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Toward Renewable Fuels

Dispatchable green and flexible distributed power

Europe is aiming for carbon neutrality by 2050. This global transition is centered on the transformation from a largely fossil-based to a low or even zero-carbon energy system. This implies strong growth of well-known but volatile renewable energy sources (RES) such as wind and solar PV. But maintaining a stable and steady energy supply requires a flexible backup solution, which best can be provided by dispatchable gas power plants, ideally with flexible gas engines running on renewable gas.

- **About 6,000 INNIO Jenbacher gas engines are running on biogas and biomethane.**
- **Hydrogen, green synthetic methane and methanol are the future fuels for gas engines.**
- **Gas engines are an ideal technology for natural gas as well as for 100% renewable fuels.**

What has been achieved so far:

Highly efficient cogeneration of power, heat and/or cold (CHP) is the typical application for gas engine solutions provided by INNIO Jenbacher.

More than 80% of the 12,000-plus Jenbacher gas engines installed in Europe are running in CHP application. A gas engine CHP system typically achieves about 30% primary energy savings compared to the separate generation of power and heat and can reduce specific carbon emissions by about 50% when replacing the heat provided by a gas boiler.

Most of the newer CHP installations in Europe are combined with heat storage, which allows the decoupling of power and heat supply while still achieving high fuel utilization. These gas engines mainly run when wind and solar are less available or the electricity demand is high. This makes gas engine CHP power plants a very flexible and highly efficient power generation solution that complements the volatile RES.

Biogas and biomethane are the most common carbon-neutral gases used for gas engines.

INNIO Jenbacher has about 6,000 biogas engines installed in Europe that are converting raw biogas and biomethane into electricity and heat. Biogas is one of the most common dispatchable and reliable RES, and at the same time it can be used for distributed power and heat generation at the point of use.

INNIO's mature and efficient gas engine technology can be used for continuous or flexible operation with raw biogas from crops, agriculture, industrial and municipal waste, landfills or sewage sludge.

Biomethane is raw biogas upgraded to natural gas pipeline quality. It can be injected into the natural gas system without limitations and is therefore an ideal fuel for gas engines and any other end consumer of gas. Because biomethane is injected into the gas network, it can participate in the existing gas storage system and therefore can be considered a renewable energy that can be stored.

What are the green fuels of the future?

Green synthetic methane—the ideal addition and replacement for natural gas

Synthetic methane is produced with methanation from green hydrogen. Because it has the same physical properties as natural gas, it can be injected into the natural gas system without limitations or modification on the gas infrastructure. All end consumers of gas, including gas engines, can continue to run reliably with current optimized performance and emission standards.

Green methanol—a **carbon-neutral** fuel for gas engines

Like synthetic methane, methanol is produced from green or blue hydrogen. Widely used as a chemical base product, methanol is liquid and has the advantage of being easily storable and transportable. Apart from its use in stationary engines, it can be used for land or sea transport, and it is a perfect alternative for areas without a connection to the gas grid. Islands, microgrids or remote areas that today rely on diesel or heavy fuel easily could be transitioned to methanol. Gas engines could run on methanol with some modifications, and the same infrastructure could be used without major changes. The switch from heavy fuel and diesel to a carbon-neutral solution with methanol is a very promising alternative for many remote areas around the world.

Green hydrogen—a **carbon-free** fuel

Hydrogen can play an important role in replacing fossil natural gas. It is carbon-free and can be used as a fuel for gas engines. Over the next decades, the further growth of wind parks and PV installations could provide green hydrogen via power-to-gas. Although different than natural gas, hydrogen can be transported via pipelines and tanks, and to some extent existing natural gas infrastructure could be used. Finally, hydrogen can be used in different sectors, such as industry, heating, transportation and power generation.

INNIO Jenbacher has been operating gas engines with high hydrogen content for many years. Steel gases and synthetic gases with high hydrogen content of up to 60%(v) are in operation. Newer projects use local hydrogen blending to natural gas up to 60%(v). There is high flexibility in admixing hydrogen to natural gas fuel for Jenbacher gas engines. In the future, gas engines will run on 100% hydrogen. By 2021 the first Jenbacher gas engine running on 100% hydrogen should be available.

Hydrogen also could be injected into natural gas pipelines. In this case it is essential to have the information about hydrogen content available to the end consumer running the gas engines. INNIO Jenbacher recommends having available a signal about hydrogen content in pipeline gas, especially if it reaches a content above 5%(v).

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What is important to know:

Retrofits for changing from natural gas to:

Biomethane or green synthetic methane
› no retrofits required

Green methanol
› field upgrades required and will be available when needed

Green hydrogen locally admixing
› field upgrades required depending on the hydrogen content and will be available

Green hydrogen as part of pipeline gas
› field upgrades could be required above 5%(v) and will be available

Pure green hydrogen
› field upgrades required and will be available when needed

It is important to recognize that while Jenbacher gas engines initially may be installed for natural gas operation, they can be converted to run on a variety of alternative fuels.

Green gas cogeneration and >90% fuel utilization

Jenbacher gas engines can achieve 90% and more fuel utilization when installed as CHP applications. This saves about 30% of primary energy input compared to the separate generation of power and heat.

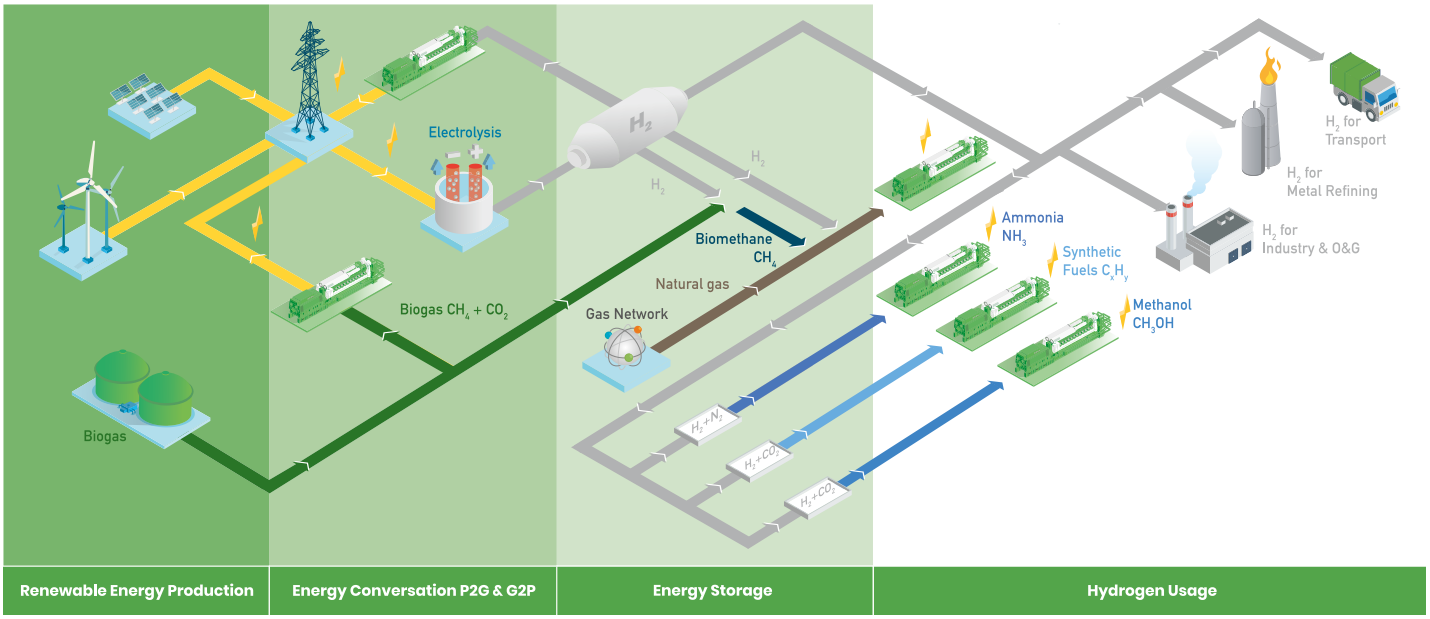
As renewable fuels are more expensive than natural gas and there is a scarcity in availability of renewable fuels, it is even more important that we reduce primary energy consumption as much as possible. Combined with the installation of heat storage systems, gas engine CHP plants can operate very flexibly. Gas engine CHP plants are, therefore, a dispatchable renewable energy source (dRES) and an ideal complement to volatile RES such as wind and solar.

Conclusion:

Using renewable gases in gas engine power plants is less costly than a purely electric energy system with its need for a massive electricity grid expansion and very high storage capacities to ensure sufficient backup. While we as an industry can provide the technology, policy needs to ensure that the renewable fuels to support the ongoing transformation of the energy system become available – may they be biomethane or may they come as synthetic methane, green methanol or even as hydrogen from renewable sources.

Gas engines are an excellent technology providing affordable distributed power and heat with high fuel utilization rates above 90% and the ability to run on a wide range of carbon-free or carbon-neutral fuels, making them a dRES.

A predictable roadmap is needed to provide a reliable framework for technology development and for creating the necessary trust for investors. Such a roadmap should include targets for replacing shares of the fossil gas supply with renewable gases. These targets, similar to the renewable electricity target, should be accompanied by national plans detailing how to achieve them. In parallel, technical standards and regulatory frameworks must be adjusted and synchronized with the implementation roadmap in due time. It is important to synchronize adaptation of standards and frameworks to the actual availability of natural gas and hydrogen mixtures in pipeline gas, and the differing readiness of various sectors including industry, transport, heating, power generation etc. Otherwise this could lead to unnecessarily high costs and less energy efficiency.



INNIO* is a leading solutions provider of gas engines, power equipment, a digital platform and related services for power generation and gas compression at or near the point of use. With our Jenbacher* and Waukesha* product brands, INNIO pushes beyond the possible and looks boldly toward tomorrow. Our diverse portfolio of reliable, economical and sustainable industrial gas engines generates 200 kW to 10 MW of power for numerous industries globally. We can provide lifecycle support to more than 52,000 delivered gas engines worldwide. And, backed by our service network in more than 100 countries, INNIO connects with you locally for rapid response to your service needs. Headquartered in Jenbach, Austria, the business also has primary operations in Welland, Ontario, Canada, and Waukesha, Wisconsin, US.

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