Biogas: Renewable Energy for your Region!

Biogas ACTION

Table of contents

- **About biogas and BiogasAction**

Page 3 BiogasAction

Page 4 Biogas and Biomethane

Page 6 Biogas Development

- **BiogasAction in practice**

Page 8 Toolbox

Page 10 The regional Perspective

Page 22 Peer Learning

- **The outcomes**

Page 24 Key Developments

Page 28 Conclusions & Recommendations

Page 30 Contacts

P 8

About biogas and BiogasAction

Background & Importance

P10

BiogasAction in practice

Actions & Achievements

P 12

The outcomes

Results & Impact

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BiogasAction

Biogas plays an important role for Europe to achieve its ambitious climate targets for 2020 and 2030. Biogas is a major game changer in finding suitable solutions for the most polluting sectors in Europe, including electricity, transport, industry, agricultural and residential sectors.

BiogasAction was initiated to promote the production of sustainable biogas on regional levels giving rise to renewable gas on regional level, throughout the whole country and beyond. Special focus lies on exchanging best practices, creating new business models and increasing investments in biogas production.

The purpose of the project is to serve as a vehicle for rapid development of the European biogas/biomethane sector. This undertaking will contribute to the EU-2020 targets, by focusing on the removal of non-technical barriers to enable the widespread production of biogas from manure and other waste.

The project is based on a deeper cooperation between the different policy levels (regional, national and European), and on its implementation in various EU regions.

This publication draws up an overview of the activities developed during the BiogasAction project. It shows positive examples and recommendations to steer the promotion of biogas in the EU, focusing on regional pre-conditions and approaches.

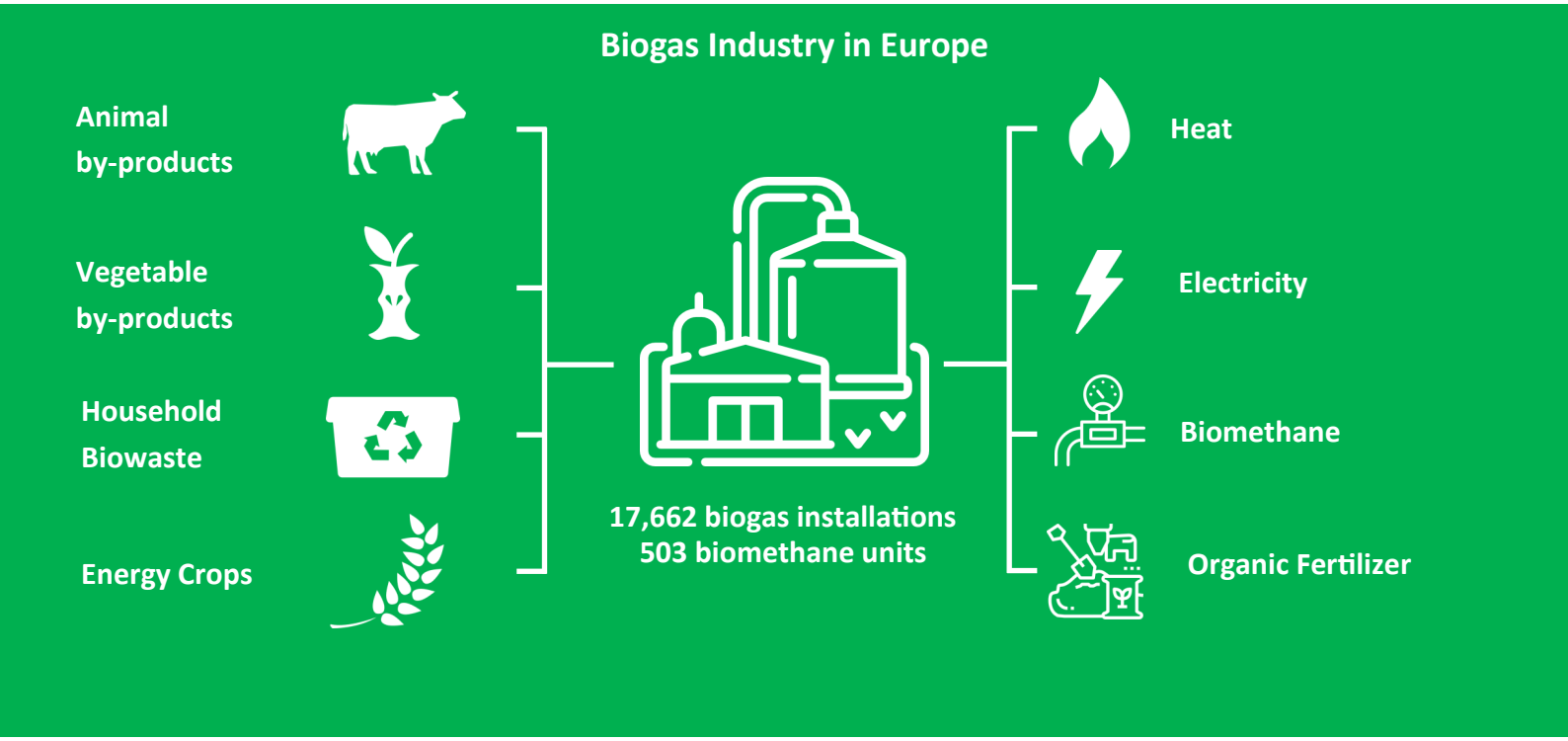
For more information, see:
biogasaction.eu/downloads

Biogas

Biogas production is a **natural degradation process** of organic biomass taking place in the absence of oxygen. The biogas production process is very robust and accepts a wide range of biomass types such as households biowaste, animal by-products and plant residues. **Biogas is a gas mixture of mostly methane and carbon dioxide**, along with water, oxygen and other trace gases, which can be converted into **electricity** and **heat** in cogeneration units (Combined Heat and Power - CHP). The share of methane (CH_4) in biogas can be increased to provide **biomethane, a product of natural gas grade**, with the purpose to be injected into the gas grid and used for any known gas end use such as heating and cooling or transport. The degraded biomass is transformed into **digestate**, a stable organic matter rich **in nutrients usable as fertiliser in organic agriculture**.

The biogas production process and its related technologies have been used for centuries in Europe and around the world: there is evidence of anaerobic biogas production going centuries back with for example the Chinese dome digester and the Indian floating dome.

The total biogas production amounted to roughly 180,000 GWh (end 2015) and more than 30 TWh of electricity (end 2016), with 10% of the biogas production being upgraded to biomethane (17,200 GWh, end 2016).



In Europe, the biogas industry has been growing significantly since the beginning of the 1990s, reaching **17,662 biogas installations** and **503 biomethane installations** by the end of 2016.

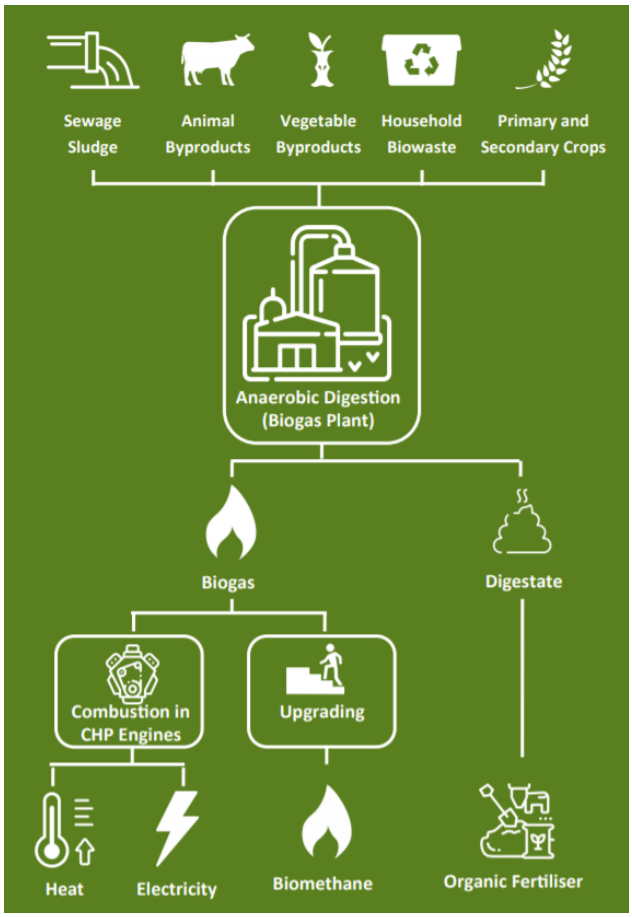
The findings obtained during the BiogasAction project show that more than 70% of the 2016 biogas production is likely to have been caused by national support schemes. The sectoral growth is now stabilising in some countries due to national legislation updates and support schemes running out.

Many forecasts however estimate that the biogas industry has much space to grow, based for example on newly developed feedstock such as cover crops.

Biomethane

Biogas can be upgraded by separating carbon dioxide and hydrogen and thus increasing the share of methane. After the **upgrading** process, **biomethane** is obtained, which has the same properties as natural gas and can therefore be easily injected into the local gas grid.

Biomethane production is currently sky-rocketing in Europe. High climatic performance of biomethane, for example in the transport sector, could play a crucial role for emission reduction and is being promoted in Scandinavia, Italy, UK France and Estonia. Other promising innovative technological pathways, such as **biomass gasification** (syngas) and **power-to-methane,** are expected to lead the way for growth in future years for the biogas industry.



Biogas development

A great variety of factors are likely to have a considerable impact on biogas and renewable energy production. BiogasAction has identified four main pillars for the successful market integration and expansion of the biogas technology:

- **Social and environmental conditions**
- **Legislative context**
- **Technology development**

LEGISLATION

ECONOMIC

1. Costs
> CAPEX (investments)
> OPEX (substrates, maintainance)

2. Support
> Investment & operation

> Bank loans

3. Revenues
> Biomethane, electricity, heat and digestateor

TECHNICAL

1. Input material: Substrates

2. Output: biogas/CHP, biomethane, digestate

3. Efficiency and stability of the process

SOCIAL

1. Social acceptance by local community

2. Social acceptance of the technology branch on national level

3. Market requirements

4. Public opinion on waste treatment, agriculture and independence for energy and heat supply

ENVIRONMENTAL

1. Greening agriculture

2. Climate change and emission mitigation

3. Waste treatment

4. Green energy

5. Circular economy

STAKEHOLDERS

Plant operators of existing plants, plant investors, biogas plant supporting environment

ECONOMIC ASPECTS

Renewable energy technologies are quite young compared to the conventional energy generation based on fossil fuels and therefore need financial support during their phase of emergence.

Support schemes are implemented into European and national policies with the aim of generating artificial market demand for renewable energy and thus stimulating technical progress and increasing the renewable energy share in Europe.

TECHNOLOGY OPTIONS

Biogas can be used on site to either generate heat and electricity in combined heat and power units (CHP) or heat in a gas-fired boiler. Therefore, biogas producers can generate energy on-site with their own residues and reach energy self-sufficiency for their own enterprise, and also for local communities.

Digestate is the second but often underestimated product of anaerobic digestion. It contributes to carbon and nutrient sequestration into the soil and is a valuable organic full-compound fertilizer.

SOCIAL BENEFITS

Biogas and biomethane are ‘all-rounders’; their many advantages can improve the daily life of the public while significantly contributing to the EU targets for greenhouse gas emissions (GHG) and climate change mitigation.

In addition, this renewable energy is generated locally and brings many advantages to rural regions in Europe such as allowing for local investments and increasing the local employment rate.

ENVIRONMENTAL BENEFITS

Biogas and biomethane, as some of the most flexible renewable energy carriers, are an excellent solution to many of today’s energy-related problems.

Biogas technology is a crucial player for Europe to meet its energy and climate targets.

Biogas contributes to circular economy, as it closes the nutrient cycle and is an excellent solution for waste management.

Toolbox

One of the outputs of BiogasAction has been the implementation of an online toolbox providing information to help biogas plant owners manage and develop their own plants. The project analysed existing documentation and tools providing information on past EU projects, national tools and biogas plant success stories.

In former national and EU projects databases, tools and guidelines have already been developed and applied within project duration and eventually longer by project participants. However, the produced outputs don't find wide application afterwards. The BiogasAction toolbox makes such successful tools available to the public.

The main goal was to provide an EU-wide analysis of the biogas sector with a specific focus on successful regional initiatives. Throughout the whole project, data and information were gathered to build a solid knowldege base of existing EU and national projects and tools concerning the biogas industry both at Pan-European and national level. This compilation of data provided essential information on the state of play of biogas development, which was used to build the roadmap of the BiogasAction project.

The toolbox includes:

- **National tools**
  - ◊ Information materials (publication, scientific paper, promotional brochure, technical brochure, video, etc)
  - ◊ Website
  - ◊ Networking tool
  - ◊ Map
  - ◊ Policy/legislation tool (policy paper, position paper, recommendation paper, etc)
  - ◊ Calculation tool
  - ◊ Software
  - ◊ Description of national/regional projects

The BiogasAction Toolbox provides

> Best-fitting tools to develop a new biogas plant project

> Detailed information to find your optimal biogas project set-up

> Information on existing biogas incentives

For more information, see:
http://tools.biogasaction.eu/#/

Toolbox: Database to guide biogas plant developers

BiogasAction has developed a free-access online platform to share the compilation of data carried out during the first stages of the project. The information is presented via a user-friendly search tool, allowing visitors to find the best fitting tools, guidelines and success stories for any given biogas project by selecting the specific pre-conditions for that project.

Search filters on the front page of two search tools allow the user to choose suitable categories (language, tool type, support, substrates, plant size, output), leading to the corresponding tool. The user is provided with a list of European countries involved and the type of information the tool is providing.

Tool I: Discover the best-fitting tools available to develop your project!

Visitors can make use of the extensive BiogasAction database, providing existing tools and guidelines for biogas promotion in Europe to boost the development of your operating biogas plant or to find answers for your planned biogas project.

Tool II: Find your optimal biogas project set-up!

This online tool allows users to discover successful biogas installations across Europe and find the perfect match for their own local conditions. Users can navigate between different plant categories based on the main substrate use, the production type and received support. Information about the legal backgrounds of each European country and their influence on the development of the national biogas market, along with national renewable energy targets, are available.

Toolbox: Information on existing biogas incentives

The European Biogas Association (EBA), the international BiogasAction partner, has gathered information on existing European incentives for biogas plants, (support schemes, FiT, FiP, tax exemptions, etc.) set at national level. The availability and quality of such instruments are compared to the national development of the biogas sector.

The report covers more than the EU-28 Member States, beyond the BiogasAction partner countries, providing statistics going back to 1990. The data gathered for 30 different countries suggests that 70% of the 2016 biogas production was likely to have been caused by the main support scheme in the country, with an average of three years lag time between the start of the main support scheme and a significant rise in biogas production.

These findings show that adequate support schemes are crucial for the development of renewable energy: the 2016 biogas production would not have reached 16.6 Mtoe without the national schemes in place through the different EU countries. Adequate support schemes are needed to secure new technological pathways in the biogas sector, such as power-to-gas, dry AD and biomass gasification.

The regional perspective

The experience of BiogasAction project partners showed that the most effective trigger to stimulate the deployment of biogas/biomethane technology is a regional approach which was tackled through six main actions.

Actions at regional level:

1. **State of departure and implementation plan**
2. **Institutional building**
3. **Strengthening the biogas sector framework**
4. **Optimizing business models & financing of biogas**
5. **Optimizing biogas production**
6. **High-quality biogas project development**

Regional Action 1

State of departure and implementation plan

The purpose of the first task was, for each partner, to define an intervention strategy and implementation plan, addressing almost all relevant aspects of biogas deployment. This functioned as a guideline to evaluate the achievements during the whole project.

Before setting the scene for an intervention strategy, each partner prepared a detailed state of departure which focused on the institutional set-up, the local or national framework, challenges among financing and business models, training and capacity building and finally an overview of existing and planned biogas plants. The findings were analyzed through a SWOT and stakeholder model and then used to set the scene for the implementation plan.

The implementation plan was built taking into account the state of departure for each region. The result was that each region could face its challenges and benefit from the intervention at a local level and at the same time learn from the other regions, as different approaches were taken to tackle the same challenges.

Actions and findings

- **There is great potential for biogas in all countries – especially from agricultural waste and by-products.**
- **To release the potential, there is a need for more support, external financing or involvement of other actors such as energy companies.**
- **The incorporation of positive externalities from biogas production is important.**
- **Biogas plants are missing educational facilities to educate current and future staff.**
- **New markets are emerging and new technologies are becoming more reachable e.g. upgrading technology.**
- **The political environment towards biogas differs from one region to another.**

The regional perspective

Regional Action 2
Institutional building

The focus of institutional building is establishing national/regional platforms for a local steering group, a stakeholder forum or an expert group and ensure that the promotion of biogas is on track.

These platforms provide input and guidance throughout the project's life and, after the project ends, to the respective region. The institutional-building was also complemented with networking, mobilization of stakeholders, assistance to solve bottlenecks and exploration of new solutions during action.

The project supported the establishment and development of networks according to the regional or local situations and requirements. In case of existing national or regional biogas networks close collaboration was initiated. Different kinds of events were organized, ranging from small networking meetings aiming to develop close connections to big biogas conferences with a high number of participants aiming to exchange on biogas development.

The stakeholders of the networks were usually quite variable. Some of them were focusing on the policy issues while others were more focused on the technology of biogas production. The approaches of the partners were adapted to the local situation, which is a real strength of this project.

Activities and findings

- **Both existing and new networks have been established and strengthened.**
- **Network building was elaborated on all levels – from national to regional to local level – from political to technical level.**
- **In some regions, there is a growing and existing interest in biogas and therefore networks have functioned as both knowledge sharing and coordinating networks.**
- **In other regions, the biogas knowledge needs to be spread and incorporated to the political sphere.**
- **The networks are reflecting the local situation and the local challenges.**
- **Networks and institutional building were well integrated to the project and will carry on when the project ends.**

Denmark

Network for biogas plants and educational institutions

The Danish project partner, the Danish Technology Centre for Biogas (DFFB), has built a network among biogas plants to optimize their operation. This has comprised benchmarking and cooperation on different aspects of biogas production.

The Danish project partner has also identified opportunities to improve the training for the biogas industry. This has resulted in a network that provides courses for teachers and also courses and programs for the biogas plant operators. Before this intervention the Danish biogas sector was an unknown area for the Danish educational institutions, which now recognize vocational training and certified education fitted to the biogas business.

UK

Working with Government and communities in Wales

The BiogasAction intervention in Wales has concentrated on the promotion of small **on**-farm Anaerobic Digestion (AD) that digests animal wastes (slurry, manure and litter) to facilitate best practice in terms of pollution abatement, nutrient and soil management and use of biogas. The Welsh partner, Severn Wye Energy Agency (SWEA), formed a stakeholder group to bring representatives of the Government together with other stakeholders – including regulators, academics, AD trade bodies, farming bodies and plant designers and manufacturers. This relationship proved highly beneficial with information and valuable contact information flow.

Institutional-building has also taken place with community-owned companies located in the post-industrial slate towns and villages in northern Gwynedd, on the edge of the Snowdonia National Park. As part of this, SWEA has helped to assess the potential use of waste products from processes in the area and made proposal on how to use these products (spent lees, pot ale, wash water and draff) as well as capturing biogas from a slurry tank. This represents a considerable replication potential as there remain many uncovered slurry tanks around Wales.

The regional perspective

Regional Action 3

Strengthening the biogas sector framework

This action sought to define and influence ways to improve the identified framework in the state of departure. It was focused on how to improve the conditions for biogas development. A key issue was to ensure the involvement of policy/decision makers and to establish a fruitful dialog between stakeholders. It was also essential to engage farmers' associations, financing institutions and other relevant actors in this process.

Each regional partner had different approaches to this action. Partners focused on how to influence policy makers and how to improve the framework for biogas. In some regions, the framework for biogas was already quite successful, while others struggled with the biogas framework.

Strengthening the framework was both done through conferences, workshops and network activities. In some regions the partners had to start from almost zero and build up new views on biogas. This was done for instance by integrating biogas in a new perspective for the region, such as highlighting its role on agriculture or promotion of renewable energy sources. In other regions with good national framework conditions, the focus was on the local framework for biogas through close contact with local authorities. In the project, the partners had the opportunity to share the different approaches and ways of strengthening the framework.

Highlights

- **There are multiple ways to handle the biogas sector framework.**
- **Public authorities have multiple points of view on the development of biogas.**
- **It is important to inform public authorities (and citizens) that biogas:**
  - **has a different economy of scale compared to wind and solar.**
  - **is more than just energy – it also has a crucial effect on climate, environment, industries and agriculture.**
  - **is storable.**
  - **is part of a circular economy, contributing to carbon and nutrient recovery.**
- **We need to break down silo thinking! Biogas is important for many aspects influencing the political sphere.**

Sweden

Regional Strategy & Action Plan for biomethane in South East Sweden

The Swedish partner of BiogasAction, Energikontor Sydost (ESS), has long been involved in developing strategies to help its three counties reach the target set by the Swedish Government of a fossil fuel independent transport sector in 2030.

Building on previous projects, BiogasAction has helped facilitate specific initiatives to fulfil this vision. A real breakthrough came with the public procurement of buses that, in Sweden, goes under the name of “Doing a Kalmar”. This procurement resulted in a big interest to produce biomethane especially among farmers and thus has been a key factor in boosting the development in those countries.

Latvia

Raising awareness and energy planning competence

It is important to raise the awareness of the biogas potential among local municipal administrations, regional planners and decision makers. The Latvian BiogasAction partner, Ekodoma, organized public events and participated in trade fairs to pave the way for a better understanding of the technology, notably biomethane which is still quite unknown in Latvia.

In partnership with the Zemgale Planning Region, an event was organized for municipal administration officials to discuss potential biogas resources for green transport. The intention was to integrate biogas in the municipal Sustainable Energy Action Plans (SEAP) for the next seven years, and, based on these SEAPs, to motivate municipalities to cooperate with local biogas operators and to find mutual benefits in biogas production. The recommendations of BiogasAction were included in 16 SEAPs within the region. This included the use of different project tools to develop a comprehensive regional plan for transport energy. In the long-term, these efforts could lead to more stable and sustainable policies regarding the development of the biogas and biomethane industries in Latvia.

The regional perspective

Regional Action 4

Optimizing business models & financing of biogas

The aim of this task was to create opportunities for bringing relevant business or distribution models into play, such as promoting community investment projects for biogas. Again there were different starting points for each region. The models and good practices from earlier projects, identified in an earlier stage, were first adjusted and implemented at local level, and then combined with the experience at EU level and the major trends in the area. Each intervention partner had to go into dialogue with upcoming biogas projects to optimize business and financing models based on the knowledge obtained and shared in this project.

This part of the project provided important developments, as the regional partners were working with business or financing models for different projects on different levels, from small to large scale biogas plants, from production issuers to financing issuers.

Some of the partners used models from precedent projects, such as Bioenergy Farm II, to obtain their first calculations. This model was supported with figures from other different projects. This procedure enabled partners to get more precise calculations. Getting figures from previous experiences was a useful supplement but the information was not always easily accessible.

Highlights

- **Empirical figures are a good supplement to theoretical calculations.**
- **Earlier developed tools can be useful when adopted to a new local reality.**
- **Biogas is unknown by financial institutions – BiogasAction contributed by providing knowledge.**
- **Business models and financial models take a long time to develop.**
- **Business models are heavily depending on framework conditions and therefore we need long-term legislation to ensure their implementation.**
- **Business models (especially plants based on manure) are depending on the agriculture situation due to transporting costs.**

France

Guidebook on financing of biogas projects

The development of a biogas project is complex and requires significant investments from project holders. The French BiogasAction partners, AILE and RAEE Auvergne-Rhône-Alpes and North-West France, together with two consultancy firms specialized in financial studies, have prepared a guidebook providing advise on risk analysis, as well as expert answers and feedback to attract investors. It encourages the stakeholders to make a diagnosis of their project that will help them handle their relations with financial institutions.

The guidebook has been sent to 500 stakeholders of the French biogas sector. It has also been used in the Financing working group and training courses organized by ATEE Club Biogaz, the French Biogas Association.

Netherlands

Biogas hub Noord Deurningen

The biogas hub in Noord Deurningen (Overijssel) is a unique project, where a group of 20 farmers, all situated within a radius of 7 km, plan to build a joint micro scale digester. The produced biogas will be transported to a nearby industrial zone, where several factories will use the biogas to produce steam for their production processes. CCS, as the Dutch partner of BiogasAction, helped to develop this business case. On every farm, a simple mono-manure digester is built and manure is pumped from the stable to the digester. The biogas is dried on farm and then transported to the industrial area, via a dedicated biogas pipeline. There the biogas is used by several companies to produce steam.

Building such a hub of many small biogas producers together with some industrial activity brings important benefits and the investments per farm are kept as low as possible. Training is offered to the operating farmers connected to the hub and the example is used to inspire other initiatives in the Netherlands.

The regional perspective

Regional Action 5

Optimizing biogas production

A key aim of biogas development is to undertake training and capacity building at the management and operational staff level. The state of departure showed that almost all countries/regions had no or only few training activities concerning production and management of biogas. Technical and management training contains a great potential for developing the biogas sector and requires collaboration with educational institutions for developing training and educational facilities.

This task included the establishment of a training structure, participation in training activities and undertaking periodical training in partner countries of existing and future plant operators, farmers, etc. These activities could also build on the existing material from the previous biomethane regional projects. The aim was to continue the training after the end of the project and to replicate the training structure Europe-wide.

In this action, different approaches around training and knowledge sharing were undertaken. Partners have completed training session for operators and board members in different ways. Some have also worked with a plan for training package. The training sessions have been done through knowledge sharing between operators and through educational institutions.

Highlights

- **Many biogas plant operators are self-thought.**
- **A large number of training sessions and activities have been developed**
  - **knowledge sharing, class room training, training on the job, videos, etc.**
  - **pumping courses, financial training, management training, board training, production training etc.**
- **Challenges:**
  - **At small scale biogas plants, training is not known or little known.**
  - **Most training is done "on the job" – "we are building while we are sailing" .**
  - **Training material is not developed at the educational institutions (need for developing material)**

Latvia

Education of biogas professionals in Latvia

The operators in the Latvian biogas industry are mostly self-taught, having received little training in the field. The increasing research on biogas production carried out recently should be accessible to biogas operators.

The Latvian partner of BiogasAction, Ekodoma, offered accessible training to all interested parties from biogas industry professionals to the general public.

In partnership with Riga Technical University, Ekodoma organised a summer school led by academic experts and professional industry practitioners in the field of renewable energy. The intention is to organize this academic event on a yearly basis as a platform to develop the biogas industry.

France

Advisory committees to train companies & institutions in Auvergne-Rhône-Alpes

BiogasAction partner AURA-EE, as regional energy agency, is in touch with local suppliers/companies, local authorities, institutions and project owners in the region. AURA-EE organized advisory committees twice a year with companies, administrations, research centers and project owners to promote the exchange of expertise and know-how on topics developed within the advisory committee. There are two types of events: conferences with local partners that share their knowledge on specific topics and information-exchange sessions with a visit to a local company.

The topics discussed have to be in close connection with the latest evolutions in the sector. The lively discussions between the different stakeholders, notably on sector challenges, have proved to be a productive way to promote improvements in the current framework.

The regional perspective

Regional Action 6

High-quality biogas project development

The scope of this key action was to exploit specific opportunities for biogas production and to help potential entrepreneurs bring forward their projects. It provided practical assistance to farmers, private investors, other target groups and planning authorities. BiogasAction partners worked with planning tools, calculations and other kinds of advice support, which are summarized in the online toolbox, in order to develop projects.

This was done in connection with private investors, local authorities and other stakeholders. The project partners took every opportunity to help the development of local sustainable biogas and biomethane production by looking at different local projects and guide them with help and supervision.

There was a wide range of projects supervised in the framework of BiogasAction, from small scale farm-based biogas plants to larger biogas plants, which were expanding the production of biogas. Also projects with combined heat and power (CHP) production often started to focus on biogas upgrading to produce biomethane.

The amount of time needed from the conception step to the implementation stage was one of the major challenges. For that reason, many of the projects monitored in the framework of BiogasAction have not resulted in a biogas plant yet and they are still underway or in a planning phase beyond the lifespan of the BiogasAction project. This highlights the need for further assistance in the development of high-quality biogas development.

Highlights

- **New biogas plants have been established during the project.**
- **We have seen both CHP plants and upgrading to biomethane.**
- **Pre-treatment plants have been assisted.**
- **The establishment of new ecological biogas plants was supported, bringing new possibilities and market opportunities of biogas plant operators.**
- **Cross-country corporation for biogas plants development.**

Czech Republic

Internal use of biomethane for transportation

The Czech BiogasAction partner, Czech Biogas Association (CzBA), provided support to optimize an existing biogas plant on the Choťovice farm. This farm had previously been expanded to run an agro-tourism taking advantage of the heat from their combined heat and power production unit. The new initiative was to produce biomethane to be used by the vehicles of the own farm.

The implementation of such new technology tends to be complicated and difficult. However, there are good prospects that it can offer a new and cheap technology solution for wide replication.

Croatia

A family farm with a biogas plant

This case represents a pioneering example of creating synergies between farming and biogas production in Croatia. The Croatian BiogasAction partner, Energy Institute Hrvoje Pozar (EIHP), has investigated in finding feasible ways for biogas development following the reduction of financial support in the sector. OPG Vrček is the only family-farm producing biogas in Croatia. It is well integrated within the family business of meat production, together with their 300 ha of arable land for fodder, food and fuel production. In 2016, this plant received the “The best family farm” prize.

In addition, the biogas plant provides solutions for manure and waste management. The substrate to produce biogas is slurry coming from the farm with addition of organic matter, including a portion of energy crops grown on their own land. The digestate resulting from biogas production is applied as rich fertilizer for growing the crops, which closes the loop of the nutrients cycle. The OPG Vrček plant proves that a family farm can also be a biogas producer in Croatia. This is a very positive example which can be followed by other family farms.

Peer learning

The regional perspective was an essential pillar of BiogasAction. This approach was complemented with peer learning activities where project partners shared their experiences and learnt from each other.

The peer learning activities were aimed at looking into successful examples and testimonies from experienced partners, identifying local initiatives and needs or sharing information about the tools and methodologies available.

Building on this knowledge-sharing activities, BiogasAction partners were able to identify success factors for biogas development at regional level and reflect on how the different initiatives can be transferred to other EU regions.

In the framework of BiogasAction,
3 peer learning workshops were dedicated to:

- **Institutional building**
- **Business models and financial tools**
- **Advanced applications**

Institutional building

The process of institutional building is necessary to create a positive perception on the development of biogas. It helps mobilizing stakeholders to build trust and create a favorable environment for the development of the sector.

Establishing the adequate links becomes crucial, for instance, by connecting project owners and local authorities to make communities understand the positive return of biogas development. In the economic perspective, it is necessary to display the positive economic effects to companies and suppliers working on the biogas environment to promote future developments. In legislation, the link between the national level, where targets are set, and the regional level, where these are implemented, is also essential.

Business models and financial tools

During this session, BiogasAction partners analyzed different types of business models and financial tools for biogas projects, including calculations based on former projects. They also looked at best practice examples from the different regions. This activity helped them identifying important aspects to take into account when developing and promoting a new biogas project in their regions:

- Involve local authorities, elected representatives and neighborhood as much as possible, as they often play an important role in the development of the projects.
- Identify stakeholders, learn about their needs and understand the connections between them.
- Choosing the adequate approach to each project is essential.
- Use convincing arguments: economic and environmental benefits, such as job creation or emissions reduction.
- Take advantage of existing communication and calculation tools developed by former projects.

The peer learning activities were aimed at:

- **Presenting successful examples and testimonies from experienced partners.**
- **Identifying local initiatives and needs.**
- **Sharing information about the tools and methodologies available.**

Advanced applications

This workshop aimed at::

- Providing an insight on the available biogas application technologies.
- Learning about farm scale digestion, energy production and consumption.
- Providing information on nutrient recovery technologies.
- Looking at the different biogas application technologies and nutrient recovery technologies in practice.

On this occasion, the workshop combined the knowledge-sharing activities with an excursion to two biogas plants using advanced biogas applications. These plants provided some of the best examples of the advanced biogas applications which had been discussed.

Key developments

Public acceptance

Public acceptance is identified as a key factor influencing the broad implementation of renewable energy technologies and the accomplishment of energy policy objectives. Significantly expanding bioenergy will not be feasible without social acceptance, which is primarily established through public trust and support, and this requires a policy framework for efficient and interactive communication between stakeholders.

Public acceptance depends on perceived benefits, trust and perceived costs. The current situation should be analyzed considering the following elements:

- Attention for renewable energy: how well people understand and how well people are informed about biogas and its applications in general
- Biogas interest: preferred applications of biogas and preferred resources for biogas production
- Biogas project acceptance: pros and cons of biogas production in the neighborhood
- Regional climate: open-mindedness of local actors and trust in local actors

- Demands to the region: sustainability, support needed from local authority
- Individual values and commitment: concrete actions the biogas promoter might take according to local public needs

At least 2 major actions can facilitate public acceptance:

Networking: *In order to effectively improve relations with neighbors, it is necessary to combine forces in favor of goals that are to be reached by biogas applications. Networking can change alone plant owners' position from futile complaining to coordinated, concerted action.*

Public Relations: *Good public relations are a precondition for the development of successful actions. The concept of public relations is the management of an enterprise's or individual's public perception. When an activity is planned, this should build on a solid base of well-established relationships between the actors and the public.*

Arguments beyond economic factors

Biogas support policies are fast changing and feed-in tariffs are either being reduced or cancelled, leading to new economic conditions for the sector. Biogas plants need to revise their strategies to overcome this change and develop new business models addressing new applications, societal and environmental challenges.

Several new opportunities have been considered to further support the development of biogas:

- Regional distribution (green labels, regional incentives for environmental friendly approaches in Germany)
- Marketing through direct grid connection and distribution (electricity and gas produced and sold directly to local customers: new regulations)
- Fertilizer business (alternative to direct spreading on the fields, producing organic fertilizers)
- Flexible production of electricity (production when high price of electricity through biogas storage)
- Gas use from slurry and digestate storages (covering digestate storages)
- Gate fee tariff (waste plants)
- Improve political acceptance (reduce GHG emissions, energy independence, diversification and energy mix, rural development)
- Indirect value (improved quality of liquid manure and avoidance of contamination of the ground and surface waters)
- Biogas upgrading (selling gas, biomethane injected into the grid, biomethane as vehicle fuel)

Lessons learnt

- **The biogas situation is changing due to national legislations (less electricity support)**
- **Energy crops are limited and hence economically less interesting**
- **The focus was on:**
  - **Different ways of marketing the AD products biogas and digestates**
  - **Flexible production of electricity: the AD system is the only renewable solution to the flexibility issue of renewable energies**
  - **Biomethane as a biofuel for transportation**
  - **AD technology as solution for manure and biowaste treatment**

Key developments

Pocket-sized digesters

Small-scale or pocket digestion is a technology where the anaerobic digestion process is applied to proprietary biomass flows for the on-site production of renewable energy. Pocket digestion is a tool for agricultural companies to increase self-sufficiency in terms of energy demand and thus to be less dependent on fluctuating energy market prices. In addition, the farmer is able to produce renewable energy using residual (waste) streams inherent to the daily operation of the agricultural enterprise, and at the same time actively help achieving the European goals for renewable energy.

Although there is no internationally accepted legal definition for pocket digestion, there is a consensus that the term "pocket digestion" is applicable to installations with a proprietary biomass supply that produce energy in function of the proprietary energy demand. It could be characterized by being physically small in size rather than by its output.

Non-technical barriars:

- European regulations
- Health and Safety issues
- Lack of standards for biogas boilers
- Renewable energy incentives have largely removed the "polluter pays" principle
- Lack of awareness for the circular economy approach of the biogas sector

Key findings:

- **Pocket digestion is a tool for agricultural companies to increase self-sufficiency in terms of energy demand and reduce the environmental impact (i.e. greenhouse gas emissions) of residual waste streams.**
- **Technology solutions exist across Europe that have been deployed in the UK, BE, NL, France, etc.**
- **It is an opportunity in a "bright new world":**
  - **with less packaging – especially plastic packaging,**
  - **more public pressure for holistic solutions,**
  - **a greater emphasis on local produce**
  - **and AD regulated better (i.e not simply treated as a Waste Management system).**

Is there a place for such digesters in the EU?

- If the driver is solely renewable energy then the practical and legislative problems will deter all but the most enthusiastic people.
- If the diversion of food or other organic "waste" from the waste stream is the primary motivation then it will usually be far less complicated to contract with a larger AD plant to take the material
- It is the "holistic" system that is likely to be the major opportunity – driver.

Capacity building

Capacity building (or capacity development) is the process by which individual and organizations obtain, improve, and retain the skills and knowledge needed to do their jobs competently. It encompasses a wide variety of activities (such as fundraising, exposure visits, office and documentation support, on the job training, etc.) and organizations (training centers, academic actors, consultants, etc).

Several new opportunities are being considered to further support the development of biogas:

- Biogas is a recent field of activity – very few dedicated and integrated courses are available. Trainers are lacking. Many biogas plant operators are self-taught.
- Business associations tend to focus on framework conditions for biogas and less on capacity building.
- Paradigm shift for farmers and plant operators to integrate biogas production for power and heat generation with the production of organic fertilizers.

Highlights & valuable advice:

- **Know well your national and regional educational systems and closely cooperate on the development of biogas integrated or dedicated courses.**
- **Consult farmers and plant operators. Identify their training needs and best ways of implementing them.**
- **In complement, propose courses they already know – e.g. ATEX (safety courses in DK) – that way they get to know you.**
- **Develop adapted training solutions for "self-taught" plant operators.**
- **Follow up one plant in particular and gain on-site knowledge and experience.**

Conclusions & recommendations

BiogasAction has aimed to serve as a vehicle for speeding up the development of the European biogas/biomethane sector, by focusing on the removal of non-technical barriers to the widespread production of biogas from manure and other waste in different EU regions.

A consistent biogas framework

Biogas production involves many different players: farmers, industry representatives, energy producers or public authorities, among others. **Thus, the successful development of biogas requires regular cooperation within the different stakeholders** to exchange information and knowledge on the state of play of the biogas sector. An important challenge for BiogasAction was the promotion of synergies and exchange of information between these different actors. One of the key actions of the project has been the development of an online Toolbox in the form of a free-access online platform (http://tools.biogasaction.eu) with useful information and tools for biogas plants developers. This Toolbox can be applicable across EU countries, whilst other information and tools must be adapted to the local level.

The development of a suitable regulatory framework is also essential to promote biogas development. BiogasAction partners have identified a lack of knowledge on biogas within the public authorities, which can be challenging for the development of biogas. This can be tackled by promoting knowledge-exchange between public authorities and other stakeholders. Case studies and other materials have been developed by BiogasAction to showcase how this can be done in practice.

Raising awareness on competitiveness of biogas compared to other renewable sources is also crucial. Biogas helps develop local energy production, reduce emissions and promote the implementation of a sustainable economy. At the same time, it has advantages concerning energy production, as it is a storable and flexible energy source, which can help balance the intermittent supplies of other renewable energies. In addition, the soil application of biogas is important for closing nutrients cycles: some of the elements resulting from biogas production can be used as organic fertilizers, which is an important contribution to circular economy.

Initiatives for biogas development for existing and forthcoming biogas plants

The development of a biogas plant has to be adequately assessed and supported by existing data and information. Having this in mind, the development of biogas models, the optimization of biogas production and the implementation of biogas projects have been a large part of BiogasAction. Working with biogas models requires both a theoretical and empirical foundation. A well-established relationship with existing biogas plants is essential to get the adequate data to support successful models for biogas development.

Biogas production tends to be predominantly self-taught across Europe. The close cooperation between the industry and the research sectors is of paramount importance when considering biogas optimization. Regular and high-quality training and education for biogas professionals are essential for the development of new technologies to improve biogas production.

Further cooperation between biogas developers is also essential. Each year, biogas projects and plants are spreading in numbers across Europe. Understandably, such endeavors take time to come to fruition. For that reason, it is crucial to initiate constructive dialog with potential project carriers as early as possible to help ensure the highest possible quality of outcome. In that respect, the Toolbox and examples of BiogasAction can be inspiring and enriching.

Recommendations

- **Increase cooperation between the different stakeholders involved.**
- **Take advantage of available knowledge, data and information – e.g. BiogasAction toolbox.**
- **Create knowledge groups to improve competences on biogas among the public authorities.**
- **Incorporate biogas in strategic plans for energy, as it provides alternatives to challenges that other types of renewable energy, cannot solve.**
- **Raise awareness on the need for further support to biogas to improve business competitiveness.**
- **Encourage biogas owners to share knowledge with their peers.**
- **Build relationships with upcoming biogas plants as early as possible.**

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