

This is one of 12 case studies presented in the report "Biogas from manure, and waste products – Swedish case studies"
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The NSR biogas plant in Helsingborg

Facts/unique: Biogas to the gas grid and piped bio-manure. Initiator of the bio-manure certification system.



Figure 1 Hose spreader for spreading liquid manure, Helsingborg

The NSR biogas plant in Helsingborg started operations in 1996. NSR is a regional waste recycling company owned by six local authorities in north-west Skåne (Bjuv, Båstad, Helsingborg, Höganäs, Åstorp and Ängelholm). The original driving force behind the development of the biogas plant was the need to treat various organic wastes that were unsuitable for landfilling. Nowadays, the production and refinement of biogas as an alternative vehicle fuel is an additional motivation.

Several improvements and extensions to the biogas production and distribution systems have been made since 1996. Upgrading of biogas started in 1997. Work on

expanding the original biogas plant to double its capacity began in 2006 and was completed by the summer of 2007. The capacity of the upgrading plant has also been increased. 'NSR Bio-manure' started marketing bio-manure to agriculture as early as 1997 and its quality is nowadays recognized under the certification system. A pipeline was laid in 2006 to pump it directly out to the fields.

Food wastes represent a relatively large proportion of the substrate digested in the reactors, and the pre-treatment of this kind of waste has been continuously developed during the life-time of the plant. A new pre-treatment facility for food wastes and packaged food will start operations in the summer of 2008. There are also plans to use dry digestion to treat the remaining material after removing the pure food waste and packaging materials. NSR has also been innovative with respect to the distribution of bio-manure and was one of those responsible for the establishment of the certification system for bio-manure according to SPCR 120 regulations. NSR also has an advanced system for collecting landfill gas at the Filborna landfill, and is participating in an international research project in which new methods will be developed to detect methane losses from landfills.

The biogas plant and substrate

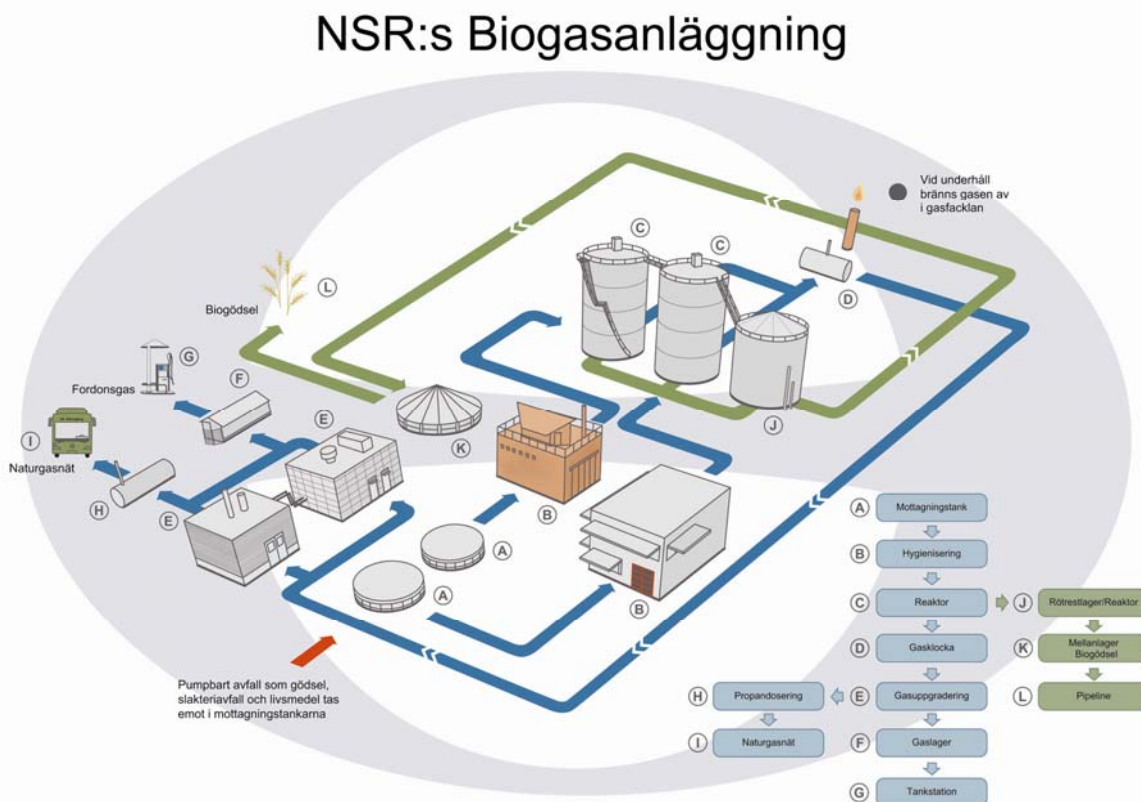


Figure 2 Diagram of the biogas plant at NSR, Helsingborg

The raw materials consist of process waste from the food industry, fresh pig manure and source-sorted food wastes. The plant is designed to accept up to 80,000 tons per year of different kinds of waste, including waste that can be pumped, and source-sorted and compressed food waste and packaged foods. Contracts have been drawn up with local farmers and food manufacturers to ensure a constant supply of substrate to the biogas plant. Two tanks, each 1000 m³ in size receive the waste, which is first chopped and mixed. The material is then pasteurized in three separate tanks at 70°C for one hour. The heat is supplied by a wood-burning furnace. A compost filter removes odours during the pre-treatment. The one-step process takes place in two mesophilic (37°C) reactors, each 3000 m³ in size, with a retention time of c. 30 days. There is also an additional digestion chamber (1000 m³) where material is stored prior to distribution.

Upgrading and use of the biogas

In 2007, the plant produced c. 23,000 MWh of raw biogas. Production is expected to increase significantly in 2008, since the plant was extended in 2007. All the biogas is upgraded to vehicle fuel quality. The first pilot-scale upgrading plant was built in 1997. This was replaced in 2002 with a full-scale plant, while the pilot-scale plant was moved to Växjö. Both upgrading plants used the PSA method. Another upgrading plant was built in 2007, this time with the water wash technique. The methane content after upgrading is 98%. About 12,000 MWh of upgraded biogas was produced in 2007. The total production capacity is more than 40,000 MWh.

Distribution of the biogas

The upgraded biogas is dried, compressed to a pressure of 280 bars and stored in canisters. The store holds c. 7000 m³ of biogas. Some of this gas is sold in NSR's public filling stations located at Filborna re-cycling plant, and is also used to run refuse lorries. However, most is distributed through the gas grid and is used to run buses. Propane is added to this gas to give it the same energy content as natural gas. In total, the biogas produced by NSR runs 100 buses, 20 refuse lorries and a large number of cars both locally and regionally.

Bio-manure

The quality of NSR's bio-manure has been certified since 2003. In 2007, 44,000 tons of bio-manure was produced at the plant. Of this amount, 20,000 tons are pumped through a 10 km long pipeline to ten farmers who are participating in the project. In a few years, the capacity of this pipeline will double. The bio-manure is stored in four tanks prior to spreading with mobile spreader equipment and feeder hoses.



Figure 4.2.3 Map of the bio-manure pipeline

Financing

So far, 120 million SEK has been invested in the biogas plant, including the systems for the distribution of biogas and bio-manure. The plant built in 1996 was self-financed. Since then, NSR has received a little more than 19 million SEK in KLIMP grants for various extensions and improvements, some of which are still underway. Amongst other items, NSR has obtained KLIMP grants for the pipeline for bio-manure, the development of a dry digestion technique, the purchase of new gas-driven vehicles and to increase the capacity for biogas production at the plant. In the long-term, NSR's biogas project will be a profitable investment.

Lessons learned

The extensions to the systems for biogas production and distribution of both biogas and bio-manure have gone according to plan. Competition for substrate in the region is one problem that is sometimes experienced. It is therefore important at the planning stage to carefully investigate the availability of substrate. A market for the bio-manure is another critical factor. The certification system has been an important factor in this respect, since it has enabled the application of bio-manure to agricultural land. The location of the biogas plant must also be chosen carefully, both with respect to logistics and the avoidance of odour problems.

Benefits for the environment and society

The biogas produced in 2007 replaced more than 1.3 million litres of petrol and thereby reduced carbon dioxide emissions by 2800 tons. The increased capacity of the plant is expected to result in even greater benefits for the environment in 2008. Large parts of the plant were built with re-cycled construction materials. For example, two of the reactors came from the old sugar refinery in Hasslarp. The bio-manure pipeline has reduced truck traffic by c. 22,500 km each year. This figure will double when the pipeline capacity increases in a few years time. This will reduce the annual emissions of fossil carbon dioxide by 78 tons. An important issue for the agricultural industry is whether the bio-manure is approved for application on land that is used to produce food. Certification guarantees the farmer that NSR's bio-manure is hygienic, has a high nutrient content, and that the contents of heavy metals are below allowable limit values.

Facts 1. Basic data on the biogas plant

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|---------------------------------|---|
| Start year (biogas production): | 1996 |
| Digester volume: | 2 x 3 000 m ³ , 1 x 1 000 m ³ |
| Process temperature: | 37 °C |
| Start year (upgrading): | 1997, 2002 and 2007 |
| Upgrading method: | PSA and Water wash |
| Total investment costs: | 120 million SEK |

Facts 2. Yearly inputs & outputs

| | |
|-----------------------------------|-------------|
| Substrate: | |
| Source-sorted organic food wastes | 5 600 tons |
| Pig manure | 3 400 tons |
| Process wastes from food industry | 35 200 tons |
| Biogas: | |
| From the biogas plant | 23 000 MWh |
| Upgraded biogas | 12 000 MWh |
| Bio-manure: | |
| Total bio-manure | 44 000 tons |
| Bio-manure in pipeline | 20 000 tons |

Contacts

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| | <p>www.nsr.se</p> <p>Karin Eken Södergård, Product Manager Biogas Telephone: +46 42 400 13 35 E-post: karin.eken@nsr.se</p> <p>Jessica Cedervall, Section Manager, Biological Treatment Telephone: +46 42 400 13 53 E-mail: jessica.cedervall@nsr.se</p> |
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Suppliers

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|----------------------|--|
| Biogas plant: | <p>Malmberg www.malmberg.se</p> <p>AnoxKaldnes www.anoxkaldnes.com</p> |
| Upgrading plant: | <p>Läckeby Water www.lackebywater.se</p> <p>Biomil www.biomil.se</p> |
| Bio-manure pipeline: | <p>Oden entreprenör AB www.odn.nu</p> |
| Manure tanks: | <p>Abetong www.abetong.se</p> |