HAFFMANS BIOGAS UPGRADING
SCHAAP BIO ENERGIE, NETHERLANDS

CASE STUDY

KEY FACTS

Product
Advanced system

Technology
Membrane/Cryogenic

PLANT CAPACITY
Biogas
350 Nm^3/h
Biomethane
220 Nm^3/h

Methane Use
Injection into gas grid according to Dutch specifications

Biogas Source
Manure, feed remnants and other organic waste

Benefits
- Full process control without methane (CH_4) slip
- Liquid carbon dioxide (CO_2) provides process cooling energy
- Low total cost of ownership
- No chemicals
- Easy to operate
- Compact solution

CLOSING THE CIRCLE BY BRINGING BIOMETHANE TO THE GRID

Schaap Bio Energie, a Dutch farm operation and energy producer, has been turning manure and other organic material into heat, electricity and high-quality fertilizer since 2007. To obtain a better return on investment, the latest biogas upgrading technology was recently installed to expand the plant, which allows Schaap Bio Energie to supply biomethane to the national gas grid.

As a young agricultural entrepreneur, company owner Ids Schaap wanted to do more than just carry on his family's 125-year-old dairy operation, so at the Schaap farm in Tirns he installed one of the first manure digesters in the Netherlands.

"Branching out into biogas was attractive as it opened up a new economic perspective, provided sustainability benefits, and gave me the opportunity to help local farmers comply with environmental regulations," Schaap said.

Return on investment
However, producing biogas and burning it in a Combined Heat and Power (CHP) plant does not always bring the return that justifies the investment. The volume of manure and other waste streams finding their way to the Schaap farm grew faster than the local demand for heat. Ids Schaap found himself looking for a new solution that was both ecologically and economically sustainable.

Anaerobic digestion produces raw biogas that consists roughly of 60 percent methane and 40 percent CO_2. To upgrade biogas to biomethane the biogas is split into a methane-rich stream and a CO_2-rich off-gas stream. Additional treatment is required to produce biomethane of sufficient quality for injection into the natural gas grid or use as transport fuel.

Depending on the composition of the raw biogas and legal requirements, the separation process involves drying the gas and removing trace substances such as oxygen, nitrogen, hydrogen sulfide, and ammonia.

More methane and pure CO_2
Compared to conventional upgrading technologies, Pentair Haffmans' solution offers significant advantages.

"Our combination of membrane and cryogenic technology results in a 100% methane yield – so there is no methane loss – and allows for the recovery of pure CO_2," said Toine Toten, product manager CO_2 & Biogas Systems. "The raw biogas first goes through a scrubber and an activated carbon filter to remove impurities. Then, a compressor provides the pressure needed to push the biogas through the membrane unit, where the main separation process takes place."

The off-gas from the first membrane process step goes to the CO_2 recovery plant, where it is pressurized to 17.5 bar and cleaned in an activated carbon filter/dryer. The gas is stripped and liquefied by cooling to -24°C, while any remaining methane is fed back to the membrane unit. This unique second process step completely eliminates the environmentally-harmful 'methane slip', already illegal in some countries, as methane expelled into the atmosphere is 22 times more harmful as a greenhouse gas than CO_2. The produced food-grade fluid CO_2 is stored in buffer tanks for use in a variety of commercial applications.

Turnkey solution
Biogast, a Dutch company specializing in turnkey biomethane installations, handled the project, and Biogast and Pentair Haffmans jointly developed the ideal

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upgrading solution for Schaap Bio Energie's biogas. The produced biomethane has the same specifications as natural gas. To make the biomethane suitable for the national gas grid, additional treatment steps, including odorization, are required. Biogast's Bio2Net feed-in station serves as a gatekeeper to the grid, continuously checking the volume, pressure and chemical composition of the gas.

Schaap Bio Energie now produces 1.6 million m^3 of biomethane per year. The CO_2 by-product is used to provide the cooling energy needed in the biogas upgrading process. This saves electricity in the cooling unit and contributes to the plant's overall energy efficiency. In the future, Schaap has plans to sell the produced CO_2.

Ids Schaap is pleased with his multi-product biomethane plant and enjoys being a green energy producer. "We use manure for our biogas plant, so do not process anything that could be used as food or fodder," he said. "Nature puts a lot of energy in the raw materials we use. We can now make sure that none of it goes to waste."

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TÜV Nederland QA B.V.
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HAFFMANS BV
P.O. BOX 3150, 5902 RD VENLO, NETHERLANDS NLVENMARKETING@PENTAIR.COM WWW.HAFFMANS.NL