Spotlight on: Energy Efficiency and Turbines

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Why turbines are important to reach Europe's energy efficiency targets?

Energy efficiency is an important building block of Europe's climate and energy strategy, as the recently increased efficiency targets demonstrate. The idea is simple: more efficient energy use will lead to a decrease in energy consumption and wastage.

While the debate focuses on an improved use of energy in private households – from A++ fridges to a better insulation of houses - it is crucial to go beyond this small scale. EUTurbines invites you to consider the important role of gas and steam turbines in energy efficiency, highlighting two core applications:

- Energy efficiency in industry: Reducing the high energy consumption in industrial production processes via the utilisation of waste heat and waste gases and therefore avoiding pollution and increasing energy efficiency.

- Efficient power generation: Making power generation use the primary energy (regardless if it is renewable, nuclear or fossil) more efficient also reduces our need to consume primary energy and thus increases energy efficiency.

Energy efficiency in industry

Industrial processes are often energy intensive. The production of chemicals, steel, paper cement and many other products needs a lot of energy, mainly heat. At the end of these industrial processes, lower grade heat will usually be emitted to the environment.

Steam turbines recovering waste heat

Today	Areas for further improvement
Steam turbines are well proven products to partially recover industrial waste heat and to convert it into rotating energy (e.g. for mechanical drives) or via a generator into electricity. In steam turbines, steam at relative high pressure expands by passing the turbine blades. This way, the kinetic energy of the steam will be converted into mechanical work that drives the turbine rotor. This application is based on a traditional	One of the promising research areas are innovative steam turbine solutions that allow a better utilisation of waste heat. Innovative steam turbine solutions are based on advanced thermodynamic cycles, like the Organic Rankine Cycle or Supercritical CO_2 cycles. The idea behind this is to use new working fluids and advanced components that open-up opportunities to recover waste heat down to lower

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thermodynamic principle, the so-called Rankine Cycle. The operation range of this cycle is limited by the available temperature difference and the steam characteristics. Already today a lot of energy intensive industries use steam turbine applications to covert waste heat into useful energy. However, should the waste heat be outside the typical temperature range of the Rankine Cycle, it is often economically not attractive for industry to use the waste heat.	temperatures. Depending on the site conditions and steam parameters, different cycles can be combined to extend the operation range and to better utilise the waste heat. While the principles are already known, it will need some efforts to adapt the idea, develop the components and test it in operational environments. A typical challenge for European research projects.

Gas turbines processing waste gases

Today	Areas for further improvement
Gas turbines are an excellent solution for the processing of waste gases recovered from industrial processes used in the steel industry, refineries and others. Admixing those gases to the fuel gas reduces the fuel consumption and often reduces emissions. A variety of waste gases can't currently be processed to a large extent, as their composition does not allow an easy burning due to low heating value or the composition of the gas (e.g. sulphur). Today these gases are often filtered and flared.	Making use of so far unused waste gases requires e.g. improved turbine parts that can better handle aggressive components of these gases, causing corrosion and further damage. Developing turbines that can make use of a bigger range of industrial waste gases, like hydrogen, ammonia or sour gases, in an economically, safe and environmentally friendly way would further improve the efficiency of industrial processes. Fuel pre-treatment is an option to further extend the range of gaseous fuels.

Efficient power generation

Efficiency in power generation, referring to the conversion rate of primary energy input to the energy output, is an often-neglected area for improving the overall energy efficiency. Technology providers have achieved considerable improvements for thermal power generation.

Turbines in combined cycle plants and cogeneration

Today	Areas for further improvement
Modern combined cycle power plants, combining a gas turbine with a steam turbine, achieve efficiencies of over 60%, by far the highest efficiency in thermal power generation. In such a plant, the exhaust heat resulting from the operation of the gas turbine is directed to a heat recovery steam generator, that provides the steam driving the steam turbine. The principle of cogeneration even allows for efficiencies of over 90%. Cogeneration is the	In the past, combined cycle power plants were mainly used for continuous operation at optimal conditions. Today and even more in the future, turbine-based power plants will run in a more flexible scheme to provide the necessary back-up power to the growing share of energy from wind and sun in Europe. This implies that turbines need to be operated in a more flexible manner: quickly starting up and shutting down and constantly adapting to cover the gap between the supply of these variable renewables and

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combined use of heat and power from the power plants. This principle is used in two main applications: power plants operating in district heating systems and industrial power plants.

As mentioned, many industrial processes like the paper production, refineries or chemical plants require at the same time electricity but also heat or cold. They are ideal for the use of combined heat and power (CHP) generation, also called cogeneration – or, if used for power, heat and cold generation simultaneously: trigeneration.

demand. Maintaining a high efficiency despite this "cycling" is a major challenge for the sector.

Further areas for improvement:

- Through downsizing the technology could also become an economically attractive energy solution for smaller industrial or commercial applications

- The combination with renewable generation technologies in hybrid solutions and the use of renewable gases to fully decarbonise the process are development challenges allowing at the same time decarbonisation and increased efficiency.

Gas- and Steam Turbines are major enablers for higher energy efficiency

Investing in the further development of gas and steam turbines and their applications will help reaching Europe's ambitious new energy efficiency targets. Avoiding waste heat and gases from industrial processes significantly contributes to the improvement of a circular economy.

Regarding power generation, the political discussion seems to sometimes neglect the benefits and potential of energy efficiency: CHP turbine applications are the most efficient energy conversion technology. Switching to a pure electrical heating system would be less efficient.

Instead Europe should support the use of more and more renewable gases in turbine-based cogeneration, allowing a clean but at the same time highly efficient provision of energy. To drive the turbine technologies towards low carbon power generation, significant additional R&D activities are necessary.

About EUTurbines

EUTurbines is the European industry association representing all leading gas and steam turbine manufacturers in Europe. The member companies represent a business volume of 25 billion Euro and directly provide jobs for 70,000 employees in Euro

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