

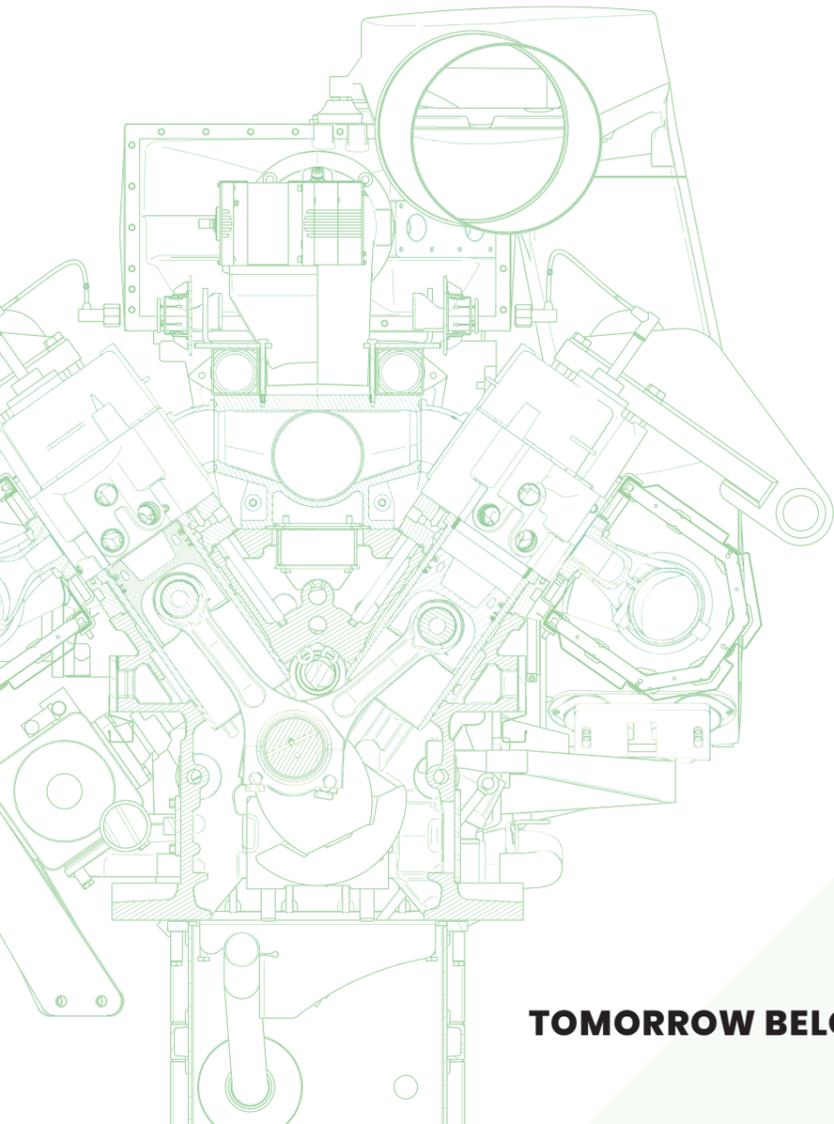
JENBACHER

THE GREEN SIDE OF COAL.

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 life cycle support to the more than 50,000 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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Jenbacher J420



Jenbacher coal mine solutions from INNIO – your gas engine expert

TOMORROW BELONGS TO THE BOLD.

COAL MINE GAS AS ENERGY SOURCE

Coal mine gas develops during the geochemical conversion of organic substances to coal (carbonization). It is present in fissures, faults and pores of coal seams and as adsorbed gas on the inner surface of coal and neighboring rock. Worldwide, many underground mines with a certain rank, permeability and location of coal strata can be considered gassy.

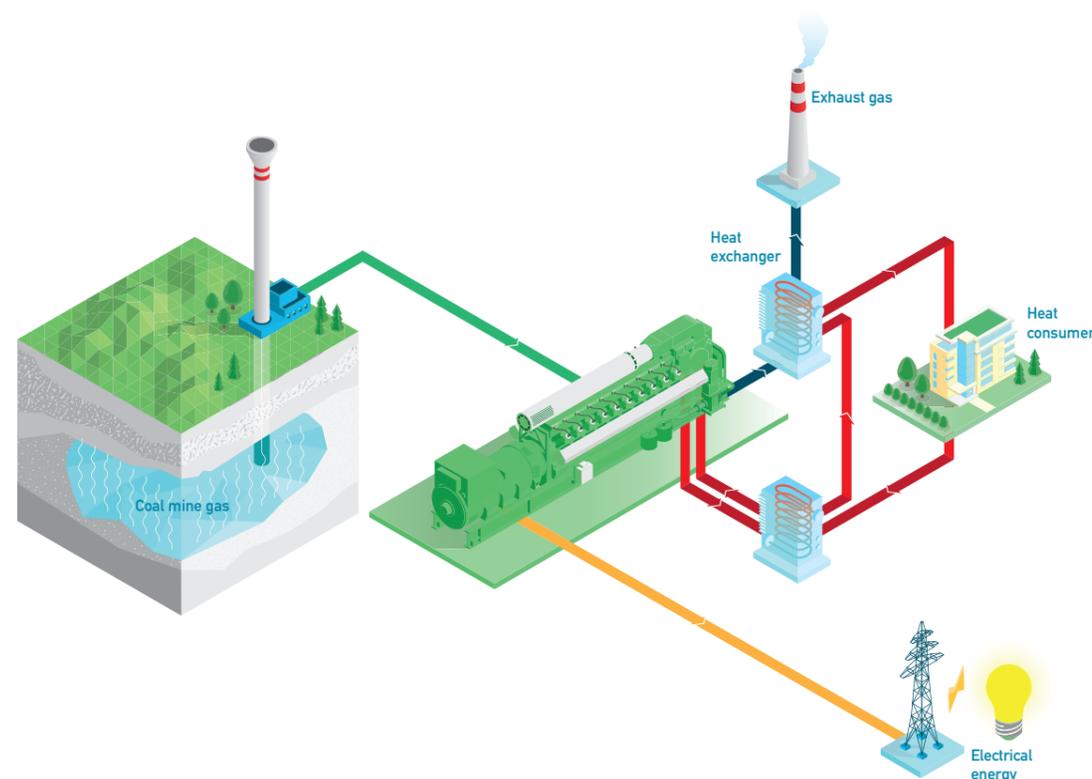
MINE DEGASIFICATION

Coal mine gas is a problematic phenomenon associated with pit coal mining since the gas and air can form explosive mixtures. If the ventilation system is not able to prevent such risk, mines need to be degasified further to keep up worker safety. This can be achieved through the installation of various types of gas suction systems prior, during and also after coaling. In addition to increasing safety standards, capturing coal mine gas provides a modern energy source and also helps to mitigate greenhouse emissions, especially in countries with large coal production. If not captured, the methane-laden mine air is vented to the atmosphere by exhaust fans.

DIFFERENT TYPES OF COAL MINE GAS

Dependent on the capturing time and method, three different types of coal mine gas can be identified:

- **Coal Bed Methane (CBM)**
So-called Coal Bed Methane or Coal Seam Gas (CSG) from unmined coal beds consists of more than 90% methane and can be harvested independently of coal mining in some locations. The gas composition is very stable, meaning that the gas can be fed either directly into the natural gas network or a gas engine.
- **Coal Mine Methane (CMM)**
Coal Mine Methane, a methane/air mixture released during active coal mining, must be vented and captured for safety reasons. CMM typically has an oxygen content from 5% to 15%. The methane content ranges from 25% to 60%. However, the methane/air proportion can change suddenly, thus complicating its use in gas engines.



- **Abandoned Mine Methane (AMM)**
Even after coal mines are shut down, coal mine gas continues to be released. Coal mine gas from abandoned mines typically contains no oxygen, but a considerable amount of carbon dioxide (3–20%), and its composition changes slowly compared to CMM. The methane content ranges from 40% to 80%.

- Alternative disposal of a problem gas while simultaneously harnessing it as an energy source
- Increased worker safety due to installation or refurbishing of gas suction system
- Additional revenues from feed-in tariffs or through carbon credit projects

Investments in the gas suction system or gas supply to reach a certain coal mine gas quality and stable gas flow do pay off. In combination with a highly efficient and specialized cogeneration unit, this setup will optimize the profitability of coal mine gas power generation projects. For coal mine gas projects that include a carbon credit trading scheme, not only does INNIO ensure the highest availability of its Jenbacher gas engines, but it also provides support for gas supply and conditioning, mitigation monitoring, carbon monetization, financing and more.

THE JENBACHER CONCEPT

Most of the larger underground hard coal mines provide a potential for Coal Mine Methane and Abandoned Mine Methane and can be effectively used for power and heat generation with gas engines. The sudden changes in the composition of coal mine gas from active mining (CMM) put greater demands on the engine design. INNIO* has developed a special gas mixing and engine control system that allows the efficient use of this gas down to a methane content of only 25%. Additionally, Jenbacher* gas engines are designed to operate on full load despite low gas pressure, high humidity, dust load and altitude.

The electrical energy generated can be used in the coal mine to meet electricity requirements or fed into the public power grid. The thermal energy can be used for heating purposes on-site or fed into a district heating system.

OUR COMPETENCE

The first Jenbacher systems using coal mine gas were installed in Germany and Great Britain in the early 1990s. Today, more than 380 units, with a total electrical output of about 900 MW, run on coal mine gas worldwide. Also in remote areas with critical frame conditions, the Jenbacher engines achieve maximum availability of 8,000+ operating hours per year.

These plants have the potential to generate about 7 million MW- hours of electricity a year – enough to supply about 2¹⁾ million EU homes. Generating this amount of electrical power with coal mine gas could save over 1,600 million cubic meters of natural gas a year. In addition, using coal mine gas in Jenbacher engines can reduce the release of methane into the atmosphere by about 85% compared to venting the gas, which corresponds to CO₂ savings of 24,000 tons²⁾ per year and MWeI.

ADVANTAGES

- Smooth operation despite fluctuations in gas pressure and methane content
- Overall efficiency of up to 90%, in the case of combined heat and power, and up to 44.6% in the case of power generation alone
- Compact units with lowest footprint requirement and dynamic weight per kW
- Basic design and support for gas conditioning if required
- Integrated methane measuring unit complying to UNFCCC specifications
- Enlarged engine control panel and extensive remote services
- Contractual Service Agreements

¹⁾ Based on average electricity consumption of households in EU, 2014, World Energy Council <https://wec-indicators.enerdata.net/>
²⁾ Based on 2017 global data on carbon density of power generation, IEA <https://www.iea.org/tracking/tcep2018/power/>