**Market conditions & policy framework**

**P. Jansohn**

Comments from the PB meeting

P. Jansohn:

* keep the structure
* mention the three Ds in the text: Decentralisation, Decarbonisation, Digitalisation.

A. Sayma:

* adapt the title to *Market conditions & policy framework*, as *political* would refer more to politics than policy.

A. Sayma:

* The power range of micro gas turbines must be defined.

U. Simeoni:

* The range defined in the MGT Technology Summary could be used.

### Operating conditions of gas turbine based power plants

G. Terzer:

* mention *operational flexibility* in this section.

M. Ruggiero:

* a differentiation should also be made between *centralized* and *decentralized* power generation
* add a sentence on *hybridization*.

### Decentralised electricity production

O. Bernstrauch:

* mention the *2050 ETIP SNET vision*, or even refer to it.

Energy systems are undergoing fundamental changes across the world, driven by three key trends: **Decarbonisation**, **Decentralisation** and **Digitalisation**. Decentralised energy generation, intelligent power grids, overall system integration, unconventional fuels and of course, renewable energy sources (RES) are at the top of the energy agenda. On a global scale the pressing needs to cut CO2 emissions as well as local air pollution is resulting in an accelerated phase-out of fossil fuel (especially coal fired) power plants and in strongly increased investments in clean energy technologies. Digital solutions are being developed and become available on a widespread basis, transforming energy systems to make them smarter, more reliable, more interconnected, safer and, above all, more efficient.

Despite the renewable boom, it is foreseen (e.g. by the International Energy Agency (IEA)) that conventional gas-fired power generation will continue to play an important role to provide a reliable and cost effective, dispatchable power source to respond to peaks in demand and when intermittent renewable sources are not available.

This chapter outlines topics which have a strong influence on gas turbine technology development, gas turbine sales and gas turbine deployment and use. It is our intention in this report to highlight technology development opportunities that will contribute to reaching the global energy and climate targets.

## Economic environment for gas turbine markets (oil & gas, power generation)

After some years of depressed price levels for crude oil (at times as low as …), prices have recovered somewhat in 2017 to reach levels back up in the range of $70-80 per barrel. The ups&downs have had immediate effects on the exploration of shale (and other unconventional) gas resources and general investments in the oil & gas business. With the oil price recovery the situation has eased somewhat, even though the investment levels still remain significantly lower than in the pre-depression period (before 2014). The availability of shale gas (mostly in the USA) in huge quantities, combined with strongly enhanced worldwide distribution of LNG, and the general diversification of the energy mix have already changed the global energy landscape significantly, and this megatrend will definitely continue.

The unfavourable conditions of the European gas turbine market for power generation has also a certain influence on the gas turbine technology development for oil & gas applications as synergetic development effects vanish. This has shown already to have significant implications on the gas turbine manufacturing industry, leading to a wave of mergers & acquisitions, as well as major divestment decisions.

**Decarbonization of energy supply systems**

The United Nations Framework Convention on Climate Change (UNFCCC) COP21 Paris Agreement entered into force on the 4 November 2016 have given new strength to policies on climate change and the energy transition to a low-carbon energy system. However, according to the International Energy Agency (IEA) projections for Organisation for Economic Cooperation and Development (OECD) economies, the average CO2 intensity of electricity needs to fall from 411 grams per kilowatt hour (g/kWh) in 2015 to 15 g/kWh by 2050 to achieve the goal of limiting the global increase in temperatures to 2°C. While many studies conclude that this is both technically and economically feasible, reaching this goal calls for new power market designs.

The roles of Carbon Capture and Storage (CCS) and low CO2 emission technologies need to be considered in order to achieve CO2 mitigation goals. However, for the moment, there is no market pull for the reduction of CO2 emissions in Europe as the EU Emission Trading System (ETS) does not yet incentivise the investments needed in the sector.

The EU has some of the most ambitious carbon emission reduction targets in the world with the agreement on the new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for 2030.

**Targets for 2030**

* A 40% cut in greenhouse gas compared to 1990 levels;
* At least a 27% energy efficiency increase(target to be reviewed by 2020 with a proposal for 30%;
* At least a 27% share renewable energy consumption;
* 15% increased energy interconnections between member states by 2030.

**Policies for 2030**

* A reformed EU emissions trading scheme (ETS)
* New indicators for the competitiveness and security of the energy system, such as price differences with major trading partners, diversification of supply, and interconnection capacity between EU countries
* First ideas on a new governance system based on national plans for competitive, secure, and sustainable energy. These plans will follow a common EU approach. They will ensure stronger investor certainty, greater transparency, enhanced policy coherence and improved coordination across the EU.

These targets and policies aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas (GHG) reductions target (long-term goal of reducing GHG emissions by 80-95% when compared to 1990 levels).

**Operating conditions of gas turbine based power plants**

Gas turbines are a viable and secure option both economically and environmentally for power and heat generation. In future energy scenarios renewable energy resources (wind, solar) will play a much more significant role than in the past. As these resources do exhibit a weather dependent fluctuating non-controllable energy source (for electricity production), it is indispensable to have additionally controllable electricity production technologies available which can compensate the variable electricity production from wind & solar, in order to keep the electricity network stable i.e. to maintain the balance between production and consumption of electricity. Even with large electric storage systems becoming economically viable in the future, flexible controllable electric power generation technologies, like gas turbine power plants, will be still required to provide sufficient generation capacity necessary to maintain grid stability and security of supply for electricity.

**Flexible gas turbine based solutions**

The increasing share of intermittent Renewable Energy Sources (RES) is changing the pattern of energy generation. In the short term, (medium size (<100 MW)) GTs and Micro Gas Turbines (MGT; < 1 MW) can help the integration of RES into the energy system by absorbing the fluctuations of the RES in the grid as well as by using low or CO2 neutral fuels like natural gas, biogas, off-gas from industrial processes or landfill gas. In the long term, hybrid GT and MGT applications that can assure high utilisation of RES and ensure security of energy supply due to the fuel flexibility if needed. This will provide significant contributions to a decarbonisation of the energy system and to the full deployment of RES in the grid.

Rapid improvements in low-carbon, demand-response and storage technologies can lead to a smarter, more efficient and more secure system, but achieving their full potential requires new approaches to policy and regulation. “Power-to-gas“ technology could provide significant amounts of hydrogen (H2) and/or synthetic natural gas (SNG) making it necessary to adapt gas turbines for the future use.

**Decentralised electricity production**

We are currently moving from a highly-centralized to a more decentralized energy system relying on more distributed generation, energy storage and a more active involvement of consumers through demand response. If regulatory regimes, market design and system operation end up lagging behind technology deployment, the result may undermine electricity security and, ultimately, the low-carbon transition itself.

In this context, small scale power plants and MGT with micro-CHP can play a substantial role in supporting renewables and meeting the challenges of the modern electricity grid. MGT technology is able to support renewables at the system level in Europe and can realise multiple benefits in form of demand response solutions. They can operate as a stand-alone unit in off-grid operations or grouped in farm arrangement generating higher output and providing electrical power support to a local microgrid. As such, small turbines offer hybridization solutions with renewable energy sources, flexibility in operations, fuels and grid connection, resilience through modularity, as well aslower emissions than most alternative generation systems. All these features are honoured in the Vision 2050 of the European Technology and Innovation Platform for Smart Networks for Energy Transition (ETIP SNET) which outlines integrated smart network schemes for the ongoing energy system transition.

