



# Bioenergy Insight

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## Fields of opportunity

Taking advantage of the energy crops market

## Harvest vs deforestation

Settling the great biomass debate



**Regional focus: Scandinavia and the Baltics**

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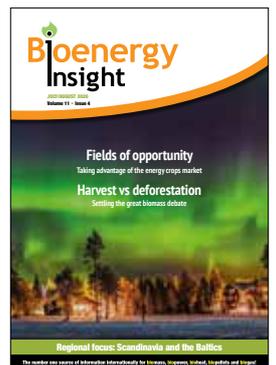
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# Getting circular in Norway

The town of Jevnaker harnesses bio-CNG with DMT Clear Gas Solutions

**G**iven the recent 25th anniversary of the 1994 Olympics Winter Games, DMT Clear Gas Solutions has been reflecting on its project with Hadeland og Ringerike Avfallsselskap (HRA) – one of the first biogas upgrading facilities in Norway. This project paved the way for other renewable natural gas (RNG) plants in Europe to harness membrane technology when other biogas upgrading technologies were dominating the market. Additionally, it serves as an example of RNG creating a circular economy and how it can be a part of the solution and not part of the problem.

## Green Olympic Games

The story begins in 1994 when the Olympic Winter Games came to Lillehammer, Norway. It was deemed the first ‘Green Olympic Games’, laying the foundation for developing Olympic environmental standards and for strengthening Norway’s commitment to sustainability. More than 20 sustainability projects were implemented at that time, focusing on issues such as waste management, wildlife protection or resource quality<sup>1</sup>.

## About the project in Jevnaker, Norway

With the city of Jevnaker and surrounding towns wanting to play an active role, a consortium of waste facilities began working together to create one composting facility ran by HRA. From 1994 to 2005, the facility expanded with recycling, composting, landfill gas, and household plastic collection. In 2005, HRA built



Jan Reistad, former Operations Manager of the HRA biogas facility, stands next to the 15,000 tons of organic household waste collected annually to generate biogas

its first biogas plant from wet organic waste in order to heat and power a plant in Trollmyra.

In 2014, the biogas plant was upgraded to handle double the capacity and updated to generate vehicle fuel. Today, HRA collects, sorts, and recycles the waste from 66,000 inhabitants of Hadeland and Ringerike, and uses food waste to create renewable compressed natural gas (bio-CNG).

The HRA biogas facility uses anaerobic digestion of organic fraction from municipal solid waste to process 15,000 tons of organic household waste annually. It uses DMT’s Carborex® MS, a membrane separation (MS) system to extract carbon dioxide (CO<sub>2</sub>) from the methane stream, and upgrades 250 standard cubic feet per minute (SCFM) of biogas into bio-CNG. With bio-CNG being a clean and competitive alternative to conventional vehicle fuel, this is piped to HRA’s CNG fuelling system and used as transportation fuel for HRA’s waste-collection trucks as well as sold to fuel other trucks, buses and privately-owned cars in Oslo.

“The Carborex®MS is easy to operate,” explained Jan Reistad, former operations manager of the HRA biogas facility. “The membranes run 400 normal meter cubed per hour (Nm<sup>3</sup>/h) of biogas. The biomethane that comes out is compressed to 210 bar and as such, is the ideal fuel for our trucks. We make green gas and CNG. With this installation, it is all possible. The HRA trucks take 25% of the fuel and we sell the other 75% of the production to the Oslo area.”

## Membrane technology for biogas upgrading

While the most important cost determinant is plant size, the cost of upgrading biogas to RNG is dependent on the specific technology used. In Norway, the seller of RNG to natural gas networks is responsible for the gas quality and the cost of upgrading raw biogas. Therefore, the choice of upgrading technology influences final RNG quality and, thereby, its suitability for different uses.

“Circumstances in Norway are remarkable,” said Reistad. “It can be -20 °C in the

wintertime so every solution with water is not an option. We went to Poundbury in the UK to see the first commercial biogas upgrading plant – the Carborex®MS. Because it was new, we did not know the lifetime of the membranes, but we were convinced very quickly because no water or chemicals were needed.”

By investing in MS technology, HRA became pioneers in the European biogas upgrading industry. In 2014, HRA received Ringerike Nærings forum’s industry award for its innovative work on transforming organic household waste into environmentally friendly energy in the form of methane gas. It also won the ISY Innovation Award from Norconsult Information Systems for being a driving force in the application of new technology as well as the award for best standing on Ringerike Day.

“In the end, it wasn’t a gamble. It was a good choice,” said Reistad.

## Today’s European biogas climate

Though growth in the European

biogas market has levelled out in recent years, the European RNG market continues to develop at an impressive rate, showing a 51% increase of RNG plants in the past two years<sup>2</sup>. In the Nordic region, Norway, Sweden and Denmark are all focused on biogas as a source of renewable energy and have various systems in place, such as feed-in-tariffs, investment grants, and tax exemptions, to help increase biogas production. Norway's biogas production remains the smallest of scale compared to other Nordic countries, with most of its biogas plants being public and based on source separated organics from domestic waste and sewage.

Generally, the challenge for Norway has not been financing the plants but rather finding sufficient biomass and a viable market for RNG. Additionally, low electricity



The HRA biogas facility in Jevnaker, Norway uses DMT's Carborex® MS, a membrane separation system to extract CO<sub>2</sub> from the CH<sub>4</sub> stream and upgrades 250 SCFM of biogas into bio-CNG

prices stemming from ample hydroelectricity in Norway makes the energy market exceedingly competitive. Despite increasing interest in using manure as a biogas feedstock and a national goal of utilising 30% of the manure produced in the country for biogas products before 2020, biogas project development

in Norway has been slow<sup>3</sup>. This is partly due to the small average size of farms that are widely dispersed as well as little focus on mixing substrates of domestic waste, sewage, and manure. Currently, Norway has clear strategies in place to increase biogas production. The Norwegian Environment

Agency estimates a potential increase in biogas production by 400% between 2015 and 2025 as gas-powered buses drive biogas demand and as transport or shipping companies invest in liquefied natural gas<sup>4</sup>. Additionally, the Norwegian Climate Act, enacted in January 2018, aims for a low-emission society by 2050 of which biofuels are required to comprise at least 10% of the fuel volume used in road traffic annually. ●

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