbines also include short construction times, increased reliability of heat and power supply to consumers, minimal volumes of harmful emissions into the environment, reduced inertia of thermal regulation and losses in heating networks, relative to networks connected to large distribution systems and thermal power plants.



***Gas turbine units*** *are a power plant, the design of which includes an electric generator, the gas turbine itself, a control system, a gas-air path, and auxiliary equipment. The exhaust gases leaving it can be used to produce steam or hot water.*

*Gas turbines are capable of operating on liquid or gaseous fuel (working - gas, reserve - diesel fuel). They belong to heat engines in which useful work is obtained by transferring heat from the combustible fuel directly to the working fluid, which does not change its state of aggregation. This "body" is gas.*

*Gas turbine units have a number of advantages over steam turbine units. The most important thing is the absence of condensers and a steam boiler, systems and various mechanisms of the boiler unit.*



**Gas turbine technology.**

The basis of the gas turbine is a gas generator, which serves as a source of compressed hot combustion products to drive a power turbine. The gas generator consists of a compressor, a combustion chamber and a compressor drive turbine. The compressor compresses atmospheric air, which enters the combustion chamber, where fuel (usually gas) is supplied to it through nozzles, then the fuel is burned in the air flow. Combustion products are supplied to the compressor turbine and power turbine.

The power developed by the power turbine significantly exceeds the power consumed by the compressor for air compression, as well as overcoming friction in the bearings and the power expended on driving auxiliary units. The difference between these values represents the useful power of the gas turbine unit.

A turbogenerator (electric generator) is located on the turbine shaft.

The gases exhausted in the gas turbine drive go through the exhaust device and the silencer into the chimney. It is possible to recover heat from exhaust gases when the exhaust gases enter a waste heat boiler, which generates thermal energy in the form of steam and/or hot water. Steam or hot water from the waste heat boiler can be transferred directly to the heat consumer.

The electrical efficiency of modern gas turbine plants is 33–39%. However, taking into account the high temperature of exhaust gases in powerful gas turbine plants, it is possible to combine gas and steam turbines. This engineering approach can significantly improve fuel efficiency and increases the electrical efficiency of installations to 57–59%.

The advantages of gas turbine units are low specific weight, compactness, ease of transportation and ease of installation. It is allowed to install gas turbine units on the technical floor of a building or to locate low-power gas turbine units on the roof. This useful property of gas turbines is an important factor in urban development.

When operating gas turbine units, the content of harmful NOx and CO emissions in their exhaust gases is minimal. Such excellent environmental qualities make it possible to easily place gas turbine units in close proximity to human habitation. Small-capacity gas turbine units are usually supplied in the form of one or several fully prefabricated units, requiring a small amount of installation work, and their relatively small dimensions allow them to be installed in conditions of a cramped master plan. Hence the relative cheapness of construction and installation work. Gas turbine installations have minor vibrations and noise in the range of 65–75 dB (which corresponds on the noise level scale to the sound of a vacuum cleaner at a distance of 1 meter). As a rule, special sound insulation is not needed for such high-tech generating equipment.

Modern gas turbine plants are highly reliable. There is evidence of continuous operation of some units for several years. Many suppliers of gas turbines carry out major overhauls of equipment on site, replacing individual components without transportation to the manufacturer, which significantly reduces the cost of servicing the unit. Most gas turbine plants have the ability to overload, i.e. increasing power above rated. This is achieved by increasing the temperature of the working fluid.

However, manufacturers impose strict restrictions on the duration of such modes, allowing operation above the initial temperature for no more than several hundred hours. Violation of these restrictions significantly reduces the installation resource.

Let's look at the largest manufacturers of gas turbine units in Europe and Asia.

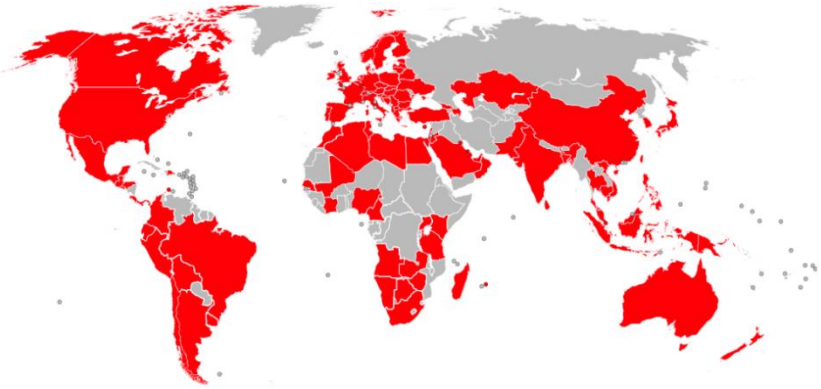
**Manufacturers of gas turbine units in Europe and Asia**

1. **ABB Ltd**

ABB Ltd is a Swiss multinational corporation headquartered in Västerås, Sweden and Zurich, Switzerland, with 850 subsidiaries and 180,000 employees operating in 140 countries, listed on the Swiss SIX exchange in Zurich, Nasdaq Nordic in Sweden and OTC Markets Group in the USA.

Large manufacturer of electrical equipment. The company's activities include production, transmission and distribution of electricity; discrete automation and robotics.

Web: https://global.abb/



*Countries of presence of ABB*

The ABB Motion division produces ABB generators for steam and gas turbines with a full range of powers up to 85 MVA, which are used at sea and on land, in power plants and in shipping, in sugar pulp mills and paper mills, etc..

**Products**

- Compact high voltage generators / Synchronous compact high voltage generators for steam and gas turbines of medium power - from 1 to 8 MVA / 3.3 - 13.8 kV / 4 - 10 poles

| | Technical specifications |
|---|---|
| Standard | IEC60034, ISO 8528 |
| Power | Up to 8 MVA |
| Shaft heights | 500, 560, 630 (mm) |
| Number of poles | 4-10 |
| Ex protection | Ex ec (nA), Zone 2 |
| Voltages | Up to 15kV |
| Frequency | 50Hz or 60Hz |
| Ambient | -20 °C up to 55 °C |
| Cooling | Open air cooled, Air to air, Air to water, Open ventilated system |
| Protection | up to IP55 |
| Enclosure material | Welded steel |
| Bearings | Antifriction or sleeve |

- Large synchronous generators

| | Technical specifications |
|---|---|
| Standard | IEC60034, IEC60079-2, NEMA MG-1 |
| Power | Up to 85 MVA |
| Shaft heights | 710, 800, 900, 1000, 1120, 1250, 1400 (mm) |
| Number of poles | 4-6 |
| Ex protection | Ex ec, Ex p(e) |
| Voltages | Up to 15 kV |
| Frequency | 50Hz or 60Hz |
| Ambient | -50 °C up to 60 °C |
| Cooling | Air to air, Air to water |
| Protection | up to IP56 |
| Enclosure material | Welded steel |
| Bearings | Sleeve |


For more information, please contact your local ABB representative or visit new.abb.com/motors-generators/generators/ generators-for-steam-and-gas-turbines.

2. **Ansaldo Energia**, Genoa, Italy

A company with a 17-year history, specializes in turbomachinery and generator production.

All Ansaldo Energia gas turbine systems can be used in existing energy facilities and run on a mixture of natural gas and hydrogen without any (or minor) modifications. Current hydrogen utilization ranges from 40% to 70% depending on the engine model. Ansaldo Energia aims to achieve 100% hydrogen production capacity by 2030 or earlier across its product range.

Web: https://www.ansaldoenergia.com/

**Products**

The company's extensive turbomachinery portfolio includes high-power gas turbines and steam turbines for large-scale applications, as well as microturbines for the rapidly growing distributed energy industry.

| Hydrogen capability | Model | Standard offering (up to) |
|---|---|---|
| Heavy-duty turbines | GT36 | 70% |
| | GT26 | 45% |
| | AE94.3A | 40% |
| | AE94.2 | 40% |
| | AE64.3A | 40% |
| Microturbines | AE T100 | 80% |

The turbines can burn natural gas, heavy oil and other fuels, all capable of producing hydrogen in varying percentages, and are equally suitable for both power generation and synchronous condensation needed to improve grid reliability

- **Heavy gas turbines**

| Type | ISO power (MW) | | Frequency (Hz) |
|---|---|---|---|
| | Simple cycle | Combined cycle (depending on configuration) | |
| GT36-S5 | 560+ (43.00%) | 800+ (62.60%) | 50 |
| GT26 | 370 (41.00%) | 540 (61.00%) | 50 |
| AE94.3A | 340 (40.30%) | 495 (60.00%) | 50 |
| AE94.2 | 191 (36.80%) | 287 (55.80%) | 50 |
| AE64.3A | 78 (36.40%) | 120 (55.70%) | 50/60 |

Heavy duty E-, F- and H-class gas turbines from 78 to 560+ MW (ISO Power) for simple cycle, from 120 to 800+ MW for combined cycle and cogeneration.

### *GT36 H-class turbines*

| Natural gas ISO conditions | GT36 S5 |
|---|---|
| Power Output* (MW) | 560+ |
| Frequency (Hz) | 50 |
| Efficiency (%) | (43%) |
| Exhaust Mass Flow (Kg/s) | 1,058 |
| Exhaust Temperature (°C) | 621 |

*Including OTC contribution

| Optimized combined cycle | GT36 S5 1+1 | GT36 S5 2+1 |
|---|---|---|
| Net Plant Power Output (MW) | 800+ | 1600+ |
| Net Plant Efficiency (%) | 62.6% | 62.8% |

### *Turbines GT26*

| GT26 ISO performance | |
|---|---|
| Gross GT Power Output* (MW) | 370 |
| Gross GT Efficiency (%) | 41 |
| GT Exhaust Mass Flow (Kg/s) | 741 |
| GT Exhaust Temperature (°C) | 635 |

| GT26 optimized combined cycle | 1+1 | 2+1 |
|---|---|---|
| Net Plant Output (MW) | 540 | 1,083 |
| Net Plant Efficiency (%) | 61 | 61.2 |

### Turbines *AE94.3A*

| AE94.3A ISO performance | |
|---|---|
| Gross GT Power Output (MW) | 340 |
| Gross GT Efficiency (%) | 40.3 |
| GT Exhaust Mass Flow (Kg/s) | 755 |
| GT Exhaust Temperature (°C) | 593 |

| AE94.3A optimized combined cycle | 1+1 | 2+1 |
|---|---|---|
| Net Plant Output (MW) | 495 | 992 |
| Net Plant Efficiency (%) | 60 | 60.3 |

### *Turbines AE94.2*

| AE94.2 ISO performance | |
|---|---|
| Gross GT Power Output (MW) | 191 |
| Gross GT Efficiency (%) | 36.8 |
| GT Exhaust Mass Flow (Kg/s) | 555 |
| GT Exhaust Temperature (°C) | 550 |

| AE94.2 optimized combined cycle | 1+1 | 2+1 |
|---|---|---|
| Net Plant Output (MW) | 287 | 578 |
| Net Plant Efficiency (%) | 55.8 | 56.2 |

### *Turbines AE64.3A*

| AE64.3A ISO performance | |
|---|---|
| Gross GT Power Output (MW) | 78 |
| Gross GT Efficiency (%) | 36.4 |
| GT Exhaust Mass Flow (Kg/s) | 215 |
| GT Exhaust Temperature (°C) | 580 |

| AE64.3A optimized combined cycle | 1+1 | 2+1 |
|---|---|---|
| Net Plant Output (MW) | 120 | 243 |
| Net Plant Efficiency (%) | 55.7 | 56.4 |

- **Microturbines AE-T100**

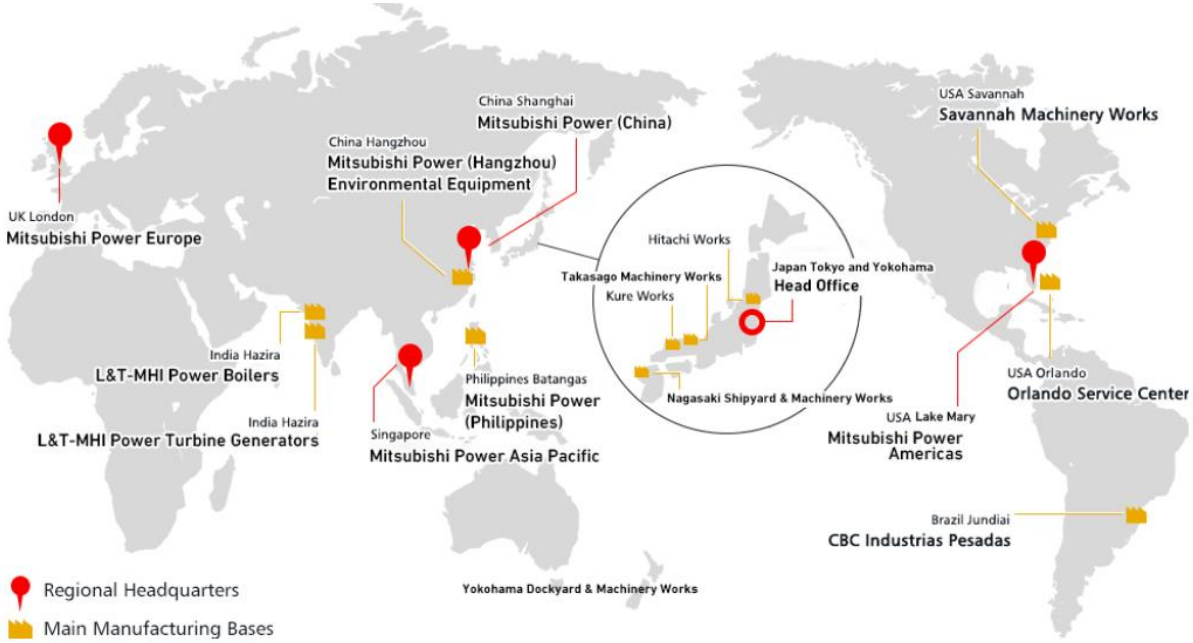
The AE-T100 microturbines can reach 90% efficiency and are available in three different versions: externally heated (AE-T100E); biogas powered (AE-T100B); and running on natural gas (AE-T100NG).

| Micro Gas Turbines | Performance | Main feature |
|---|---|---|
| AE-T100NG | 100 kW<br>30% | • Indoor/Outdoor<br>• Hot water/flue gas applications<br>• With/without flue booster<br>• Pollutants abatement systems not needed |


*Ansaldo Energia independently develops and manufactures key equipment for power generation. Turbines and generators are offered as equipment for new turnkey plants, as high-tech components for the modernization of existing facilities, or as separate packages for direct sales to customers or other EPC contractors.*

### 3. Mitsubishi Power

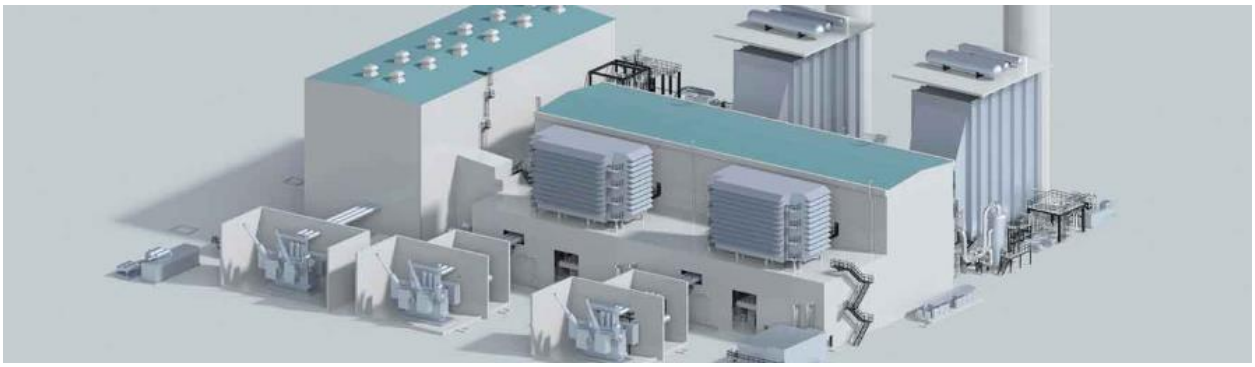
**Mitsubishi Power** is a global corporation operating in the field of electric power, production and storage of electricity.




*Global network Mitsubishi Power*

**Products offered:**

- Combined cycle gas turbine power plants (GTCC)



Gas turbine combined cycle (GTCC) power plants use natural gas and have power generation efficiencies that are 20% higher than traditional coal-fired thermal power systems. This reduces CO 2 emissions by approximately 50%. World class power generation efficiency of at least 64% (LHV); class from 30 to 1332 MW.

- Steam power plants
- Integrated Coal Gasification Combined Cycle Power Plants (IGCC)
- Geothermal power plants
- Gas turbine units Паровые электростанции

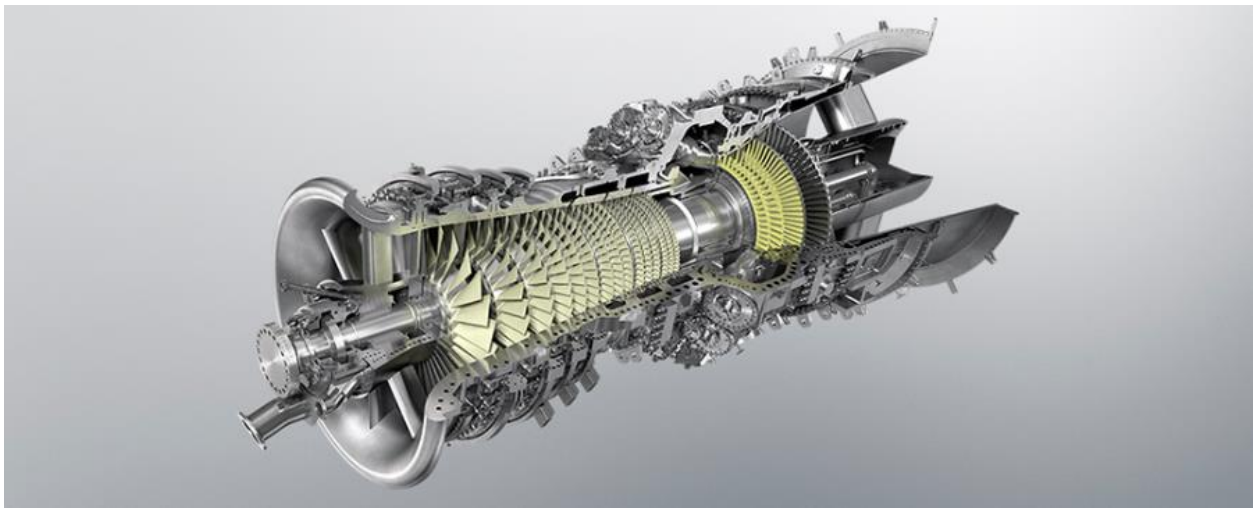
Gas turbine plants are the main components of gas turbine combined cycle (GTCC) power plants. Have a power input temperature of 1600℃.

The lineup:

Gas turbines of medium and low power (class from 40 MW to 120 MW)

A line of models with an output power ranges from 60 MW to 350 MW and high installation efficiency of 55-58%.

High power gas turbines (class from 120 MW to 560 MW)



For 50Hz: M701D Series, M701F Series, M701G Series, M701J Series

For 60 Hz: M501D Series, M501F Series, M501G Series, M501J Series

- Aviation gas turbines
- team turbines
- Boilers
- Air quality monitoring systems (AQMS)
- Generators
- Control systems
- SOLUTIONS FOR ENERGY STORAGE SYSTEMS
- Other
- Power plant peripheral equipment

**Mitsubishi Electric Europe**

Mitsubishi Electric Europe offers services for rotating machinery including gas turbines, steam turbines and generators.

**Divisions:**

**Europe**

**UK:** Mitsubishi Power Europe, Ltd.

**Belgium:** MHI Power Aero Europe SRL

**Germany:** Mitsubishi Power Europe GmbH, Meeraner Dampfkesselbau GmbH, Babcock Fertigungszentrum GmbH

**Italy:** ATLA S.r.l.

**Romania**: MHI Power Romania SRL UK, Mitsubishi Power Europe, Ltd.

**Belgium:** MHI Power Aero Europe SRL

***Asia***

**India:** Mitsubishi Power India Private Limited L&T, MHI Power Turbine Generators Private Ltd., L&T- MHI Power Boilers Private Ltd.

**Singapore:** Mitsubishi Power Asia Pacific Pte. Ltd.

**Thailand:** Mitsubishi Power (Thailand) Ltd., EGAT Diamond Service Co., Ltd., MHI Power Project (Thailand) Co., Ltd.

**Indonesia:** PT. Mitsubishi Power Indonesia PT., Power Systems Service Indonesia

**Philippines:** Mitsubishi Power (Philippines) Inc., MHI Power Technical Services Corporation, MHI Power (Philippines), Plant Services Corporation

**China:** Mitsubishi Power (China) Co., Ltd., MHI Power Dalian Electricity Equipment Co., Ltd., Mitsubishi Heavy Industries Dongfang Gas Turbine (Guangzhou) Co., Ltd, Mitsubishi Power (Hangzhou) Environmental Equipment Co., Ltd., MHI Power Jieneng (Qingdao) Steam Turbine Co., Limited, MHI Power Dongfang Boiler Co., Ltd., Mitsubishi Power Gas Turbine Engineering Technology (Nanjing) Co., Ltd., MHI Power (Beijing) Management and Consulting Ltd.

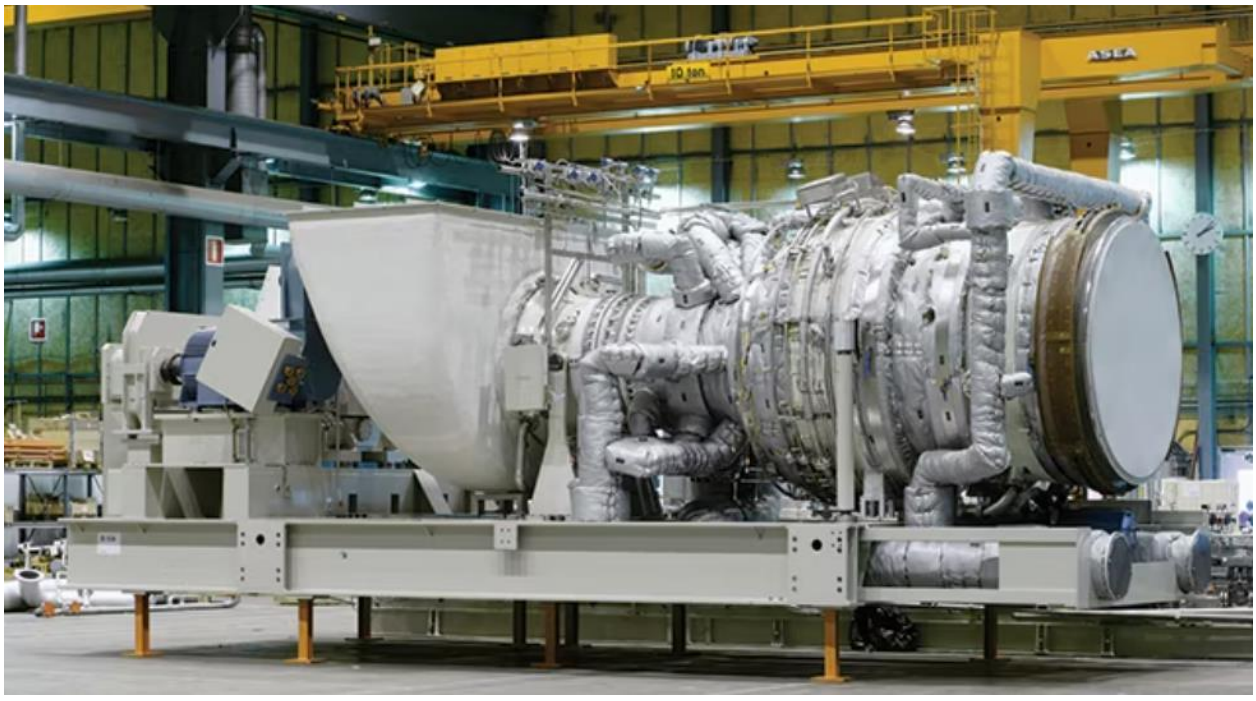
**Korea:** MH Power Systems Korea, Ltd.

**Web:** https://power.mhi.com/

4. **Siemens,** Germany

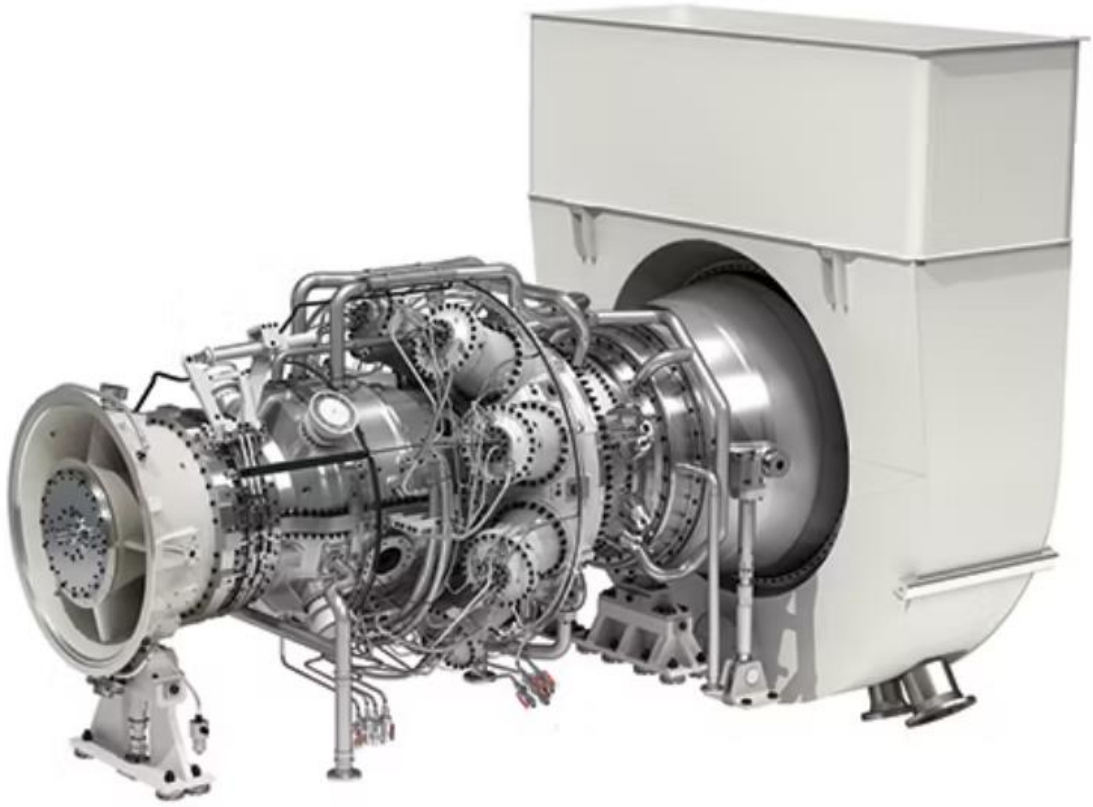
**Siemens Energy Sector** is a leading global supplier of a wide range of products, services and solutions for the production, transmission and distribution of electricity, as well as for the production, processing and transportation of oil and gas.

In the 2010 financial year, the total revenue of the Siemens Energy Sector amounted to 25.5 billion euros and profit of 3.6 billion euros. The sector employs approximately 88,000 people worldwide, with approximately 1,500 employees based at the Siemens Industrial Turbomachinery plant in Lincoln, UK.



**Peoducts:**

- Solutions for power generation and distribution,
- compressors with electrical and mechanical drives,
- steam turbines,
- gas turbine units
- process technology and automation



Siemens Energy offers gas turbines for a wide range of applications:

- highly efficient, robust and flexible gas turbines designed for large simple or combined cycle power plants in commercial operation and suitable for cogeneration applications as well as peak, intermediate or base load applications.

**Models of high-power gas turbines**

- SGT5-9000HL (593 МВт)
- SGT5-8000H (450 МВт)
- SGT5-4000F (329-385 МВт)
- SGT5-2000E (198 МВт)
- SGT6-9000HL (440 МВт)
- SGT6-8000H (310 МВт)
- SGT6-5000F (215-260 МВт)
- SGT6-2000E (117 МВт)

**Industrial Gas Turbines:**

The high steam pressure boosting capabilities of turbines help achieve overall plant efficiencies of 80% or more.

**Models of industrial gas turbines**

- SGT-800 (45-62 MW)
- SGT-750 (40/34-41 MW)
- SGT-700 (33-35/34-36 MW)
- SGT-600 (24/25 MW)
- SGT-400 (10-14/11-15 MW)
- SGT-300 (8-9 MW)
- SGT-100 (5/6 MW)
- SGT-50 (2 MW)

**Aeronautical Gas Turbines (SGT-A35 and SGT-A05):** Aeronautical gas turbines are compact and flexible with quick start capabilities, suitable for both aviation and oil and gas power generation applications, and also perform well in decentralized power generation applications.

**Gas turbines for the oil and gas industry:** Turbines are used for oil and gas production and processing, as well as for pipelines, LNG and refineries.

**Gas turbines for industrial power generation:** have high energy efficiency, high return on investment, low energy costs and uninterrupted supply of power and heat for power generation and cogeneration in many industries including:

- Buildings and infrastructure
- Cement/Mining and Minerals
- Chemistry/Rubber and Plastic
- Food and drink/Palm oil
- Manufacturing/Industrial parks
- Metals/Ceramics and Glass
- Pulp and paper industry

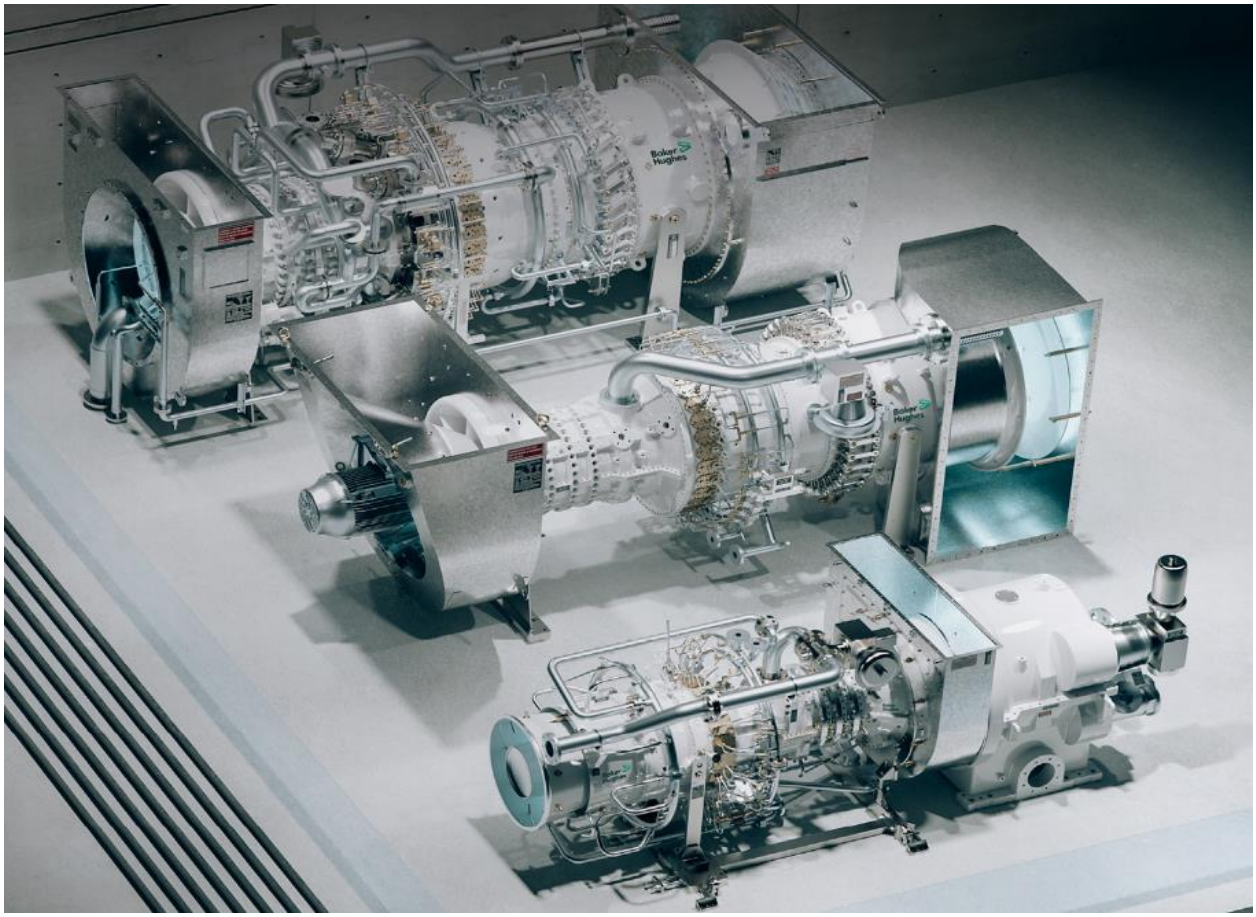
**Gas turbines for power generation:** As a reliable project partner for independent power producers, municipalities and utilities, Siemens Energy supplies gas turbines with flexible and short start-up times, high efficiency and low power generation costs.

**Web:** https://resources.sw.siemens.com/

5. **Baker Hughes,** Florence, Italy

Energy technology company providing solutions for energy and industrial customers.

Baker Hughes turbines are specifically designed to operate at 9 ppm NOx at 15% O 2 for natural gas fuels (50% to 100% load) in both mechanical drive and power generation systems. The NovaLT™16 turbine can start and burn gas mixtures containing up to 100% hydrogen. It can also switch from natural gas to natural gas blends or 100% hydrogen without any hardware changes.



**Products:**

- gas and steam turbines for power generation (50/60 Hz) (from 5.7 MW to 130 MW) NovaLT™ Gas Turbines

- Steam turbines
- Centrifugal and axial compressors
- Piston compressors
- Generators, synchronous capacitors and motors
- Gearboxes and gear couplings
- Air-cooled expanders and heat exchangers
- Centrifugal pumps
- Valves

NovaLT™ turbines can achieve efficiencies of over 37% in a simple cycle configuration and up to 85% in a cogeneration configuration. Requires only 45 days to install, exceptional 35,000 hour average service interval and 24 hour engine replacement capability.

**Web:** https://www.bakerhughes.com/

### 6. Solar Turbines

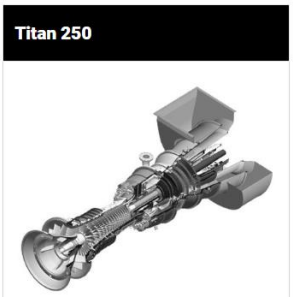
**Solar Turbines Incorporated**, California, USA, a subsidiary of Caterpillar Inc., designs and manufactures industrial gas turbines for onshore and offshore applications. Represented, among others, by a group of companies in Europe and Asia.

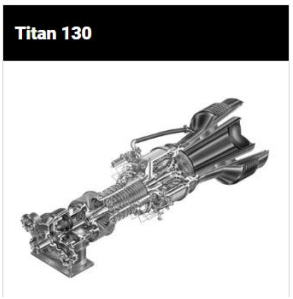
**Products:**

- Gas compressors
- Gas compressor units
- Mechanical drive packages
- Oil and gas generator sets
- Electricity generating plants
- Turbomachinery for power generation, as well as compressor devices and engine-driven units in the range of 1–39 megawatts.

Turbomachinery complexes: power 38,000 KWE, 34,000 KWE, 23,100 KWE, 16,530 KWE,





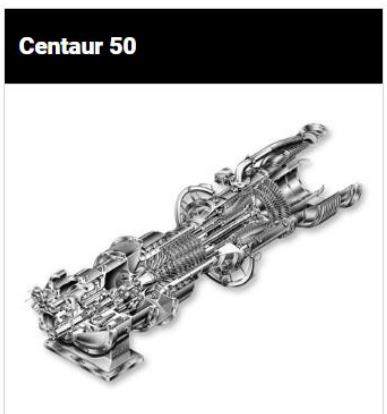




power 11,350 KWE, 9450 KWE, 7965 KWE, 5670 KWE,



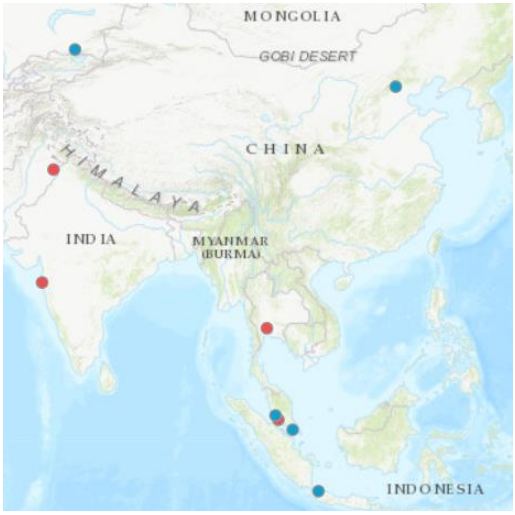


power 4600 KWE, 3515 KWE, 1210 KWE





Global network of Solar Turbines presence in Europe and Asia:


**Belgium:** Solar Turbines Europe S.A.
**Германия**: Turbomach GmbH
**Denmark:** Solar Turbines Danmark
**Италия:** Solar Turbines
**Switzerland:** Solar Turbines Switzerland SAGL,
**Netherlands:** Solar Turbines
**Spain:** Turbomach S.A.U.
**Чехия:** Solar Turbines EAME s.r.o.
**United Kingdom:** Solar Turbines Europe S A
**China:** Solar Turbines (Beijing) Trading & Services Co. Ltd.
**Kazakhstan:** Solar Turbines International
**Pakistan:** Turbomach Pakistan Private Ltd.
**India:** Solar Turbines India Pvt. Ltd.
**Thailand:** Solar Turbines (Thailand) Ltd.
**Malaysia:** Solar Turbines Malaysia Sdn Bhd
**Indonesia:** P.T. Solar Services Indonesia

**Web:** https://www.solarturbines.com/

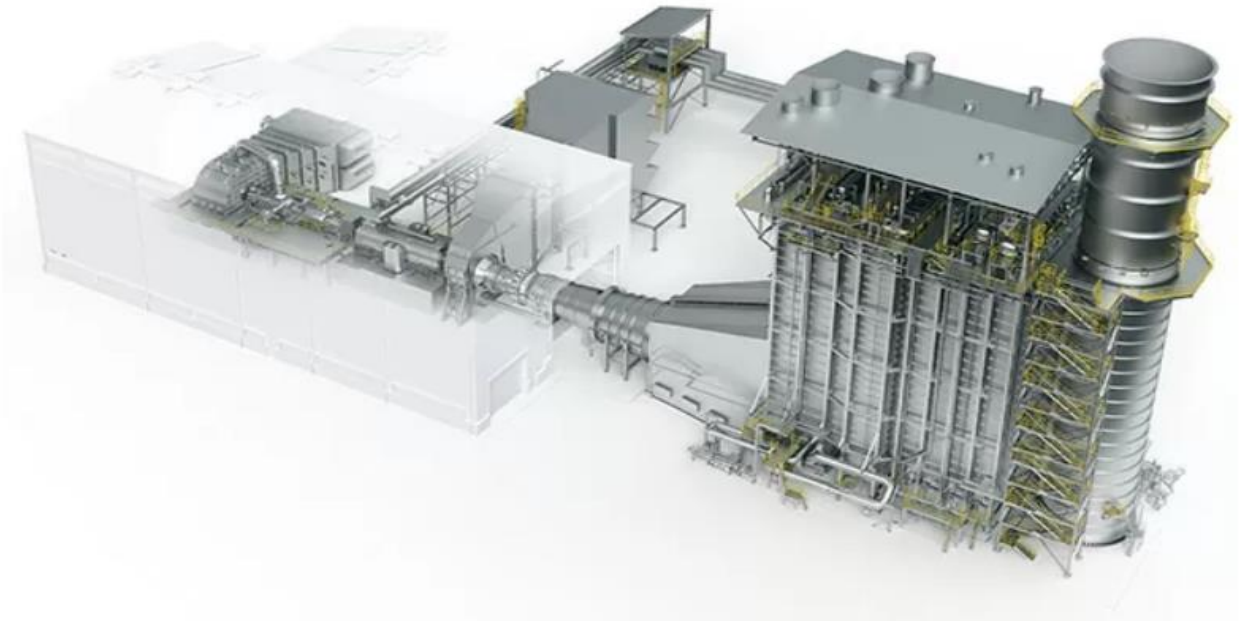
### 7. GE Vernova

American company, manufacturer of equipment for the energy industry, 75,000 people in more than 100 countries. The technological base includes about 54,000 wind turbines and 7,000 gas turbines, generating about 25% of the world's electricity.

GE Vernova until April 2024, as part of General Electric, combined two divisions:

- renewable energy - production of wind generators, equipment for hydroelectric power plants and power grids, turnover $15.1 billion, net loss $1.4 billion;

- energy equipment - production of gas turbines for energy and industry, as well as various equipment for nuclear power plants, oil and gas and mining industries, turnover $17.7 billion, net profit $1.4 billion.



Revenue for 2023 amounted to $32.78 billion, by region: USA - 38%, Europe - 25%, China - 4%, rest of Asia - 12%, Americas excluding USA - 10%, Middle East and Africa - 12%

**Products:**

**Gas turbines:**

- **H-class:**
  9 HA (50 Hz) has two available models - the 448 MW 9HA.01 gas turbine and the 571 MW GE 9HA.02 gas turbine

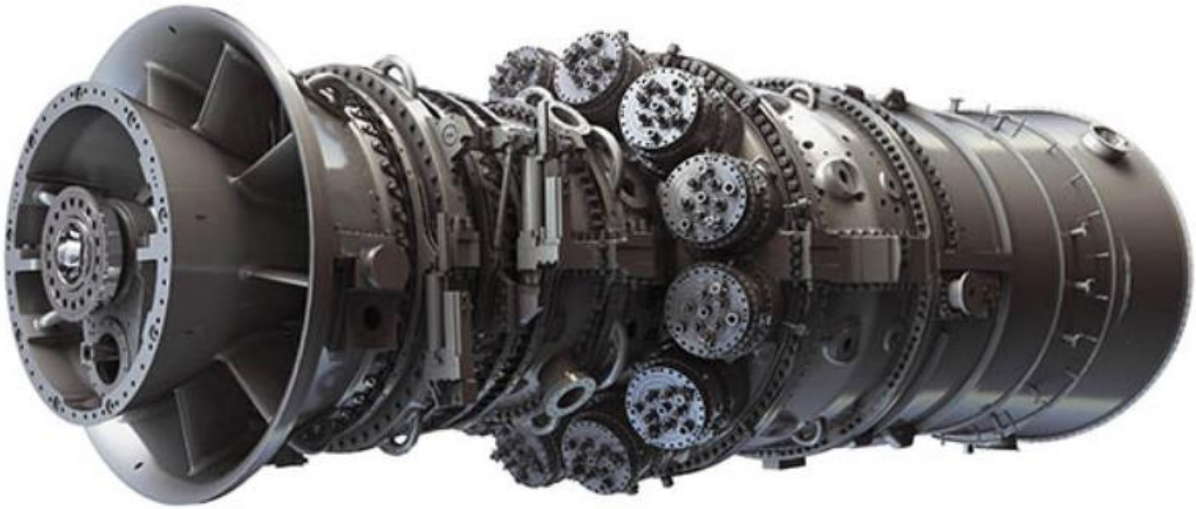
Simple Cycle

| | 9HA.01 | 9HA.02 |
|---|---|---|
| Net output (MW) | 448 | 571 |
| Net heat rate (Btu/kWh, LHV) | 7960 | 7740 |
| Net heat rate (kJ/kWh, LHV) | 8398 | 8166 |
| Net efficiency (%, LHV) | 42.9% | 44.0% |
| Ramp Rate (MW/minute) | 65 | 88 |
| Startup Time (RR Hot, Minutes) | 23 | 23 |

Combined Cycle 1x1

| | 9HA.01 | 9HA.02 |
|---|---|---|
| Net output (MW) | 680 | 838 |
| Net heat rate (Btu/kWh, LHV) | 5356 | 5320 |
| Net heat rate (kJ/kWh, LHV) | 5651 | 5613 |
| Net efficiency (%, LHV) | 63.7% | 64.1% |
| Ramp Rate (MW/minute) | 65 | 88 |
| Startup Time (RR Hot, Minutes) | <30 | <30 |

- 7HA (60 Гц) available in three models: 7HA.01 with a capacity of 290 MW and 7HA. 02 for 384 MW and 7HA.03 for 430 MW.



Simple Cycle

| | 7HA.01 | 7HA.02 | 7HA.03 |
|---|---|---|---|
| Net output (MW) | 290 | 384 | 430 |
| Net heat rate (Btu/kWh, LHV) | 8120 | 8009 | 7884 |
| Net heat rate (kJ/kWh, LHV) | 8567 | 8450 | 8318 |
| Net efficiency (%, LHV) | 42.0% | 42.6% | 43.3% |
| Ramp Rate (MW/minute) | 55 | 60 | 75 |
| Startup Time (RR Hot, Minutes) | 21 | 21 | 21 |

Combined Cycle 1x1

| | 7HA.01 | 7HA.02 | 7HA.03 |
|---|---|---|---|
| Net output (MW) | 438 | 573 | 640 |
| Net heat rate (Btu/kWh, LHV) | 5481 | 5381 | 5342 |
| Net heat rate (kJ/kWh, LHV) | 5783 | 5677 | 5636 |
| Net efficiency (%, LHV) | 62.3% | 63.4% | 63.9% |
| Ramp Rate (MW/minute) | 55 | 60 | 75 |
| Startup Time (RR Hot, Minutes) | <30 | <30 | <30 |

- GT13E2
- 9F
- 7F
- 9E
- 7E
- 6F
- 6B
- LMS100
- LM6000
- LM2500 & LM2500XPRESS
- TM2500

**GE Gas Power в Азии:**

*Asian network **GE Gas Power***

4,000 employees in the region, 1,300 gas turbines installed, 19 construction sites, 8 O&M sites, 6 repair shops.

**Thailand:** Rayong Aeroderivative Services Level 2 & Tooling Center
**China:** Qinhuangdao Service Center (QHD)
**India:** BHEL-GE Gas Turbine Services Pvt Ltd (BGGTS)
**Vietnam:** Phu My Reconditioning Workshop
**Malaysia:** Port Klang Aero Alliance – Aeroderivative Services Center & FieldCore Tooling Center
**Singapore:** Global Repair Solutions Singapore (GRSS)

**GE Gas Power in Europe**

GE continues to support power generation across Europe, with offices in 22 countries and nearly 100 GW of installed capacity, as well as numerous service centers, parts warehouses and a global research and development center.

**Web:** https://www.gevernova.com/

8. **MAN Energy Solutions**

A German multinational company based in Augsburg that produces large diameter gas and diesel engines as well as turbomachinery for marine, railway and stationary applications such as locomotives and marine propulsion systems, power plants and turbochargers.

MAN Energy Solutions employs approximately 14,000 people at more than 120 sites worldwide.

The company owns 14 production sites:

- plant in Augsburg, Germany. for the production of large-caliber four-stroke diesel and gas engines, as well as turbochargers
- Aurangabad plant (India) produces four-stroke engines
- turbomachinery plant Balgalore (India)
- turbomachinery plant Changzhou (China)
- Oberhausen plant, Germany, turbomachinery
- plant Gettendorf, Germany
- compressor plant Berlin, Germany
- Deggendorf plant, Germany (reactors)
- plant Copenhagen, Denmark
- Frederikshavn plant, Denmark
- plant for 4-pin motors Saint-Nazaire, France
- plant Zurich, Switzerland for compressors

**Products:**

- Gas engines
- Dual fuel engines
- Liquid fuel engines
- Steam turbines
- Gas turbines

**MGT6000-1S**

**MGT6000-2S**

**THM1304**

MGT6000 single shaft turbine with electrical power range from 6.63 to 7.8 MW, MGT6000 twin shaft gas turbine with mechanical power range from 6.9 to 8.3 MW, THM twin shaft gas turbine with mechanical power range from 10.5 to 12, 0 MW mech. and electrical power from 10.0 to 11.5 MW.

- Emergency diesel generators
- Compressors
- Components of a science experiment

Example for power generation: MGT6000 series gas turbine:

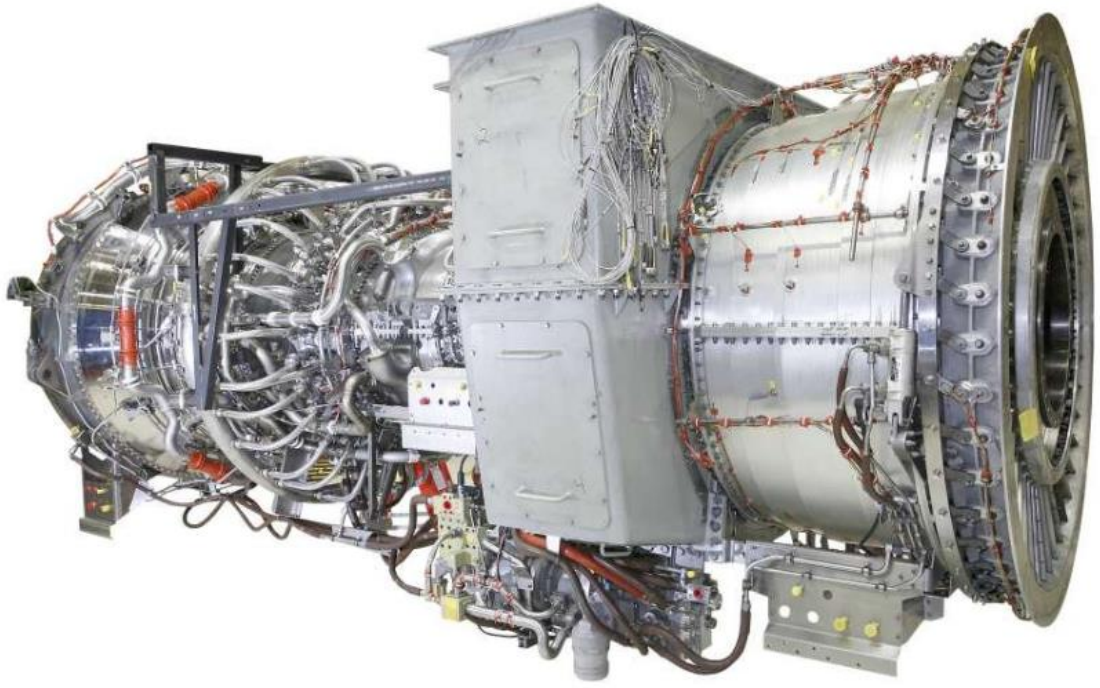
*CSVW (Volkswagen China/Shanghai motors)*

Volume: 4 gas turbine units MGT6000
Electrical output: 4x 6.63 MW (total: 26.52 MW)
Steam production: 15 t/h at 10 bar per unit (total 60 t/h)
Hot water production: 1.1 MW per unit (total 4.4 MW)

Web: https://www.man-es.com/oil-gas/products/gas-turbines

All of the above companies are members of the European Association of Gas and Steam Turbine Manufacturers – **EUTurbines.**

Web: https://www.euturbines.eu/



9. **Destinus,** Switzerland

A private European aerospace company specializing in the aerospace, defense and energy sectors, with branches in the canton of Vaud (Switzerland), Munich (Germany), Hengelo (Netherlands), Madrid (Spain), Paris (France).

**Products:**

Manufactures and services gas turbine systems with a capacity of 1.8 MW.
The OPRA OP16 gas turbine has a full radial design that provides strength, reliability, high efficiency and low emissions. The combustion systems offer multi-fuel capability, giving the OP16 gas turbine the ability to handle a wide range of liquid and gaseous fuels.
The OPRA OP16 radial gas turbine is available in the following variants:

- OP16-3A (Diffusion combustion chamber)
- OP16-3B (dry combustion chamber with low NOx emissions)
- OP16-3C (low-calorie fuel combustion chamber)

OPRA OP16 units are suitable for a variety of needs including temporary or permanent installations, onshore and offshore oil and gas industries, and a wide range of environmental conditions (Arctic, desert, etc..).

Web: https://www.destinus.com/energy

**Summary of part 1**

Despite a number of advantages: low oil consumption; possibility of working on production waste; emissions of harmful substances within 25 ppm; low, within 80-85 dBa, noise and vibration levels; compact size and light weight; ability to work on various types of gas; operation in autonomous mode and in parallel with the network, gas turbine plants also have a number of disadvantages. Namely, the need for pre-compression of gas fuel, which significantly increases the cost of energy production; a sharp drop in efficiency when the load decreases; significantly shorter service life compared to other power plants. However, the European gas turbine market is projected to grow at a CAGR of over 2.97% by 2025.

A gas turbine is an instrument that uses the energy stored in a gas, either in the form of kinetic energy of a flowing gas stream or in the form of potential energy of a pressurized gas to create rotational motion. CO2 emissions in the European energy sector fell by 4%, by approximately 1.018 million tons. Due to the closure of coal power stations (and a 12% reduction in coal production by 2018) and increased carbon price support, over 50% of the change occurred in the United Kingdom.

Countries such as Italy, the Netherlands, Germany and Greece have seen significant shifts from coal to gas. In 2016, about 8 GW of coal-fired power plants were closed in the European Union. These plants include 4.9 GW in the UK, 1.6 GW in the Netherlands, 0.6 GW in Italy, 0.6 GW in Belgium, 0.6 GW in Germany and 0.2 GW in Poland. Europe also announced the closure of a further 7 GW of coal-fired power plants during 2017-2020, representing less than 5% of the region's total coal fleet.

The share of gas energy in Europe increased from 15.5% in 2015 to 20.8% in 2018. The transition from coal to gas is one of the main factors expected to drive the development of the European gas turbine market.

While such developments in gas power infrastructure are expected to drive demand for gas turbines in Europe, the growing shift to renewable energy sources will constrain the growth of the gas turbine market.

Germany dominates the gas turbine market in Europe. The country has expanded its gas capacity in recent years as the closure of coal and lignite power plants and the phase-out of nuclear power have partially discouraged the addition of renewable capacity. The country's gas capacity grew by a net 5.67 GW from 2019, while a net 16.79 GW of coal, lignite and nuclear capacity was taken off the grid.

Stadtwerke Kiel, a German utility, has launched a state-of-the-art combined heat and power plant in the north of the country. Collectively, the 20 Jenbacher J920 FleXtra gas engines provide a total electrical output of 190 megawatts (MW) and a thermal output of 192 MW.

Previously, German energy policy largely focused on renewable energy sources with hydrogen or batteries, rather than reliable low-carbon generation options such as gas generation or nuclear generation. *

*Germany has a capacity of 225 GW, of which 63 GW is wind power (of which 8 GW is offshore), 56 GW is solar power, 40 GW is coal and lignite, almost 32 GW is gas, almost 11 GW - for hydropower, 14.5 GW - for biomass and 4 GW - for a nuclear power plant (for 2022).

Climate change concerns, increasing demand for electricity and technological developments are some of the major factors influencing the gas turbine market. Emerging technologies developed over the past decade, such as integrated gasification and combined cycle (IGCC), carbon capture and storage (CCS), supercritical and ultracritical power generation and carbon sequestration, are making thermal generation more affordable and environmentally friendly. This is why the demand for gas turbines will surpass the demand for steam turbines, since the former are more technologically advanced and efficient, with a lower environmental impact.

Consolidation in the global gas turbine market is greater than in the steam turbine market. The largest gas turbine manufacturers collectively captured 78% of the market in 2021.

Part 1 of the report contains European players in the gas turbine market, namely:

- ABB Ltd - Swiss manufacturer of gas turbines
- Ansaldo Energia, Italy
- Mitsubishi Power, a global global corporation
- Siemens Energy, a German global corporation
- Baker Hughes, Italy
- Solar Turbines, a global corporation
- GE Vernova, a global corporation
- MAN Energy Solutions, Germany
- Destinus, Switzerland