Sustainable Energy: Totally Integrated Automation for Biogas

With Totally Integrated Automation, Siemens is the only provider of a comprehensive line of products and systems for the consistent, profitable, and reliable automation and energy management of biogas plants.

Biogas is a renewable energy source with tremendous potential. A wide range of natural materials can be used for its production – for example, liquid manure, corn silage, sewage sludge, organic waste, straw, and wastewater. Biogas has a very good eco-balance in comparison with many other alternative forms of energy and is also very versatile. It is used as fuel in combined heat and power plants (CHPs) for producing electricity and heat, but it can also be processed and transferred to the natural gas grid.

For both plant engineering companies and plant operators, the economic aspects of biogas plants have top priority. With the implementation of modern automation technology, biogas plants can be operated efficiently and reliably. One key criterion in this context is the ability of the automation solution to be optimally adapted to different requirements and types of plants. It must also be scalable to allow the easy integration of later extensions. It must enable rapid, straightforward engineering because biogas plants are often built under extreme cost and time pressure. Finally, it must provide all the required functions, including instrumentation and drive technology, safety technology, and energy management, in a uniform environment.

Integrated, scalable, flexible

With Totally Integrated Automation (TIA), Siemens offers an ideal solution. The automation concept can be adapted to the plant size and process technology based on the structure, the quantity of I/Os, and the functionality required. The automation is based on hardware and software components from the comprehensive, versatile SIMATIC product line, the heart of which is the modular, scalable SIMATIC...
The Right Solution for Every Requirement

Based on a uniform system environment, automation solutions for every plant type and size can be implemented with Totally Integrated Automation:

+ **Automation of small-scale biogas systems:**
  Local control and operation with basic visualization but no process data archiving

+ **Automation solution for a medium-sized agricultural biogas system with 500 kilowatts of power:**
  Local control and operation with SIMATIC PCS 7 Box incl. visualization, and automatic archiving and reporting

+ **Automation solution for larger and industrial-scale biogas and biomethane plants:**
  Structured plant automation design as defined by plant units (e.g., biogas generation and biogas conditioning), or as main and subprocesses with a SIMATIC PCS 7 server or single-station system, also redundant

+ **Automation solution for industrial and municipal biogas plants:**
  Control and monitoring of one or several networked biogas plants with Web-based local operation using a SIMATIC PCS 7 client/server architecture

+ **Comprehensive instrumentation:**
  - SITRANS P relative, absolute, and differential pressure transmitters
  - SITRANS T temperature sensors and transmitters
  - SITRANS L systems for continuous and point level as well as interface measurement
  - SIPART PS2 positioner with state-of-the-art diagnostic functions
  - SITRANS F mass, ultrasonic, vortex, electromagnetic, and mechanical flowmeters for measuring mass and volume flow and media speed, density, and viscosity

PCS 7 distributed process control system. The products range from the basic controllers and Supervisory Control and Data Acquisition (SCADA) solutions for purely local process control to client/server architectures for the central control of several networked biogas plants, such as a sewage plant or waste processing plant in combination with a biogas plant, or a municipal network operating several biogas plants. All solutions make use of graphic configuration tools, a uniform engineering platform, integrated safety technology, and additional functions such as alarm and asset management. Because individual plant sections may also be classified as explosion protection zones, the Siemens portfolio for biogas plants also includes products and solutions for use in Ex areas, along with tools for the simple configuration of protection functions.

**Savings potential through plant optimization**

Siemens automation solutions are scalable and flexible, so new plants benefit from a short commissioning time and existing plants can be extended and modernized easily. The optimum interaction of all the implemented components enables fast commissioning and trouble-free, economical operation.

Aligned, single-source hardware and software as well as preconfigured, tested components ensure transparent investment costs and long-term economic success. All process instruments and automation and drive components are integrated into the systemwide diagnostics and are supervised continuously. Functions such as online monitoring and preventive maintenance increase availability and reduce operating costs for the entire lifecycle of the plant. Automatic archiving and reporting considerably simplify the operational analysis and documentation.

**Successful in practice**

A large number of plants already benefit from TIA. These range from smaller agricultural to large industrial biogas plants. Since 2008, one of the largest biogas plants in Europe, in Jessen, Germany, has produced electricity and heat as well as organic fertilizer as a by-product using silage and grain as feedstocks. Following expansion in a second building phase, 5.3 megawatts of power and 5.1 megawatts of heat will then be generated in four CHPs. The plant is equipped with Siemens drive and switching technology and the SIMATIC PCS 7 control system.

In a biomechanical waste treatment plant in Lübeck, biogas is generated from organic waste and sewage sludge. The gas technology of the plant comprises a gas storage facility, a compressor system, and two CHPs generating 1.9 megawatts of power and 2.3 megawatts of heat. Together with its long-term partner Haase Energie-technik AG, Siemens equipped the plant with drive and control technology.

The biogas plant in the Hoechst industrial park in Frankfurt, Germany, processes sewage sludge and organic waste for the production of biogas. The plant produces an average of 30,000 cubic meters of biogas per day, and about 4 megawatts of electricity and 2 megawatts of heat are fed into the heat and power supply system of the industrial park. The plant is controlled by SIMATIC PCS 7 and pump drive systems from Siemens.

**Info:**

[www.siemens.com/biofuels](http://www.siemens.com/biofuels)
The Right Drive for Biogas

Biogas production is a continuous process comprising areas that are classified as explosion protection zones. Accordingly, the drive technology needs to meet high demands with regard to reliability, availability, and safety.

Schmack Biogas, a full-service provider for biogas plants and biogas processing, uses compressors with proven Siemens 1MJ7 Ex protection motors in both gas purification and transfer stations. These motors are very robust and perfectly suited for permanent operation. Moreover, Siemens MICROMASTER 440 frequency converters are used for adjusting the system pressure by controlling the compressor speed. Both process areas are classified as Zone 1. In addition to robustness, the components feature high overload capability and easy assembly and commissioning.

The frequency converter is a powerful and versatile all-rounder. A particularly convenient feature, for example, is the guided commissioning, which requires only a few data points to achieve optimum interaction with the motor.

The ATEX-certified, explosion-protected 1MA6 (“increased safety”) and 1MJ7 (“flameproof enclosure”) motors can also operate in controlled-speed mode when connected to a frequency converter located outside the Ex hazardous area, providing the motor temperature is supervised by certified monitoring devices.

Precise Energy Metering for Biogas Feed-in

With Siemens process gas chromatographs, operators of biogas plants can easily monitor the calorific value and purity of their biomethane – a key requirement for the feed-in of biogas into the natural gas grid.

Biomethane is used typically to generate electricity and heat by gas motors in combined heat and power plants. Another application is the feed-in of conditioned biogas into the natural gas grid. To achieve the gas qualities required in the natural gas grid, impurities such as water vapor and hydrogen sulfide are removed from the raw biogas and the methane is concentrated in a series of conditioning steps. The quantity and quality and especially the calorific value of the processed gas are monitored.

The Ex-protected MicroSAM and SITRANS CV micro process gas chromatographs (GCs) have proven ideal for the measurement of the gas properties in biomethane feed-in due to their high accuracy and availability. The micro GCs can also measure oxygen as a single component. Oxygen can enter biogas systems by primary desulfurization, through air added during conditioning, or as a result of air leakage into process units. The oxygen content in biomethane may on no account exceed the limit of 1 percent (measured with sensors) or 3 percent (measured with calibrated micro GCs with oxygen measurement).

The basis for the high efficiency of the compact and rugged soccer-ball-sized process GCs is the size of a soccer ball. This is their standardized analytical concept using micro-electro-mechanical systems (MEMS) technology. Short analysis times (150 seconds) and excellent repeatability (calorific value: < 0.007 relative error) can be achieved with this system. The integrated automatic optimization ensures high precision (accuracy < 0.15 % relative error) and long-term stability.
New Processes for New Energy

Siemens does more than just supply modular solutions for automation and energy management. Teams of researchers and developers at Siemens are also working on optimizing processes and improving the performance of biofuels/biogas production, both in process technology and in measuring technology and analytics.

**Algæe** have great potential as a source of raw material. They can be used for direct combustion or biomass fermentation. Certain species producing lipids and fatty acids can also be processed into biodiesel. Moreover, algae are easy to cultivate. Recently, Siemens researchers were able to demonstrate in the lab that particularly fast-growing species of algae accumulate magnetite particles and can be harvested easily with magnets. The Siemens researchers are now concentrating on the energy/cost-efficiency optimization of the entire process and the magnetic particles and magnetic separation. They are also examining whether and how biomass production with algae can be made economically attractive.

Moreover, Siemens is also supporting a research project in a biogas plant in Bavaria where a key fermentation process is directly monitored by measuring acid production with infrared spectroscopy for performance improvement. One test method is the examination of samples from the fermenter with an innovative near-infrared sensor. This analysis can provide quality information during the fermentation process, for example, and at the same time improve process understanding.

From crops to “green chemicals”: with the development of new process variants, renewable natural materials can be used to generate energy and produce basic chemicals.

**Biofuels today:**
- bioethanol
- biodiesel
- biogas

**Biofuels tomorrow** (pilot phase):
- synthetic biofuels (biomass-to-liquids)
- biofuels from algae

**Biofuels in the future** (laboratory phase):
- “green chemicals”:
  - bio-butanol
  - bio-hydrogen

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**Siemens – your partner for biofuels**

Do you have any questions about our offering for biofuels production?

Would you like more information about our products, systems, and solutions?

Would you like to make suggestions on how we can serve our customers in the biofuel industry even better?

Please let us know – just e-mail us at:

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