Since theearly 1990s, combined-cycle gas turbines (CCGT) have become the technology of choice for new gas-fired power plants. CCGT plants consist of compressor/gas-turbine groups – the same as OCGT plants – but the hot gas-tubine exhaust is not discharged into the atmosphere. Instead it is re-used in a heat recovery steam generator (HRSG) to generate steam that drives a steam-turbine generator and produces additional power. Gas-turbine exhausts then leave the HRSG at about 90˚C and are discharged into the atmosphere. CCGT plants commonly consist of one gas turbine and one steam turbine. Approximately two-thirds of the total power is generated by gas turbine and one-third by the steam turbine. Large CCGT power plants may have more than one gas-turbine.

State-of-art CCGTs have electric efficiency of between 52% and 60% (lower heating value, LHV) at full load. Combined-cycle gas turbine is mature technology. It is one of the dominant options for both intermediate load (2000 to 5000 hrs/yr) and base load (>5000 hrs/yr) electricity generation. In the last decade, many CCGT plants have been built in North America, Europe, Asia, and the Middle East. These plants have become the workhorses of independent power producers all over the world. With individual heavy-frame gas turbines available in unit sizes of up to 300 MW_e CCGT plants offer modular flexibility and adaptability to the electricity demand and grid requirements. In general, gas-turbines can burn not only natural gas but also heavy/crude oil, distillate and other liquid and gaseous fuels. Obviously, large heavy-duty gas-turbines with big combustion chambers are more suitable for burning heavy fuels, while small, aero-derivate gas-turbines, with several little burners or combustion chambers, are more sensitive to changes of combustion parameters. In general, CCGT plants are designed to respond relatively fast to changes in electricity demand and service. They may be operated between 40% and 100% of nominal capacity with moderate efficiency drop (58-59% at full load to 50-52% of the full load). Due to the high efficiency and the use of natural gas, the best available CCGT power plants emit approximately 50% less CO_2 and up to nine times less NO_x per kWh than modern coal-fired power plants.

One key to a turbine's fuel-to-power efficiency is the temperature at which it operates. Higher temperatures generally mean higher efficiencies, which in turn, can lead to more economical operation. Gas flowing through a typical power plant turbine can be as hot as 2300 degrees F, but some of the critical metals in the turbine can withstand temperatures only as hot as 1500 to 1700 degrees F. Therefore, air from the compressor might be used for cooling key turbine components, reducing ultimate thermal efficiency.

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Power converters

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Power converters are devices designed to convert electric energy parameters (voltage, frequency, number of phases, waveform). Power converters are used in electrical engineering, power engineering and the electric power industry. Power converters are composed of semiconductor devices, since they provide high efficiency. Table 1 below outlines component base of power converters.

Table 1. History of converters components

Period of use	Component base
1880	Motor-generator (umformer), Still are used (dinamotor), albeit limited
1880	Transformers
1930-1970	Ionic devices (ignitron)
1960-2014	Semiconductor diodes, thyristors and transistors

Often, the emergence of new devices does not eliminate the need to use a number of instruments that existed before. For example, many semiconductor devices use transformers, but in a better high-frequency range. As a result, the device acquires the benefits of both devices.

One way of classifying power conversion systems is based on converting alternating current (AC) into direct current (DC) or direct current into alternating current. These properties are used in such power converters as inverter and rectifier.

Functions of converters:

- conversion,
- transformation and regulation,
- transformation and stabilization.

Rectifier – a device for converting AC power source into DC. They are used in urban transport systems, such as trams, trolleybuses. Inverter – the device, whose task is the inverse rectifier converting DC to AC power. Inverters are used in solar and wind-diesel power stations.

Inverters are divided into two classes: the slave, or dependent network and autonomous.

Dependent inverters.

Slave inverters convert DC power into AC to return it to the AC mains that is carried out the transformation inverse rectifier.

Stand-alone inverters.

Stand-alone inverters are devices that convert direct current into alternating with constant or variable speed and run on stand-alone (not connected to AC power) load.

By the change in level voltage converters are divided into voltage stabiliser, linear regulator, transformer or autotransformer, voltage converter, voltage regulator. This equipment is used in various systems of electricity: atomic power station, solar power plant, wind power station, hydro power plant. And the final classification is based on the change in frequency. They are called variable-frequency transformers or converters of frequency. Frequency converters are used in the DC drive.

Power converters play an important role in the electric power industry and in the DC/AC drive. Thanks to the power converters, mankind has made a big step forward in its development and improved our lives.

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