Public final report BioEnergy Farm II

Manure, the sustainable fuel for the farm

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Cover picture: BBPROJ

www.bioenergyfarm.eu

CONTENT

1. Introduction

In this chapter the project is briefly introduced. Why this project, and why are the result of any use for the readers.

1.1 Reason for the project

The BioEnergy Farm II project had as general objective 'opening the market for small scale digesters'. More specific the focus lies on farm based biogas installations, fed with manure and left-overs from that very farm.

Some of the project partners knew each other from the BioEnergy Farm (I) project. This project, running from 2010 to 2013, focused on co-digestion (and wood combustion). During workshops for biogas entrepreneurs they found a huge interest amongst farmers for small scale biogas plants. At the same time in Belgium the low-budget on-farm biogas plants become very popular. This concept triggered some partners what made them decide to initiate a new project, focusing on farm scale digestion.

As farm scale digestion is relatively new (and very old), there was a lack of reliable and actual information. Information on techniques, on financial feasibility, etc. With the actions of BioEnergy Farm II we tried to provide answers to these questions. Data on all relevant subjects was collected and transferred amongst the different countries.

After three years of project we see a complete change of the market and opinion in most countries. This is reflected in the commission of **86 small scale biogas plants** with a total capacity of almost **14 MW**.

1.2 Reason for Micro Scale Digestion

The project has a very dedicated focus to micro scale digestion. According to the project partners there are some very good reasons why micro scale digestion (MSD) deserves a whole project:

Manure is generally seen as an important source for renewable energy production. The largest volume of manure is very hard to mobilize for energy purposes, as the farmers use the manure to spread over their own fields. The only feasible option to valorize these manure with respect to energy, is to digest it at the farm.

Whilst the first boom of biogas in Western-Europe was based on manure digestion, it was co-digestion that set the standards the last decade. Increasing biomass prices, scandals with digestate and decreasing profitability once again brought manure back in the spotlight. Newer and more efficient digestion processes, together with lowered investment costs shaped an environment for mono-manure digestion. With the introduction of the "low-budget on farm manure digester" in Belgium MSD was made feasible again, without adding of co-substrates.

With a general trend of farms growing in number of livestock, a digester becomes economic feasible for more and more farmers. As the trend towards on-farm digestion is relative new, there was / is a need for clear and unbiased information. The BioEnergy Farm II project facilitated this need. On the web portal and within the written reports farmers can find all the information they need before they can decide whether a biogas plant is a feasible investment for their situation. With the offline expert calculation tool famers and farmer advisors can make an economic feasibility study. For policy makers and other third parties that have to deal with MSD the most relevant information is put together in a comprehensive guideline. For specific questions the contact details of the partners are available so, if needed, an appointment with one of our experts can be made.

1.3 Consortium

The project was carried out by a quite large consortium, representing 7 EU countries. These countries were Denmark, The Netherlands, Belgium, France, Germany, Poland and Italy. For all countries, except Belgium, two companies / organizations are involved in the project. These can be Universities, farmers organizations, branch organizations or private consultancy companies. Generally spoken each partner is represented with a 'technical partner' and a 'farmers organization' partner. For a complete list and contact details, see Annex 1.

Figure 1 the consortium present at the first project meeting.

2. Approach and methodology

2.1 Project organization

As described above the project consortium is a team of 13 companies and organizations, all over Europe. To work together a structured work plan is needed. The general coordination of all tasks and the monitoring of the projects progress was done by the Dutch consulting firm CCS (Cornelissen Consulting Services B.V.). The subtasks were coordinated by others. The market research was led by the Danish company AgroTech, the trajectory regarding policy makers was led by the Polish company NAPE. The Implementation guideline for Farmers was accomplished by the German organization KTBL and the training program was organized by the German organization IBBK. The University of Turin was responsible for the implementation at farmers level. All communication and promotion was organized by the Flemish farmers organization Boerenbond. The two calculation tools were developed also by the Dutch company CCS.

2.2 Information research

An important part of the work was the collection of information. This had to be comparable information, valid for all involved countries. Therefore standard templates were designed that were used for the data collection. These templates were completed by the different partners, according to interviews with experts and research in available publications. As the partners are experts in the field of bioenergy and have their networks in the renewable energy, we can assume that the information provided is of high quality.

Concerning the market overview and the search for investment costs and running costs our sources are the actual suppliers of biogas equipment. The calculations tools use price information based on actual offers for real biogas plants.

2.3 Making of the tools

2.3.1 Guidelines

All information gathered is used in the different tools that were made in the project. The market information found its way to the market overview. In this report an outline is given of the actual market for small scale biogas and what suppliers are out in the market. In the leaflets existing and running biogas plants were shown, including the investment costs, running costs and annual income. Also the payback period for that plant is given in these leaflets.

Figure 2 print screen from the implementation section on the website.

The information about permit procedures, existing subsidies and possible tax reductions was put together in the farmer`s handbook "Implementation guide for small-scale biogas plants". Together with a step-by-step guide through the process "from idea to actual implementation"; a short introduction into the biological biogas production; types of gas utilization and digestate treatment, this farmers guideline is a must have for every farmer with serious interest in producing biogas from his own manure. (Still available at www.bioenergyfarm.eu/en/downloads-links)

For policy makers a guideline was written with the different advantages of MSD at regional level. Things like strengthening rural areas, decentralized energy production and the creation of jobs in peripheral regions were highlighted. Also the environmental benefits of MSD, with the extra advantage of reduced greenhouse gas emissions from manure storages have been explained in this guideline.

Next to that the different support systems were compared. In the different countries the design of support systems differs extremely, but also the height of the incentives are far from uniform. According to the implementation grade of MSD some support systems were recommended above others.

2.3.2 Calculation tools

To help farmers asses if a biogas plant is economical feasible (despite all other benefits the most important aspect) two calculation tools were designed. Using MS Excel a very elaborated calculation tool was build, that starts from the available biomass, via the replacement of different types of fossil fuels ends with a custom plant design and corresponding investment overview. To present the business case to banks or other financial institutions a complete breakdown of the costs is shown as a 20 years cash flow overview.

This tool is designed in such a way that simultaneously four different cases are calculated. This makes it easier for the farmer and/or his advisor to choose between i.e. a CHP (with electricity and heat production) and biomethane production.

As the offline expert tool needs some training before one can use it, we also made a simplified online version for farmers. This tool gives a more rough estimation of the feasibility, based on available substrates and country specific data, like energy prices and subsidies. This online tool had only one scenario, which is using the biogas in an on-farm CHP. Most important aim of this tool is to give a quick estimation if the amount of available manure is enough for a further research and to get in touch with the interested farmers.

2.4 Assisting farmers

The actual implementation of the project was the performing of scans for farmers and give them personal advice on the possibilities of MSD for their farm. Via the website, newsletters, articles and exhibitions we reached out information of our activities to the farmers. Interested farmers, met in the exhibitions or who left contact details in the website, were called and a scan was performed. When the first indication seemed to be positive, a site visit was arranged and, together with the farmer, possibilities for MSD were discussed. The site visit is important to get a better feeling with the farmer and the local circumstances. On the way to the farmer potential external energy users can be localized, and a tour on the farm gives information about possibilities for daily fresh manure collection or extra need for digestate storage.

Download the offline expert tool from www.bioenergyfarm.eu/downloads-and-links

"the best free available biogas tool that I know of"
participant in international workshop

When the business plan shows positive results, the next steps were discussed with the farmers. How to deal with the permit procedure? What kind of subsidies are available, and how to subscribe for them? And what manufacturer would meet the farmers expectations best? These and more questions were discussed with the farmers and where possible the project advisors assisted in finding the respective answers.

A pro-active follow-up was necessary to keep track on the proceeding of the plans and to track if the biogas plant was taken in operation or will be. Within the project period, more than 800 farmers amongst the participating countries were assisted with a business plan.

2.5 Informing policy makers

Policy makers formed a separate target audience within our project. As the developments in MSD goes fast, it is important to keep policy makers informed. As in the recent decades most experiences were with large scale co-digesters, it is important to clearly frame what a micro scale biogas plant is. With respect to environmental impact both types of biogas plants are hard to compare. A farm-based biogas plant for example has no need for every day biomass transportation by road, whilst a co-digestion plant has multiple trucks running every single day.

Another issue with MSD is the relative high cost per energy unit, compared to larger installations. On-farm installations need better incentives to build a positive business case. These can be justified by the external benefits of small scale installations, but someone has to explain this to the involved policy makers.

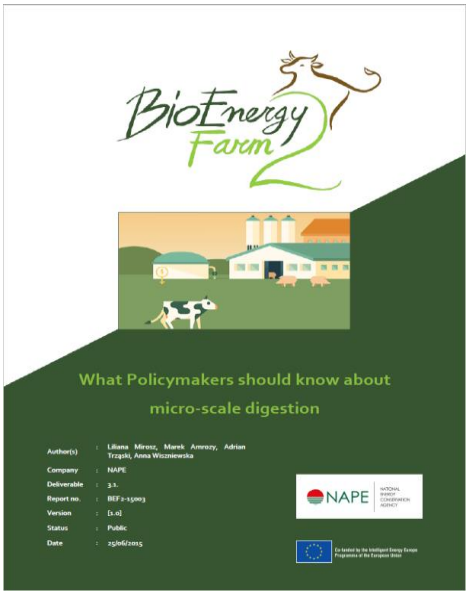

Figure 3 guideline for policy makers. Available at www.bioenergyfarm.eu/en/downloads-links/

Both topics, regulation and subsidies, were covered by the same report. This report was the basis for discussion with policy makers. The partners invited themselves to local, regional and national parliaments to explain the benefits and needs of microscale biogas plants. The respective guideline was given the name 'What policymakers should know about micro scale digestion'.
This guideline (as all other reports) has been translated and made country specific for the different partner countries. The international version of this report contains all information from the different countries and compares the different systems.

Figure 4 Picture of excursion to a biogas plant in The Netherlands

3. Direct results

The most important result of our project is the assistance of 802 farmers with a business plan. From these 802 plants we know that at least 86 are being built or are already running. These 86 plants have a capacity of almost 14 MW. Assuming a biogas plant to produce energy 8.000 hours/annum (>90% of the year), this results in 112.000.000 kWh / year.
The corresponding greenhouse gas reduction is 34.700.000 kg CO_2 equivalents per year.

3.1 Business plans

Most of the business plans that were made in the past 3 years were done for CHP, production of electricity and heat. 701 out of 802 business plans were for CHP. About 1/3rd of these business plans were not feasible (half of these were from Poland, were subsidies were dramatically decreased during the project period).
Most of the CHP business plans had a payback time below 20 years, what in most countries is the granted subsidy period. 69 business plans with CHP are to be built, or are already in operation.

For biomethane 52 business plans were conducted. Of these plans only 4 were not feasible. 34 (65%) had a payback period below 8 years, what made them good business plans with good potential to receive funding from the banks. 4 plants with a biomethane scenario are about to be built.
All biomethane business plans were made in the Netherlands and in Denmark. The plants that will be built are all in the Netherlands.

For the heat scenario 49 business plans were made, resulting in 37 plants (76%) with a payback period below 8 years. 1/3rd of these positive business plans will be actually build. Also the heat scenarios were all conducted in the Netherlands and Denmark.

3.2 Letters of intent

The part of the project focusing at policy makers had its own performance indicator, namely signed Letters of Intent. Policymakers or other legal officers we spoke to were asked to formalize their positive attitude towards MSD by signing a Letter of Intent. The general impression concerning all countries is that policymakers are very reluctant in signing anything like a Letter of Intent. We had to explain very cleary what the aim of this letter was and how this could be eventually thrown back to the ones who signed them. Despite these concerns we were able to get these signed letters of intent in all countries, cumulating to a 32 Letters of Intent.

Figure 5 Flemish policy makers signing a Letter of Intent during an excursion to a MSD biogas plant

A general response from policy makers is that the concept of on-farm digestion is considered to be positive for the environment and for local rural development. Most municipalities are very kind in collaborating with the project and individual farmers to obtain these kind of installation in their area. Where at a higher political level there might be some distance to agriculture enterprise, on the local level social cohesion is important and shapes a kind environment for non-industrial scaled biogas plants.

4. Remarkable findings

After three years working in the field of micro scale digestion we have encountered some remarkable things in this field. Some of these conclusions are described below.

4.1 Traditional conversion

Biogas production is in Europe synonym for CHP, Combined Heat and Power production. At larger scale installations we see the last years a vast increase of biomethane plants, making biomethane for grid feed-in or for transportation fuel. CHP becomes less popular thanks to ever lower prices for electricity and difficulties in valorizing the heat at rural areas (where co-digesters are located).

Regarding a CO_2 neutral economy, the role for biogas seems to be more in the field of industrial heat, substitution of natural gas and transport fuel. For electricity the focus lies on solar, wind and hydropower. Burning biogas for some electricity production is considered as too expensive in the long run.

Despite the focus in the workshops for alternative methods for energy valorization (biomethane, direct natural gas substitution) the far most business plans were made for CHP installations. As the interest for alternative scenarios during the workshops was high, this is a surprising result.

The actual reason however is quite straight forward and at the same time disappointing to a certain extend: lack of subsidies for other conversion techniques than CHP. Only in Denmark and the Netherlands there is a subsidy for heat out of biogas. In Italy there is also a feed-in tariff (FiT) for biomethane, but too low for feasible business cases.

We see that the techniques are ready, but that regulations do not fit the actual needs. As the project partners discussed these, the process of introducing new FiTs can start in these countries without support system for other energy use than CHP.

4.2 Expensive cheap digesters

The Belgium boost of small scale digesters has been one of the driving factors for our project. The concept is still very popular in surrounding countries, as it showed of a fabulous implementation rate. One of the key points of this concept is the low investment cost for these installations. The digesters are really basic, and only suitable for manure digestion. The biogas is used in small engines and the electricity is used on the farm. The business model is based on the substitution of own electricity consumption. With a revolving-counter the annual net electricity consumption can be zero. Extra produced energy can be sold on the wholesale market, for very low prices. Therefore the farmers only produce as much energy as they need for their own farm. This has resulted in low installed capacities, typically 10 or 20 kWe.

When comparing the different countries for investment cost/kWe installed these small installations turned out to be the most expensive for all countries! The differences are shown in Figure 6. The absolute investments might be by far the lowest in Belgium and be very high in Germany, the average costs per kWe installed are in the same range!

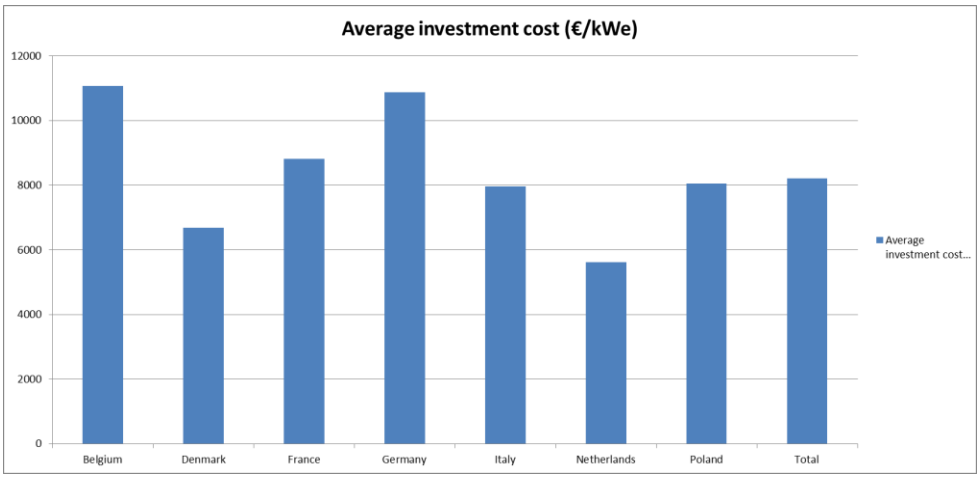

Figure 6 Average investment costs in €/kWe for the participating countries

We see for the Netherlands and Denmark much lower relative investment costs. In Denmark, this is mainly because they have much bigger plants, where there is a natural effect of scale. In the Netherlands, the absolute investment costs are slightly higher than in Belgium, as that concept is about to be copied. But with one major difference: the installed capacity. In the Netherlands small scale installations earn (nearly) the same for self-consumption as for grid feed-in. Identical farms can have double the installed capacity compared to the same farm in Belgium.

For Germany it is known that due to high quality and safety standards the installations are very expensive. In Italy the price range is also higher than on average, but less-strict regulation for adding co-products and larger livestock farms make the relative investments the 3rd lowest for the project.

4.3 Different perception of biogas

The BioEnergy Farm II project focused at on-farm manure digestion. During the project period (2014 – 2016), livestock farming in Europe faced decreasing prices for milk and meat, the primary source of income for livestock farmers. This influenced the attitude towards investments in biogas production. In some countries, like Belgium, France and Germany, farmers argue that prices are too low what makes it difficult to make investments in secondary activities like biogas production. The low market prices are a reason not to invest in biogas at this time.

In other countries, like Italy, farmers react in an opposed way. The low market prices for meat and milk stimulate farmers to invest in other sources of income that can stabilize the financial conditions of the farm. They see biogas as an alternative source of income. These farmers are much more interested to invest in the near future, because they need an extra way to make money.

Recession in market prices for the traditional products like meat and milk are for one farmer a reason not to invest and to focus on the running core business, whilst for other farmers it is a reason to invest right now in other activities that might strengthen the financial position of the farm.

5. Impacts achieved

At the end of the project period we are very happy with the achieved impacts. The impacts are of different nature, and might even differ between countries.

5.1 Informed farmers

With the training program, communication activities and the implementation of the feasibility scans we have been direct in touch with more than 1.000 farmers throughout the EU. In the exhibitions participated **969 farmers**, more than **500 farmers** participated in a workshop, and for **802 farmers** a business plan was drafted.
Besides that, articles were published with a total number of about 800.000 copies. In all countries, the project was presented 90 days on an exhibition. Not taken into account the conferences etc. were the project was presented.

We can conclude that the dissemination towards our target groups was very successful. Very hard to quantify is the actual impact of these dissemination activities. As a project with experts working in this field for years we feel a change in the general interest for MSD. Farmers are more aware of the possibilities of MSD, experts know better what critical parameters are for assessing feasibility of biogas plants. And suppliers of biogas plants report an still increasing request for offers for on-farm biogas solutions.

5.2 Improved legislation

The information supply to policy makers and sometimes concrete requests for adaptions of current legislation or subsidy systems resulted in improved legislation in most countries. Special tariffs for small scale installations were introduced, feed-in tariffs for heat and biomethane are on the agenda in several countries and overall small scale biogas is recognized as important tool in meeting the renewable energy requirements.

5.3 14 MW installed

The most important impact achieved is the installation or commission of 86 biogas plants, with a total capacity of almost 14 MW. On annual basis these installations together produce 112 million kWh, what equals an CO_2 reduction of 34,7 kton every year.

Most plants will be realized in France, 35 installations with a total capacity of 5,2 MW. Netherlands is 2nd in line, with 19 plants and a capacity of 4,1 MW. Belgium follows close with 17 plants, but with only 0,5 MW installed. Italy produced much more with 2,7 MW from only 9 plants.

For 2020 even more plants are expected to be realized, thanks to activities under this project. For Denmark 5 to 10 plants are expected, for France up to 40 biogas plants by 2020. For Poland the implementation is highly depending from improved subsidy systems. If there will be no improvement, there won`t be any activity for the next years.

6. Conclusions and recommendations

Comparing the market situation in 2014 with the situation early 2017 we see a big difference. Were in 2014 on farm digestion was something about the early days of biogas development, in 2017 it`s the new standard! All over Europe farmers, farmers organizations and political bodies recognize the value of micro scale digestion. Direct benefits like decentral renewable energy production, independent from whether conditions are highly appreciated. But also more indirect effects, like avoided emission from manure storages, improved fertilizers and strengthening of farmers financial situation is rewarded.

We are very happy to conclude that our project BioEnergy Farm II was running in this period. The project has played an important role in producing and sharing knowledge about all aspects regarding small scale digestion. From the first idea up to day-to-day management of such an digester, it`s all covered within this project. The tools produced and the platform we build online (www.bioenergyfarm.eu) can be used for the next years by all stakeholders dealing with micro scale digestion.

During the project we found out that in emerging markets everyone wants to claim his part of cake, but nobody is willing to share his knowledge. To overcome these barriers it`s very useful that projects like this one exist and can operate independently and without commercial interests as they are co-funded by the EU. Making data available and help all kinds of stakeholders with their developments is a hard to overestimate benefit of these kind of market uptake projects.

As the project has a limited time-span, it is highly recommended to start as early as possible with the dissemination to the larger public. It needs some time before such a project is well known and recognized in the field.
For dissemination purposes we used different channels to get in touch with our target audience: farmers, farmers advisors and policy makers. What worked very well was the presence at the relevant exhibitions.
Also written articles in relevant journals and interviews with enthusiast users works very well, as entrepreneurs like farmers are receptive for their colleagues opinion.

Within the project period, the partners met about 7 times for project meetings and another 3 times for training workshops. These meetings were equally spread over the participating countries. Nearly all these meetings were combined with a site-visit to a nearby small scale biogas plant. In this manner, experts from all over Europe visited together a wide variety of plants in the different countries. This exchange of knowledge between partners and countries is very important in the further development of on-farm biogas production in the EU. The challenge for all countries is to copy the better aspects from the neighboring countries, adapting it for local circumstances. In this way we assume that the best of all systems comes together in the new built plants, resulting in lower investment costs, lower running costs and higher revenues.

For any stakeholder in the field, whether he is a farmer, a farmer advisor, manufacturer or policy maker, having any questions about micro scale digestion, please feel free to have a look at the partners section below to find a contact person in your country. Also visit our BioEnergy Farm portal to stay up to date with the field of small scale biogas production.

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