Gas & Steam Turbines in the planned Environmental Goods Agreement

Gas & steam turbines are a technology for generating thermal power in the form of electricity and/or heat or mechanical energy. They are independent from the use of a specific primary fuel and are used in connection with many renewable energy sources.

Gas turbines

All gas turbines and related parts (**84.11.82**, **84.11.99**) are decisively contributing to a greener energy system.

The split within the customs code is made at 5,000 kW. Below these 5MW there is only a very specific limited global market, while the majority of gas turbines, including smaller units, are above 5MW. No environmental rationale can justify a split in size classes for gas turbines

Smaller gas turbines (however in most cases above 5 MW) are often used in cogeneration applications, generating heat & electrical power at the same time. Cogeneration is regarded by the European Commission as a technology which should be promoted due to its high overall energy efficiency. Cogeneration is used in district heating as well as industrial applications with a high demand for process heat.

Larger gas turbines, on the other hand, are able to reach the highest energy efficiency levels for exclusive electricity generation. The high efficiency leads to lower primary energy needs and low carbon emissions. From an environmental viewpoint, it therefore makes no sense to exclude larger gas turbines from the list of environmental goods.

Applications are different but the result is the same for both categories: new gas turbines are extremely energy efficient and flexible in operation, allowing quick adaptation to volatile energy needs and, by this, avoiding the generation of excess electricity or running on idle.

These turbines can be run with e.g. biogas as well as hydrogen and other carbon-free or low-carbon gases.

An example of very high import duty: China has an import duty of 35% on gas turbines and an additional VAT of 17%, clearly leading to a competitive disadvantage of the imported technology.

Steam turbines

Steam turbines (**84.06.81**, **84.06.90**) are a CO2 neutral technology. They convert steam, generated from whatever source, into kinetic energy and with the help of rotary generators into electrical energy
One key application is their use in connection with gas turbines as “Combined Cycle Gas Turbines” (CCGT). In such power plants, the waste heat of the gas turbine is recovered and used to generate steam and run the steam turbine. This contributes to increased, very high energy efficiency levels.

Renewable energy plants like biomass, geothermal or concentrated solar power (CSP) plants all use steam turbines as their key component to generate electricity from the heat they create. Also, waste heat from industrial processes in energy intensive industries (glass, cement, chemicals, steel) is often transformed into electricity by using a steam turbine.

The intention to differentiate steam turbines in those environmentally valuable applications from steam turbines which are used e.g. in coal-fired or nuclear power plants should not be done at this level, as the steam turbine technology is mainly the same. Also, the split in size classes does not help, as CCGTs or CSP plants normally use large steam turbines.

In case of a need to split between power plant types, this should be done by looking at the source of the steam, i.e. the combustion technology (eg.g. boilers), as differentiator instead of the steam turbine.

EUTurbines Position on Gas Turbines in the planned Environmental Goods Agreement

EUTurbines is the European association of gas and steam turbines manufacturers employing more than 70,000 people across Europe with a turnover of around 25 billion Euros. Our members are Ansaldo Energia, Doosan Skoda Power, GE Power, MAN Diesel and Turbo, Siemens and Solar Turbines.

The World Trade Organization is currently negotiating a comprehensive agreement to facilitate trade of environmental goods. The Environmental Goods Agreement (EGA) would accomplish this through the reduction of tariffs on certain products deemed important for the protection of the global environment and the reduction of greenhouse gases and other harmful emissions. At the present time, it is uncertain whether gas turbines should be included within the scope of such an agreement. As part of that debate, negotiators are likewise considering whether gas turbines that fall under a certain capacity range (e.g. <5 megawatts of generation capacity) should be included.

There are compelling reasons to include all gas turbines, regardless of capacity range, as well as the matching alternators in the EGA. Gas turbines and related parts (**84.11.82**, **84.11.99**) in combination with the matching alternators (**85.01.61, 85.01.62, 85.01.63, 85.01.64**), are an essential solution for a decarbonised energy system. In the short and medium term, they ensure the security of electrical supply in a system with growing share of intermittent energy from wind and sun. Their high efficiency, low carbon emissions, and ability to operate on a variety of fuels are a necessary component of any strategy to decarbonize the global energy sector. In the longer term natural gas could be replaced by biogas and carbon-free hydrogen – long-term investments in gas-fired power plants will therefore not become stranded assets in a carbon-free energy system. As a consequence, gas turbines – regardless of the size – must be included in the EGA product list.

Turbines: the natural complement for intermittent renewables

A major challenge of future energy systems stems from an anticipated high share of variable renewable energy from wind and sun in the global energy mix. Gas-fired power plants of all sizes and in differing applications and configurations are needed to provide flexible backup power during periods when wind and solar power are insufficient to meet demand. While battery and other storage solutions may help to provide this flexibility sometime in the future (with considerable capacity, dynamics, cost and environmental challenges still to be solved), gas-based power generation (using natural gas as well as other fuels, like hydrogen or biogases) can facilitate the further integration of highly intermittent renewable energy sources without endangering the security of supply.

Gas-fired turbines provide a high degree of flexibility among generation technologies, allowing quick adaptation to volatile energy needs. Simple cycle applications (with a gas turbine only) can start in 5-10 minutes and some combined-cycle applications have proven start-up[1] times of as little as15 minutes.

Decarbonising the world's economies

In Europe, coal accounts for only 26% of EU's power mix but is responsible for 80% of the total power sector's CO_2 emissions. A shift from coal-fired power plants to gas-fired combined cycle (CCGT) plants would reduce emissions of the power sector by 45%.

According to IHS Energy, replacing all coal and oil-fired generation globally to best performing CCGTs would cut emissions by 58%, reduce the world's yearly carbon budget by 15% or about 5 Gt CO2/year.

Gas-fired CCGT have the best emissions performance for plants operating on fossil fuels, emitting only about 330 kg CO_2/MWh. Hard coal and lignite, which still make up more than 40% of the global electricity mix, emit two to three times as much. Some older lignite plants emit even more than 1.2 tonnes of CO_2/MWh. This is nearly four times as much as the best performing CCGTs.

Providing high energy efficiency

Gas turbines, used as basis for combined cycle processes (CCGT), are highly efficient, leading to power plant efficiency levels[2] of more than 61%. Just this year, two new European-designed and manufactured combined cycle plants entered into commercial operations in France and Germany setting new world records in efficiency and emissions reduction[3]. The efficiency of coal-fired power plants is much lower, reaching levels of 34% on average for the global existing fleet. Nuclear power plants have an efficiency of 33 - 36%.

Such high levels of efficiency are reached thanks to the combination of a gas turbine in tandem with a steam turbine. In such configuration, the waste heat from the combustion in the gas turbine is not released to the environment, but used to generate pressurized steam routed to a steam turbine, which generates extra power, producing up to 50% more electricity from the same volume of fuel, compared to a traditional simple-cycle plant (with a gas turbine only).

The sector is committed to elevate efficiency rates even further – aiming to break the 63% level by 2020. Improving the efficiency of the average gas turbine fleet by 1% saves more CO_2 than 250 GW solar PV replacing gas power (the cumulated global capacity of solar PV was 220 GW in 2015); this clearly underlines that highly efficient CCGT are in addition to renewable energy sources a strong driver for decarbonisation.

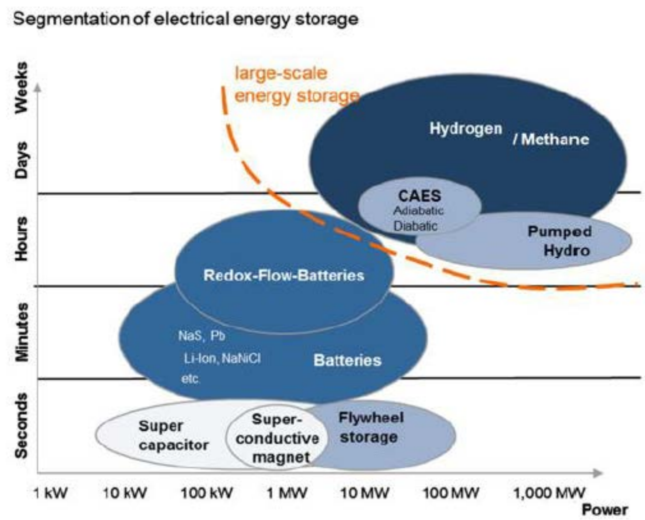
Another way to achieve even higher levels of efficiency is through cogeneration, regarded by the European Commission as a technology which should be promoted due to its high overall energy efficiency. In cogeneration, the heat generated by gas turbines is used for district heating or industrial applications with a high demand for process heat or cooling. By this, the overall combined efficiency can achieve levels above 85%. Gas turbines like the one at Öresundsverket[4] provide electricity and up to 40% of Malmö's heating requirement via district heating. In industrial plants with a high demand for process

[1] Start-up: ability of the power generating facility to move within a specified time from a defined idle state to a synchronous operation with a defined power output.
[2] The efficiency of a power plant is defined by the ratio between useful electricity output from the generating unit, in a specific time unit, and the energy value of the energy source supplied to the unit, within the same time.
[3] https://www.edf.fr/groupe-edf/producteur-industriel/carte-des-implantations/centrale-a-cycle-combine-au-gaz-naturel-de-bouchain/presentation and https://www.swd-ag.de/ueber-uns/erzeugung/neues-gaskraftwerk
[4] http://www2.eon.se/Uniper/Produktion-av-el-gas-varme-och-kyla/Kraftvarme/Vara-kraftvarmeverk/Oresundsverket

steam, heat or cooling like chemical parks, steel plants, paper and textile industry CCGTs efficiently provide this – sometimes even all three – in addition to electricity.

Key technology for seasonal storage (Power-to-Gas)

A high share of intermittent renewable energy sources will also require energy storage, an additional source for system demand/load balance. But batteries and other power storage systems will not be able to store the enormous amount of electricity needed over a longer period of time (seasonal storage). Water storage is geographically limited.



Excess energy generated from renewables can be stored as hydrogen – for instance via electrolysis – and be used when needed, contributing to the flexibility that the energy mix of the future requires. Green hydrogen produced from excess renewable energy sources via electrolysis will be a key component of a future electricity system dominated by renewables. Hydrogen (or methane produced using hydrogen and carbon dioxide) via Power-to-Gas is the only viable approach to store electrical energy of more than 10 GWh over longer time periods. In its 100% Renewables Scenario, Greenpeace expects global hydrogen-based power generation to amount to more than 2200 GW by 2050, covering all power generation beyond renewables.

In 2014, Germany was unable to utilize 1.4 GWh of potential electricity from renewables due to curtailment measures as a result of grid constraints and demand/supply mismatch. This number is expected to increase with a growing share of renewable energy sources in the power mix and the excess energy will provide a renewable feedstock for gas turbines.

As an example, the “Energiepark Mainz” produces hydrogen via electrolysis using renewable power and feeds it into the city’s gas grid. Currently, the share of renewable hydrogen fed into the grid reaches 10%. Hydrogen is currently used for heating and direct use, but an increased use of hydrogen to fire gas turbines is expected, once its availability increases.

Using renewable fuels

Gas turbines can be fueled with a variety of fuels. This includes not only natural gas or hydrogen, but also other **renewable based synthetic fuels**, such as biogas or synthetic methane.

During their lifetime gas turbine combined cycle solutions offer the opportunity to be upgraded to renewable fuel usage, making the shift to a more CO_2 free power generation also attractive for the operators, once the supply with renewable fuels is available for the specific plant.

Contribution of all sizes

The majority of gas turbines, including smaller units, are above 5 MW. Even small gas turbines deriving from aircraft engines are in the range of up to 50 MW and higher, while large gas turbines exceed 500 MW. No environmental rationale can justify a split in size classes for gas turbines.

Smaller gas turbines (however in most cases above 5 MW) are often used in cogeneration applications, generating heat & electrical power at a very high overall efficiency as noted above. They are often applied in environments where the challenges for alternative solutions are very high (e. g. oil & gas production).

Larger gas turbines, on the other hand, are able to reach the highest energy efficiency levels for exclusive electricity generation. The high efficiency leads to lower primary energy needs and low carbon emissions. From an environmental viewpoint, larger gas turbines must be part of the list of environmental goods.

Maintaining the leading role of European companies

The European market for new gas-fired power plants is currently depressed due to very low wholesale prices, inadequate CO_2 pricing and high investment uncertainty. The potential to sustain growth and innovation is driven by markets outside Europe. Trade is, therefore, the key element to sustain a vibrant global market for European suppliers of gas power plant equipment and an opportunity for Europe to keep its technology leadership by supporting its domestic champions in increasingly price-driven global markets.

The European manufacturers are in some cases in a competitive disadvantage due to imports duties imposed to them. For instance, China has an import duty of 35% on gas turbines and an additional VAT of 17%. The inclusion of gas turbine technologies in the Environmental Goods Agreement would help European manufacturers overcome such situations. Most importantly, they are essential to any global strategy to reduce carbon emissions in a cost-effective manner while maintaining the ability to provide safe, affordable, reliable and clean electricity to the world's people.