SLU

FUTURE FOOD

Policy brief

This policy brief is a collaborative production from Swedish University of Agricultural Sciences (SLU), Linköping University and Biogas Solutions Research Center (BSRC)

BIOGAS secures sustainable Swedish energy and food production

Sweden has great potential in terms of increasing domestic biogas production. Increasing production could contribute to a sustainable food system and enhance food and renewable energy security. This policy brief provides a series of recommendations aimed at strengthening Swedish biogas and biofertiliser production, while highlighting the need for cross-sectoral coordination.

Biogas is a storable form of energy that is continuously produced from organic residues generated by society and agriculture. It contains methane and carbon dioxide and can be used directly for electricity and heat production. Alternatively, methane can be separated for use as fuel for vehicles and agricultural machinery, while the carbon dioxide can be extracted for carbon capture and utilisation (CCU) purposes. Biogas production also generates biofertiliser that serves as an excellent source of plant nutrition. By substituting mineral fertilisers with biofertiliser, we can reduce the need for imported mineral fertilisers and reintroduce vital nutrients to agricultural soil. Additionally, we contribute to increasing soil carbon storage and reducing greenhouse gas emissions from Sweden's food production.

We are able to enhance the potential for sustainable food production in Sweden through the domestic production of renewable biogas and biofertiliser. Furthermore, biogas is produced from residual products from agriculture and the food industry, which enhances the profitability and resilience of agriculture and reduces greenhouse gas emissions. Despite

Photo: Shutterstock

RECOMMENDATIONS

1. **Clarify, simplify, and accelerate the permit process for biogas substrates.**
2. **Stimulate increased use of biofertilisers and refined biofertiliser products.**
3. **Promote domestic and sustainable biogas and biofertiliser production to secure food production in times of heightened preparedness.**
4. **Provide support for the further development and establishment of industrial symbiosis.**
5. **Support the capture and utilization of CO2.**
6. **Strengthen the competence supply in agriculture-based biogas production.**
7. **Set a national target of 10 TWh sustainable biogas production by 2030.**
8. **Provide long-term economic policies and directives for biogas production.**

its many apparent benefits, biogas system development is being hindered by the fact that the various advantages and positive effects fall within different societal sectors and policy areas, including climate, environment, energy, food supply and agriculture.

Sweden currently produces 2.3 TWh of biogas, but there is significant untapped potential. Sweden's biogas production could increase to 7–10 TWh in a matter of years by increasing the sorting of food waste and greater use of organic waste streams that are currently overlooked (especially animal manure and crops that do not compete with food production). Biogas production could enable farms to replace fossil fuels in agricultural machinery or become self-sufficient in electricity and heating. Additionally, biofertiliser could cover a significant portion of the agricultural nitrogen and phosphorus needs.

Ultimately, the expansion of biogas production systems will provide additional benefits such as strengthened energy and food security in times of crisis and the need for supply resilience, regional economic development, green jobs, and a cleaner environment. Many European countries are now increasing their biogas production in a bid to reduce dependence on imported fossil gas. The understanding of the positive societal effects of biogas solutions has improved and influenced both Swedish and European policies, as well as local and regional policies (1, 2, and 3). One of the key advantages of supporting biogas development solutions is the minimal conflicts of interests involved. In Sweden, there is a strong desire within the business community and academia to take the lead in significantly increasing sustainable biogas production. However, to continue to promote the expansion of Swedish biogas, long-term regulation and cross-sectoral coordination are required. This policy brief aims to provide research-based recommendations on how to contribute to securing national food supply by increasing domestic biogas and biofertiliser production.

1. Clarify, simplify, and accelerate the permit process for biogas substrates

To boost Swedish biogas production, it is imperative that the availability of biomass is increased without adversely affecting our food production. Animal manure provides a particularly significant untapped potential, as do agricultural materials and by-products. There are several challenges regarding the use of agricultural materials and by-products. Existing national guidance for the Renewable Energy Directive (RED) is ambiguous in terms of the raw materials that can be utilised. These regulations can be further clarified in the new directive, RED III.

Photo: Shutterstock

A biogas production company requires a permit to qualify for energy and carbon dioxide tax relief for biofuels or gaseous biofuels. The permit process takes the Renewable Energy Directive into account but does not specify the specific substrates. Instead, it sets requirements for a control system to prevent food crops and certain fodder crops from being used for biogas production. In this context, the lack of clarity in defining which crops and by-products fall under the category of 'food and feed-based raw materials' complicates the process, leading to prolonged permit processing times. To counteract this bottleneck: *simplify* the process, *clarify* the directive for approved substrates tailored to different Swedish conditions and *implement a fast-track* to prioritise permit processes for biogas facilities.

Furthermore, it is essential that availability of substrates for enhancing biogas production is expanded. Therefore, stimulate the cultivation of sustainable and approved 'biogas crops' that lead to increased carbon sequestration, improved soil health, increased biodiversity in agricultural landscapes through new crops, such as flowering intermediate crops beneficial for pollinator survival in late summer.

2. Stimulate increased use of biofertilisers and refined biofertiliser products

If all animal manure in Sweden were used for biogas production, efficient distribution of biofertiliser, combined with the nutrients obtained after processing of sewage sludge, could cover 90 per cent of the phosphorus and 40 per cent of the nitrogen required in agriculture. This suggests that a substantial portion of the imported mineral fertilisers could be replaced with biofertiliser, making a considerable contribution to mitigating the climate impact of agriculture and enhancing resilience during periods of crisis.

In certain cases, efficient distribution of biofertiliser requires refining in order to increase its nutrient content per tonne. Despite numerous innovative technologies having emerged recently, the current cost of these recycled and more sustainable fertilisers remains notably higher than that their mineral equivalents. This generates uncertainty about the profitability of new investments in systems for refining and handling biofertilisers. As it stands, there is a need for support to alleviate costs for producers and enhance the competitiveness of circular fertilisers in Sweden, potentially through tax incentives.

Another concrete measure that would benefit nutrient recycling is to accelerate the introduction of the Renure criteria and accompanying regulations

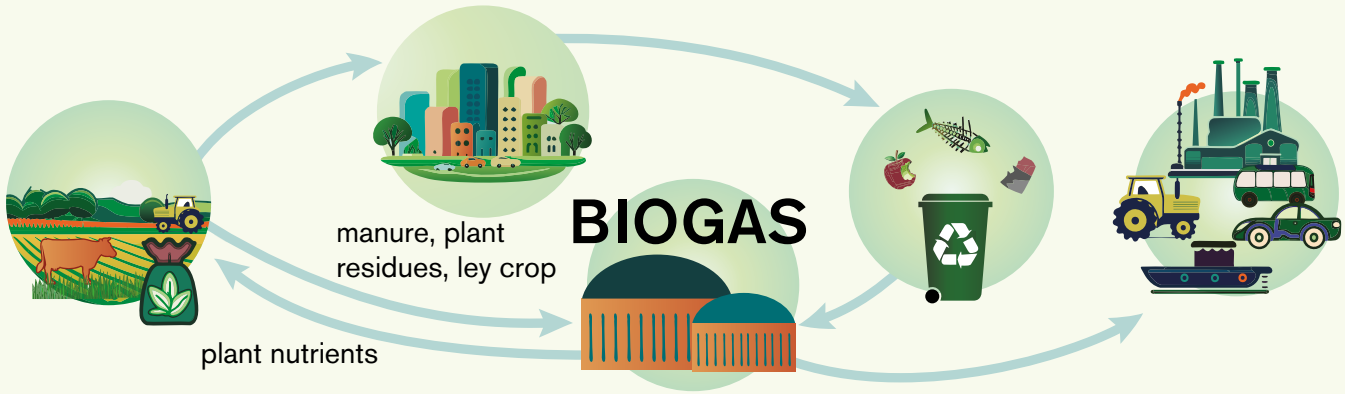

Illustration: Cajsa Lithell

within the EU (5). This initiative refers to nutrients produced through processing, such as biofertilisers. The concept aims to enable the sale of these products within the EU without being subjected to nitrogen limitations outlined in the Nitrate Directive, which typically applies to organic fertilisers such as biofertilisers, livestock manure, and sewage sludge. Instead, these products adhere to the same regulations as mineral fertilisers. The adoption of this regulation would eliminate a significant obstacle to the rapid commercialisation of biofertilisers, making it a crucial step forward.

Another possibility is to implement a payment system to increase carbon sequestration in agricultural soil. Numerous examples of various payment models in Europe already exist, where farmers implement practices to enhance carbon sequestration and receive compensation for their efforts. Biofertilisers are rich in organic material, which facilitates the accumulation of organic carbon in the soil. Therefore, a payment system encouraging increased carbon sequestration, including the use of biofertilisers, would yield positive outcomes and promote the advancement of circular fertiliser products.

3. Promote domestic and sustainable biogas and biofertiliser production to secure food production in times of heightened preparedness

Sweden's food production system is heavily reliant on functional global trade encompassing food, raw materials, fuels, and fertiliser. In times of peace, this does not pose a significant problem, but in the event of crises and wars, our national supply capacity is clearly put to the test. This concern was raised in a recent government inquiry into Sweden's food supply (6). Another recent inquiry determined that the optimal strategy for enhancing supply resilience is to implement policy measures and accelerate the transition to fossil-fuel-free agriculture (7). By establishing biogas plants, we are able to generate domestic and local energy and biofertiliser, thereby contributing to national and renewable food production. Biogas production derived from animal manure and other by-products from food production renders biogas systems less susceptible to various external disruptions. At present, biogas and biofertilisers are manufactured in both small-scale farm facilities and larger plants. However, significant expansion is necessary if we are to meet the demands of transitioning to fossil-fuel-free agriculture and strengthening Sweden's food self-sufficiency. Achieving this objective requires ongoing support for investments and gas production, including investment support such as *Klimatklivet*, and subsidies for using animal manure for biogas production. Furthermore, the prompt reintroduction of tax exemptions for biogas is essential.

4. Provide support for further development and establishment of industrial symbiosis

Thanks to its multifunctionality, the biogas system can be integrated into other parts of the energy system and generate other products in addition to biogas. The biogas process enables the conversion of by-products from both biodiesel and ethanol production into methane. In addition, the process can be linked with solar and wind power through hydrogen produced by water electrolysis with renewable surplus energy (8). There are challenges with storing hydrogen, but the methane it produces can be stockpiled and used as needed to balance the electrical system. Efficient management of the biogas process can generate a range of organic acids as either primary products or by-products alongside methane and biofertilisers. These compounds can be used for various applications, such as a carbon source for nitrogen removal in wastewater treatment, building block chemicals for bioplastics, packaging materials, food ingredients, or as a nutrient source for fodder production through the production of single-cell protein. Therefore, supporting development projects and the establishment of industrial symbiosis is critical as they often struggle to compete with the existing systems. Without this, we cannot fully utilise the potential of the biogas system and to contribute to the development of a sustainable society and agriculture.

5. Support the capture and utilization of CO_2

Not only is carbon dioxide a greenhouse gas, it is also a valuable resource in the production of many essential products such as chemicals, greenhouse cultivation, and the production of synthetic fuels (9). Biogas can play a significant role in sustainably meeting society's demand for CO_2, as approximately 40 per cent of the gas from a biogas reactor consists of renewable CO_2. During the upgrading process to biomethane, this CO_2 is separated and typically re-

leased into the atmosphere. There is currently a focus within the biogas industry on exploring the potential of capturing and storing or utilising CO_2 from biogas upgrading to substitute fossil resources and generate additional climate benefits. Increased CO_2 capture and utilisation require support in the form of long-term policies and clear regulations.

6. Strengthen the competence supply in agriculture-based biogas production

There is a significant need for a skilled workforce in the biogas sector. While higher education institutions and industry have extensive biogas expertise, the possibility of disseminating this knowledge is limited. Therefore, funds need to be allocated to a specific initiative that focuses on education courses and skills development relating to biogas.

7. Set a national target of 10 TWh sustainable biogas production by 2030

The Swedish Government's biogas market inquiry from 2019 proposed a national target of 10 TWh of biogas by 2030. However, no formal decision has yet been taken on this matter.

Such a target would unequivocally communicate to both the public and industry that this matter is urgent and is being prioritised, while simultaneously strengthening climate adaptation and energy as well as food security. Investors' intentions would be reinforced and the authorities could prioritise permit processes and other regulatory activities within the biogas sector.

8. Provide long-term economic policies and directives for biogas production

Biogas development has suffered from a lack of policy-related continuity, which has in turn hindered investments. Policies must offer predictability, enabling investors to take informed decisions for new biogas projects. One suitable approach would be to establish governance through legislation instead of relying solely on budgetary processes that may fluctuate annually. Additionally, creating greater investment certainty can be achieved by implementing a national target (as outlined in Point 7) and having influential national figures publicly advocate for the significance of the biogas sector in fostering sustainable societal development.

References

1. Biogasmarknadsutredning, Mer biogas! För ett hållbart Sverige. 2019. SOU 2019:3

2. European Commission, The Farm to Fork Strategy, 2020.

3. European Commission RePower EU. 2022.

4. Metson, G.S., R. Feiz, N.-H. Quttineh, and K. Tonderski, Resour Conserv Recycl, 2020. 9-10: 100049. doi: 10.1016/j.rcrx.2021.100049.

5. Huygens, D.G., et al., Technical proposals for the safe use of processed manure above the threshold established for Nitrate Vulnerable Zones by the Nitrates Directive (91/676/EEC), EUR 30363 EN, doi:10.2760/373351.

6. Statens offentliga utredningar, Livsmedelsberedskap för en ny tid, SOU 2024:8. 2024.

7. Statens offentliga utredningar, Vägen mot fossiloberoende jordbruk, SOU 2021:67. 2021.

8. Energiforsk, Agrivoltaics – jordbruk och solkraft i kombination, 2023.

9. Cordova, S.S., M. Gustafsson, M. Eklund, and N. Svensson, J CO_2 utilization, 2023. 77: 10.1016/j.jcou.2023.102607

Authors

Maria Westerholm[1], Mats Eklund[2], Marcus Gustafsson[2], Thomas Prade[1], Karin Tonderski[2], Anna Schnürer[1], Sven-Erik Svensson[1]

1) Sveriges lantbruksuniversiet (SLU)

2) Linköpings universitet (LiU)

Alla forskare är ingår i Biogas Solutions Research Center (BSRC)

Contact:

Maria Westerholm, SLU
maria.westerholm@slu.se

Version 1, April 2024

SLU Future Food

SLU Future Food is a platform that stimulates and develops cross-disciplinary research and collaboration for economically, ecologically and socially sustainable food systems.

- www.slu.se/futurefood
- Newsletter: Food for thought (in Swedish)
- LinkedIn: SLU Future Food
- Podcast: Feeding your mind
- futurefood@slu.se

LINKÖPING UNIVERSITY

SLU SCIENCE AND EDUCATION FOR SUSTAINABLE LIFE