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Challenges and solutions for biogas production in the Aurora-region

In the Interreg Aurora-funded project Boost Nordic Biogas one of the goals was to create an overview of the challenges and opportunities being faced by the biogas industry in the region. By doing this, the community of biogas producers, customers and research organizations can identify what research, and development should be prioritized, which good practices and technological improvements can be adopted by others and identify threats to the development of anaerobic digestion.

The process

The process started by creating a set of interview questions, to be used to in semi-structured interviews with personnel from biogas plants, such as technical managers who have insight into the aspects of running the operations and development personnel, with knowledge about the general development of the industry and safety measures at the plants.

The questions cover situations and development plans for biogas plants in both Finland and Sweden. They cover problems, challenges, working methods and practices, capacity for research and development and perceived threats to the development of the biogas industry.

Challenges

Some interviewees said that the main challenge is treatment of digestate, as well as finding enough application area for digestate, a common challenge in the industry. The changing regulations for, and attitudes to sorting of, biowaste is challenging and may lead to increased costs. There are regional differences still in sorting practices, specially plastic food containers are troublesome.

Another issue is balancing the variations in supply and demand of biogas in relation to the availability of substrates, since it leads to need for more capacity that should be in continuous use. Some interviewees also face issues caused by aging equipment or facilities.

Threats

The main threat identified in the interviews is not very surprising; it is political and regulatory uncertainty. Biogas plants and upgrading parts of existing processes are significant investments with often long pay-back times. Another, related threat is the view of biogas, especially when compared to other forms of energy. This makes it more difficult for biogas to get subsidies, and consumers might prioritize electric vehicles. For example, biogas may wrongly be viewed as similar to the usage of natural gas, which partly happens on EU-level. A more 'positive' problem is the risk that rapid biogas development creates competition for substrates, which may lead to over-capacity or decreased profitability.

Key challenges and threats

- **Digestate treatment** and finding enough land where it can be applied.
- **Changing regulations** and varying attitudes toward biowaste sorting.
- **Regional differences** in sorting practices; especially issues with plastic food containers
- **Balancing chancing supply** and demand for biogas with available substrates.
- **Aging equipment** and facilities in need of upgrades.
- **Political and regulatory uncertainty** affecting long-term investments.
- **Competition for substrates** as the biogas sector expands.

What are the solutions?

The biogas plants interviewed have varying development plans, mostly not related to the identified challenges and threats. Rather, the plans revolve around upgrading what needs to be improved due to age or new requirements. Some see future possibilities in coupling biogas with hydrogen production. LBG, liquefied biogas, is especially seen as the new market. The rapid development of LBG is both technological and a changed market, and information about this development is the most requested.

Dive deeper into LBG development

Here are some produced dedicated resources for those interested in the latest developments.

Read our report
Get a detailed technical and market overview.

Watch our webinar
Access in-depth presentations and expert analysis.

A clear improvement can also be found in better practices. Improved communication, both internal and with external actors, for example substrate providers and fueling stations, can make a positive impact on both process stability and efficiency. Due to changes in biowaste sorting in some locations, close collaboration with municipalities is required. Pluck analyses show that a large share of bio-waste in Nordic households is incorrectly sorted, with 56–80 % of mixed or residual waste having recycling potential.

Many municipalities are taking measures to improve orting, where there is potential for better collaboration between local authorities and biogas plants. Better collection, targeted local initiatives, and proper pre-treatment are keys to improving recycling rates and ensuring high-quality biogas and digestate. For more information about biowaste sorting and different practices in the northern countries, please **see our info sheet on biowaste sorting.**

One solution is to upgrade plants to meet new requirements.

Inspecting industrial equipment.

The requests from biogas plants regarding cooperation and development work mainly consist of policies that remove uncertainty in the industry. The policies need to be inter-governmental; in other words, that the policy still holds even when governments change. They should ideally be similar across countries, as far as possible given the differing conditions in Europe.

The cooperation between biogas plants, especially about the substrates, needs to be improved and structured. However, it is unclear who should be responsible for this. Cooperation projects together with research and development institutions can improve and bring the biogas plants closer, but it is difficult to maintain the cooperation after external project funding is over. Establishing more permanent platforms or agreements could help ensure continuity and shared benefits across the sector.

Key solutions and opportunities

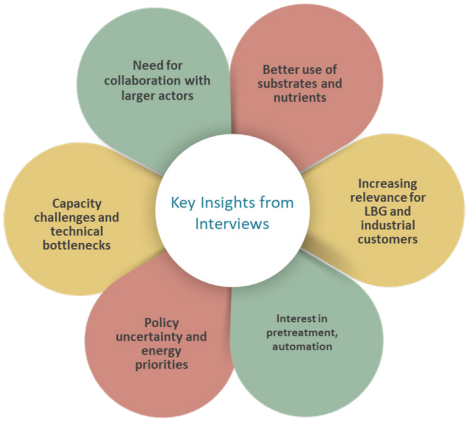
- **Upgrade plants** to meet new requirements
- **Explore new technologies** such as hydrogen and LBG
- **Better communication** with suppliers, fueling stations, and municipalities
- **Boost biowaste sorting** through collection, local initiatives, and pre-treatment
- **Clear, stable policies** across governments
  Stronger cooperation between plants and with research and development institutions
- **Permanent platforms or agreements** to sustain collaboration
- **Simple technical solution** such as buffer tanks and other storage, for more stable feeding and operation

As seen, there is no single technical solution for all problems. Problems must be solved on a case-by-case basis with a view that considers the effects on the whole plant. The technical solutions that seem to be of the most help are very simple solutions: Buffer tanks and other storage solutions for a more stable feeding and operation.

Norway – a special case

Norway was not included in the interviews, primarily due to the limited number of biogas plants in the Interreg Aurora region. According to project work in northern Norway and coverage in the press, biogas plants there have faced financial challenges, and the general perception of biogas is currently more cautious. Additionally, the limited availability of agricultural land means that both challenges and potential solutions differ from those in other parts of the Interreg Aurora region.

However, research in northern Norway has explored digestate management and compared dry and wet fermentation for biogas production. Dry fermentation needs smaller reactors, but wet fermentation is still more common today. These findings can provide a basis for future biogas projects. It also highlights the need for continued research to optimize processes locally and change the public opinion on biogas production. If you are interested in learning more, **read about development in Northern Norway in our info sheet here.**



Summary of the interviews for the workshop introduction

The workshop

Based on the interviews with biogas plants, a workshop was organized to gather further insights and discuss challenges and potential solutions. The interview results were first summarized and presented to the participants. They were then divided into three groups according to their role in the biogas chain and given a set of 10 questions derived from the interview responses. Each group could freely choose which questions to discuss.

Across all groups, the need for political support and long-term regulations that provide stability was emphasized. One group also highlighted the value of different information campaigns to improve proper biowaste sorting, which increases substrate availability and makes it easier to handle and digest. Furthermore, cultivation trials with various digestate products, carried out in this and previous projects, were highlighted as crucial for demonstrating that digestate is an effective, renewable fertilizer.

It is important that farmers also collaborate with one another, for example by sharing storage space and substrates. To support this, standardized agreements between the actors were suggested. Regional biogas networks were also highlighted as important, for bringing the latest developments to the area and raising awareness of the unique conditions in northern Nordic countries.

Recommendations from the workshop

- Biogas as a means for societal resilience
- Continue digestate trials
- Improve communication of the benefits of biogas development
- Systems thinking and models for technical solutions are needed
- Continue working with life cycle and energy balance
- Closer collaboration between biogas producers
- Clear cooperation models and business plans
- Stability despite changing regulations

How do we move forward?

This work provides a valuable overview of the current state of biogas development in the Aurora region. It also points the way forward by highlighting the needs, challenges, and opportunities for biogas actors to learn from one another.
A theme requested for future work by both project staff and the reference group is a project emphasizing the importance and potential of biogas, or the bioeconomy more broadly, for societal preparedness and resilience. This topic has been widely discussed in Nordic society, and biogas production plays a vital role in waste management by creating a local recycling system that provides both renewable energy and fertilizers.

Even though Boost Nordic Biogas and previous projects have conducted cultivation trials with digestate, future projects should continue these trials to further evaluate and demonstrate its fertilizing effects. This is especially important because long-term effects are crucial for agriculture. The same applies to communication efforts, as biogas development is closely linked to society.

The Importance of a systems approach

A detailed systems approach in biogas production is required when deciding the implementation of technical solutions or other improvements. For example, new dewatering equipment might lower the water content of digestate and improve the economy of transportation, while it will increase the volume of water that needs to be treated and thus raise treatment costs. Life-cycle analyses and mass or energy balance analyses will continue to be an important part of the development of biogas.

"Biogas development requires trials, communication, systems thinking, and collaboration."

Many interviewees and workshop participants highlighted the potential for closer collaboration among biogas producers. Either as suppliers to other industries or through a form of industrial symbiosis. However, the actors are often uncertain about how to take the first steps toward such cooperation.

For the future growth in the biogas sector in the Nordics, establishing clear collaboration models and robust business plans appears to be among the most promising solutions. These cooperative models could provide stability in a sector where regulatory frameworks and political support often change influenced by varying attitudes toward renewable energy.

More information

Find all reports, info sheets, and presentations from Boost Nordic Biogas on our project page. Topics include:

About biogas: Introduction to the role of biogas in circular and energy systems
Cultivation trials: Insights from long-term field trials using digestate
Biogas from Common Reed: The potential of common reed in biogas production
Ten years of research: Key knowledge gathered from a decade of cultivation trials
About microplastics: Effects of microplastics in soil
About biowaste: Collection and pre-treatment of biowaste
Sludge Biochar: Eco-friendly & versatile
Pot trials: Results from pot experiments with digestate
Certification processes: Standards and requirements in the biogas market
Biogas and SDGs: How biogas contributes to the Sustainable Development Goals
LBG: Development of liquefied biogas
Insights from the Norwegian sector: Wide data collection and analysis

Observing the development of the biogas sector

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