Summery scan results

Overview
Imprint

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1. Summary scan results the Netherlands

During the BioEnergy Farm project more than 80 online scans were made with the Anaerobic Digestion Profit Calculator (ADPC) and the Wood Combustion Profit Calculator (WCPC) by the Dutch Bio-Energy experts. This document is a summary of the results of the scans performed during the BioEnergy Farm project. This summary provides insight into which bioenergy cases are profitable and which are not and the reasons why.

Biogas scans (ADPC)

The biogas business cases for which a scan was made were in the range from small scale micro-digesters with an installed electrical capacity of 50 kW to large scale industrial digesters with an installed capacity of 5 MW. These large plants can digest over 100,000 tonnes of biomass per year.

During the project period of the BioEnergy Farm project, the Dutch market for biogas plants changed in different aspects. An important aspect is the available subsidy. For biogas plants the SDE subsidy is very important to achieve a financially solid business plan. Unfortunately this is still necessary, because the cost of sustainable electricity or bio methane is still higher than the prices paid for electricity from fossil fuel fired plants and natural gas. The CO2-certificate system is insufficient to ensure a level playing field between conventional energy and sustainable energy. In the last years, the SDE scheme changed several times in structure and grants.

Another important aspect are the biomass costs. The annual benchmark co-digestion of the Rabobank shows that the cost of raw materials increased with a few euro cents per kWh electricity produced in the recent years. Since the operating costs of a biogas installation consist for a large part out of the purchase of biomass, this price increase had a major impact on the financial feasibility of biogas plants which use co-products.

Because of these changes, it is very difficult to draw a general conclusion based on all the scans performed during the project. So this summary shows how changing market conditions and subsidies changed the most ideal business cases over the lifetime of the BioEnergy farm project. Because a business plan for a large industrial size digester is not comparable to the one of a micro- digester both cases will be discussed separately.

Big co-digester (> 100 kW installed capacity)

To know which biogas plants are the most profitable in the Netherlands, it is important to know how the SDE subsidy works. The SDE subsidy pays the difference between the cost of the generated renewable energy and the market price of conventional energy, ensuring that the plant owner gets a reasonable profit margin. Annually the cost of different types of renewable energy such as wind, geothermal, bioenergy etc. are calculated by ECN in cooperation with DNV KEMA. For this cost calculations they use a reference system with a certain size and a certain biomass input. To maximize the profits it is important to have a more efficient project than the reference case used by ECN. There are several possibilities:

1. A cheaper biomass mix
2. Reduce costs of digestate by using digestate treatment
3. A larger plant and therefore a more efficient operation
4. More efficient energy conversion

5. Etc.

The above points are not always easy and can also backfire. For example, when a larger installation is chosen it will be difficult to find a suitable location. Within the Dutch guidelines a bigger installation often leads to a location on an industrial side, where land prices are considerably higher than the costs of farmland. In the reference case ECN uses the price of farmland and so the additional costs of the land need to be earned back by a more efficient operation of the plant.

In 2010 (the year that the Bioenergy farm project began) the SDE2010 subsidy was in force. Within this scheme subsidy could be requested for the production of electricity and feeding bio-methane into the gas grid. If, in case of electricity production, the produced heat was deployed usefully a heat bonus was received per KWh of electricity delivered to the grid. It was therefore important to be close to a heat user which could use enough of the produced heat. In that case the full bonus was earned. An additional advantage is of course that the delivered heat could also be sold to the heat consumer to create extra income. For the injection of bio-methane into the grid the distance to a feed-in point should be as small as possible and preferably bio-methane is fed into a low pressure gas pipe line to reduce costs. This is only possible when the capacity of the pipe line is large enough. Within the BioEnergy Farm project a number of scans are performed for projects that already have a SDE subsidy from the year 2009 and 2010 to produce electricity. The scans are used to update the business plans to the current market conditions. In one case, a large heat user was found that will use the produced heat in their production plant. In another scan we chose to dry the solid fraction of digestate. Drying of digestate is seen as beneficial use of heat since 2012. The extra credit over het heat bonus is the higher income by selling the dried solid fraction for higher prices compared to the non-dried thick fraction.

In 2011 the heat bonus was still in force. With full heat utilization 0.205 € per kWh of produced electricity was received. For the reprocessing and injection of biogas in the gas grid 0.767 €/m3 was received. With these amounts injecting bio-methane into the gas grid was more profitable than producing electricity. Within the BioEnergy Farm project a number of scans are performed for relatively large installations, where the intention was to feed in biogas into the gas grid. In case the SDE subsidy would have been received, the projects would have been financially feasible. However since 2011 the SDE scheme is opened in phases, with the cheapest techniques which need less subsidy coming first. The idea behind this is that the Netherlands gets the most renewable energy for the lowest costs. The budget of the SDE in 2011 was already empty in the first phase were cheaper techniques like waste-digesters, sewage treatment plants and onshore wind turbines could subscribe. Co-digesters came in later phases and therefor did not receive any subsidy. For Co-digesters there was a possibility to subscribe in the first phase for a lower amount of subsidy, but the ADPC scans showed that these amounts of subsidy were not sufficient for positive business cases. In 2011, therefore, practically no sufficiently large enough SDE subsidies are granted to start profitable co-digestion projects.

In the SDE+ 2012 scheme an extra “cheaper” phase was added so co-fermenting had even less chance on getting subsidy. Another big change was that the heat bonus was abandoned. Instead of the heat bonus on electricity the heat was now subsidized directly. The production of electricity could now be done for 30.6 €/GJ which was available in phase three of the scheme. This corresponds with 0.11 € / kWh for the electricity generated. A major concern was that 30.6 €/GJ for supplying heat is only given for 4,000 full load hours and that the heat cannot be sold separately anymore to increase the income. For the CHP
cases it became even more important to be able to supply enough heat. Heat Customers which were fine for the 2011 regulation, because they used enough heat, were now often not sufficient for a positive business case. Only very large heat users with a continuous heat demand were sufficient for a positive financial result. Injecting biogas into the gas grid now could be registered for 0.729 €/m³. This tariff is only feasible for relatively large (> 36,000 tonnes input) projects that are not too far away from the gas grid. As in 2011, the budget for the subsidy was already oversubscribed in the first phase, so again no co-fermentation projects received sufficient amounts of subsidy.

A new option to deliver energy since the 2012 regime is supplying only heat to third parties. Basically this means that the co-digester supplies biogas to a company with a large heat demand. The biogas is converted into heat in a boiler and replaces the natural gas that was normally burned to produce the needed heat. Because no expensive CHP plant or biogas upgrading installation is needed, supplying heat is cheaper and therefore has more chance on getting subsidy in the SDE scheme. In 2012 it was possible to subscribe for 17.7 € per GJ of delivered heat. The ADPC scans showed that this is not sufficient for a profitable business case. Only when a very interesting match could be found with a heat user it could lead to a feasible case.

In 2013 it turned out that this conclusion was correct because the tariff in 2013 increased to 20.6 €/GJ which is available in phase 2 of the scheme. In phase 1 projects can subscribe for 19.4 € / GJ in the free category. This appears to be sufficient for profitable business cases in case a smart integration can be made. Within the BioEnergy Farm project some scans are made based on heat delivery. An important consideration is that the heat consumption of the third party should be continuous and 24/7, because the digester produces biogas continuously. Additional biogas storage facilities make the project unprofitable very quickly due to the increased investment costs. In one of the scans performed there was no heat demand during the weekend. This business case turned out to be negative. A major risk to the exploitation of biogas plants delivering heat is the "survival" of the heat customer. If the customer leaves, the biogas installation can no longer deliver heat and so loses its income.

Within the current Dutch policy and the current SDE regulation there is no room anymore for large-scale biogas installations producing electricity or bio-methane. Only biogas installations which deliver heat only have enough chance in receiving enough subsidy for a positive business case. For new projects companies must be found with a large heat demand and preferably with affinity for the agricultural sector. This can for example be the food industry. In case these companies also have fermentable residues for which they normally pay deposit costs it can result in financial interesting projects.

Micro - digester (<100 kW installed capacity)
During the BioEnergy Farm project it turned out that the public opinion regarding large scale biogas installations became more negative in the last years. An important issue in countries like the Netherlands, Germany, Belgium etc. is the food vs. feed discussion. Also the farmers complain because the market prices of crops like corn increased in the last years. The online biogas scans showed that most farmers are only interested in small/micro scale digesters which only use the manure of their own farm. The same opinions were heard during the workshops and excursions organised for the farmers during the project. The main reasons for this interest are the high financial risks of large biogas installations which became visible because a lot a biogas installations in the Netherlands went bankrupt in the last years.

Within the BioEnergy Farm project many scans for micro-digester are made. These scans show that micro-fermentation is only profitable, when a large number of conditions are met. First, sufficient manure should be present at the farm (> 5,000 cubic meters). Supplying
manure from third parties increases the costs too much by the necessary transport and sampling costs. Secondly, a positive SDE grant is needed. Again, the likelihood of receiving adequate funding for the production of electricity and injecting bio-methane is too small, so farmers need to find heat customers in their neighbourhood. The investment costs for micro-scale biogas installations are relatively high so also an investment subsidy is necessary to achieve a profitable business case. In the Netherlands, only the province of Overijssel gives such a grant. An additional income can be found in the small-scale manure processing. Farmer that produce more manure than they can dispose on their own land can than avoid costs for manure disposal to other farmers. When some of these incomes coincide a positive business case can be found.

Transportation Fuels
A relatively new option is the production of renewable transportation fuels. Within the BioEnergy Farm project a number of scans are made in which the produced biogas is used as a transport fuel. An important challenge is matching the production and delivery of the fuel. Positive business cases are possible, if the proceeds of the bio-tickets are sufficiently high. A major advantage of this business case is that it is not dependent on obtaining SDE subsidy. The bio-tickets are always obtained when renewable transportation fuel is supplied. The risk lies in the proceeds of the bio-tickets which depends on the supply and demand in the bio-tickets market. These demand and supply dependent on the legislation which prescribes which percentage of renewable fuel should be mixed with fossil fuels. This makes the proceeds of the bio-tickets within the duration of the biogas project unclear. Nevertheless, the production of transport fuels for the future are an interesting option.

Wood Combustion
Within the project BioEnergyFarm eight wood combustion scans were made in the Netherlands. These scans are made for firewood, wood pellets and wood chips fired boilers. For a number of living houses it was checked whether a fire wood boiler is financially profitable. Due to the relatively low gas consumption (about 5000 cubic meters per year max) for domestic heating, the payback period is relatively high. However, when own wood is used, there are financial benefits. It should be noted that perhaps more money can be earned by selling the wood. The sustainability of wood combustion is often the reason for people to invest in a wood boiler.

For some farmers and other interested people the feasibility of wood pellet and wood chip fired boilers was determined. These boilers are equipped with an automatic feeding system which transports the wood pellets or chips from the storage silo or bunker into the boiler. The choice between wood pellets and chips depends mainly on the location. For a location within the city pellets are preferred, because they can be stored in a closed silo. The storage of wood chips more space is needed and the open storage can lead to odour problems. A pellet fired boiler is cheaper than a wood chips fired boiler. Because of the standardized size of the pellets the input system and the boiler don’t need to be as robust compared to a wood chip fired installation. In all cases, it appears that, when the gas consumption is constant and large enough (> 30,000 cubic meters / year), wood combustion is financially profitable. This means that a wood boiler is feasible for residential complexes, swimming pools and broiler farmers. This is evident from the scans performed. However, the financial benefit depends very much on the wood price developments. In Germany, where the wood market is further developed compared to the Netherlands, for example, the prices are already much higher than in the Netherlands. In the Netherlands farmer pay between 30 to 50 euros per ton of fresh wood chips and pay around 180 euros per ton of pellets, current prices in Germany are respectively 80 and 250 euros per tonne.
2. Summary scan results Estonia

Totally we made 40 offline scans (cost-benefit analysis) with BioenergyFarm Tools in Estonia in 2012. 30 scans were made by using Offline Anaerobic Digestion Profit Calculator (offline scan for biogas production) and 10 scans were made by using Offline Wood Combustion Profit Calculator (offline scan for wood combustion).

The cost-benefit analyses of biogas production were done mainly in livestock farms, of which the larger amount was dairy cattle farms. Also some pig-breeding and cattle farms were analysed. In addition the biogas production cost-benefit analyses were performed also for grain production cooperation, for a enterprise of plant processing company and for a horticultural enterprise. Most of the wood combustion cost-benefit analyses were carried out for grain producers, but also one vegetable producing and one fruit producing farm were involved.

Currently in some farms the investments for bioenergy production are already made time and some farms are in the phase of technical blueprinting of the bioenergy unit. The rest of the farms, for which the offline scans were performed, are still in the stage of conceptual design.

For biogas production the most cost-effective were the projects, where cattle manure with at least 30% of grass mass in addition was available. The annual volume of substrate for running the fermentor was essential.

The projects of biogas production are more cost-effective, if the complex approach is used. For example, in one scanned project a greenhouse is planned to be built next to cattle barn. In this greenhouse there is possible to use the extra heat from electricity production from biogas. By using such a solution there is possible to get quite short payback period.

In conclusion, the offline scans gave an estimation that the production of electricity and heat from biogas is foremost profitable in case when the annual volume of substrate is more than 30 000 tonnes of substrate (manure and grass mass). As a rule, the projects with annual substrate volume less than 10 000 tones have too long payback time or are not profitable at all. A short payback time can be predicted only for the farms with very large amount of cattle, which have an access to large grassland area. Simultaneously there should be a certain requirement for most of the extra heat produced together with electricity from biogas.

In wood combustion projects for example was feasible the case where the diesel boiler for cereal drying was replaced with the wood chips boiler. In this case mainly switching from fossil fuels to wood biomass causes the cost-effectiveness. The investments costs are relatively small and ensure the quick cost-effectiveness.

We conclude also some remarks about the use of offline biogas and wood combustion tools:

1. the offline tools are very good initial analyses of the farm data. According to the offline scans there is possible to make a decision about case feasibility and plan further activities about reasonable specification requirements;
2. the exploitation of offline tools is relatively easy and enables quick additions in order to analyse their influence to the project;

3. the offline tools are translated to the mother tongue that enables understanding of terms and supports right decisions;

4. in the future it would be even better support to farms to analyse the investments into the bioenergy, if the offline tools were developed by module enabling on the computer screen simultaneous comparison different projects (i.e. different options) of the same farm. Such design solution would give the better possibility to analyse the effect of changes in the basic data;

5. the modification and addition of the substrates basic data need data, which are today not in the database of offline tools and should be found from the other databases. For example, in one case in the cattle farm we decided to use manure data from local samplings instead. This change made the scan information more precise and gave significantly different output information if large quantities. While adding new substrate there a lot of specific data about that substrate are required and if even one parameter is not valuated, the substrate can not be added to the tool substrate list;

6. the residence time of the substrate in the fermentor should be related to the ingredients of substrates by default and if needed the user of offline scans should be able to change this;

7. also the loan repayment schedule should be available on the separate page of offline scans, in order to use the repayment profile based on annuity as well as that on fixed reimbursements;

8. in biogas offline tool there is not possible to make analyses only with co-substrates. However, in practice there was a farm interested in such a case. The explanation that the main substrate (manure, silage etc.) is obligatory is correct, as without that it is difficult to get critical relation between nitrogen and carbon for fermentation (30/13). At the same time there was a practical need to analyse only the potential of co-substrates;

9. in practise addition of two co-substrates to the database was required. For this purpose we used the data from German technical literature, as currently Estonian specific numbers were not available;

10. in one farm where the offline tool of wood combustion was used, the preliminary idea was to use cereal residues instead wood. However, in the database such a substrate was lacking. Therefore, the data of low quality of wood chips was used instead, with the presumption that these combustion characteristics are in similar range.
3. Summary scan results Poland

Bioenergy Scans

The experience gained in the course of BioEnergy Farm project implementation proved that a decision concerning an investment in a biogas plant depends on a number of factors. There is no universal "success recipe." Also, the lack of publicly available and reliable information on the technical possibilities and prospects for exploitation of a biogas plant in a given localization turns out to be a major obstacle in the way of development of agricultural biogas production. So to foster more dynamic development of this type of renewable energy production, farmers should be encouraged to perform preliminary technical and economic analyzes for biogas, which can be compared with the cost-effectiveness of the current farm profile.

In the first half of the year 2012, 81 biogas scans were performed by Polish experts in the framework of the BioEnergy Farm project. The farms whose cases were analysed are located in the Pomeranian and Mazovian Voivodships, because the Pomeranian and the Mazovian Agricultural Advisory Centres cooperated with the National Energy Conservation Agency during the course of project implementation.

Characteristics of Regions

The Mazovian Voivodship is the largest in Poland, with 35 598 km² (11,4% of the whole country area) and population of over 5 million. It is a lowland with 2,38 million ha agricultural land (67,1% total area). About 94% of arable land is in the hands of private owners. The average farm size is 7,2 ha. Crops are mostly wheat (52,4 % of arable land), potatoes (15,2 %), sugar beets (2,2 %), rape and turnip (0,2 %). Raising cattle, pigs and chickens is also significant in Mazovia.

The area of the Pomeranian Voivodship is 18 293 km² (5,85 % of the whole country area) and has a population of 2,2 million people, 32,2 % of which live in the country. The total area of arable land is 863 335 ha and forest land is 671 126 ha. Agricultural production is diversified, wheat, sugar beets, rape, and other plants are grown. A large area of permanent grasslands favours cattle raising. Farms with a size of 1-5 ha comprise 37% of all farms (55% on country scale).

There are no official statistics concerning the number of biogas plants in Poland. According to the list published on 30.09.2012, by the Energy Regulatory Office (URE), there are 193 biogas plants in Poland, 26 of which produce agricultural biogas. The table on the next page presents more detailed data.
## TOTAL RES in Poland

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>No. of install.</th>
<th>Power [MW]</th>
</tr>
</thead>
<tbody>
<tr>
<td>biogas power plants</td>
<td>193</td>
<td>124.015</td>
</tr>
<tr>
<td>- biogas from wastewater treatment plants</td>
<td>75</td>
<td>40.503</td>
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<tr>
<td>- agricultural biogas</td>
<td>26</td>
<td>26.456</td>
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<tr>
<td>- landfill biogas</td>
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<td>56.456</td>
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<tr>
<td>- mixed biogas</td>
<td>1</td>
<td>0.600</td>
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<tr>
<td>biomass power plants</td>
<td>24</td>
<td>559.260</td>
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<tr>
<td>- mixed biomass</td>
<td>11</td>
<td>400.110</td>
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<tr>
<td>- forestry, agricultural and horticultural residues biomass</td>
<td>8</td>
<td>13.550</td>
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<tr>
<td>- industrial residues of wood and cellulose</td>
<td>5</td>
<td>145.600</td>
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<tr>
<td>solar power plants</td>
<td>8</td>
<td>1.252</td>
</tr>
<tr>
<td>- solar radiation</td>
<td>8</td>
<td>1.252</td>
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<tr>
<td>wind power plants</td>
<td>663</td>
<td>2341.313</td>
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<td>- onshore wind farms</td>
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<td>hydropower plants</td>
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<td>- run-of-the-river hydroelectricity up to 0.3 MW</td>
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<td>- run-of-the-river hydroelectricity up to 1 MW</td>
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<td>54.608</td>
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<td>- run-of-the-river hydroelectricity up to 5 MW</td>
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<td>- run-of-the-river hydroelectricity up to 10 MW</td>
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<td>- run-of-the-river hydroelectricity above 10 MW</td>
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<td>- pumped-storage hydroelectricity or ROR with a pump unit</td>
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<td>co-combustion plants</td>
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<tr>
<td>- co-combustion of fossil fuels and biomass</td>
<td>42</td>
<td>0.000</td>
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<tr>
<td>- co-combustion of fossil fuels and biogas</td>
<td>2</td>
<td>0.000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,697</td>
<td>3984.001</td>
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Source: URE, data update: 30.09.2012

### In the Mazovian Voivodship:

<table>
<thead>
<tr>
<th>Type of installation</th>
<th>No. of install.</th>
<th>Power [MW]</th>
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<tbody>
<tr>
<td>biogas from wastewater treatment plants</td>
<td>8</td>
<td>2.173</td>
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<tr>
<td>landfill biogas</td>
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<td>industrial residues of wood and cellulose</td>
<td>2</td>
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<td>mixed biomass</td>
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<td>solar radiation</td>
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<td>onshore wind farms</td>
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<tr>
<td>- run-of-the-river hydroelectricity up to 0.3 MW</td>
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<td>1.687</td>
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<tr>
<td>- run-of-the-river hydroelectricity up to 1 MW</td>
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<td>0.375</td>
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<td>- run-of-the-river hydroelectricity above 10 MW</td>
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<td>20.000</td>
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<tr>
<td>- co-combustion of fossil fuels and biomass</td>
<td>5</td>
<td>0.000</td>
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</table>

### In the Pomeranian Voivodship:

<table>
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<th>Type of installation</th>
<th>No. of install.</th>
<th>Power [MW]</th>
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</thead>
<tbody>
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<td>biogas from wastewater treatment plants</td>
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<td>3.897</td>
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<td>agricultural biogas</td>
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<td>landfill biogas</td>
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<td>onshore wind farms</td>
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<td>- run-of-the-river hydroelectricity up to 0.3 MW</td>
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<td>- run-of-the-river hydroelectricity up to 1 MW</td>
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<td>- run-of-the-river hydroelectricity up to 5 MW</td>
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<td>- co-combustion of fossil fuels and biomass</td>
<td>3</td>
<td>0.000</td>
</tr>
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</table>
Most Polish biogas plants produce heat. This results from the fact that biogas installations in wastewater treatment plants and by landfills are usually located nearby urban areas with an already existing district heating network. A large portion of heat is also produced by biogas plants by wastewater treatment plants that require large amounts of heat for their own operation.

**The Current Status and the Potential of Agricultural Biogas Use in Poland**

The Polish power sector is on the verge of its production capacity. Power reserves are minimal and the energy demand constantly increases - according to the forecasts, even taking into account investments that are not completed yet, after the year 2016 Poland will experience a power shortage. Biogas plants provide a possibility to supplement the domestic power production capacity and guarantee the security of energy supply on a local scale.

According to the register of companies engaged in the production of agricultural biogas run by the Agricultural Market Agency (ARR), as of 24.08.2012, there were 25 agricultural biogas plants registered and their total declared power was 26,056 MW\(_{el}\).

Although the country’s agricultural biogas potential evaluated based on the arable area and availability of agricultural residues is similar to Germany’s potential, Poland’s primary energy production from agricultural biogas in 2008 was a couple of hundred times lower than Germany’s. According to the Statistics Bureau data, in the year 2009 the total primary energy production from biogas in Poland was 188 TJ; power generation from biogas was 21,7 GWh, heat generation - 80 TJ. In the year 2008 agricultural biogas comprised only 0.05% in final energy consumption in Poland, and all types of biogas together, including biogas from wastewater treatment and landfills, amounted to a 2.3% share (according to data by GUS for 2009).

**Scan Results and Conclusions**

The experience gained so far leads to a conclusion that larger scale biogas plants (more than \(~300-400\) kW electric power) and those based on substrates produced on the same farm, such as manure and residues, are generally more profitable. The most common agricultural land use scheme in our country is characterized by large distances between cultivated fields and potential buyers of heat from a biogas plant. For this reason the cost of the heat transporting network, or some alternative solution to deliver the heat to the recipient, is usually a significant element in the investment costs balance. It should be mentioned that a big portion of the analysed investments reached the threshold of operational profitability only in case of heat sale being possible (and hence the possibility of acquiring certificates for energy produced in cogeneration - so called "yellow certificates"). Also the avoidance of heat costs can be treated here as heat sale, when there is a considerable heat demand at the farm (ex. greenhouse, drying processes, etc.) Biogas treatment eliminating \(\text{CO}_2\) to produce biomethane and deliver it to the grid turned out to be unprofitable in all cases. The analysis of information collected in the course of project implementation shows that operating costs not directly related to biomass acquisition are a major factor influencing the investment profitability.
Taking into account the cost of equipment maintenance, amortization and operational cost of the loan in case of smaller agricultural biogas plants (up to ~100kW) most often resulted in a negative balance in the economic analysis. The investment cost mostly depends on the cost of the digester and the cogeneration unit. In case the heat recipient is located at a distance, the cost of constructing a heating network becomes significant.

Summing up, both the exploitation and the investment costs are to a large extent dependent on the specific characteristics of a given case. Therefore, it cannot be concluded that investing in biogas plants in Poland is either profitable or not profitable at the moment. The only noticeable trend is that the average profitability of the investment depends on the size of the biogas plant, which showed an increasing tendency with the increase of the scale of equipment (the largest case analysed was 437 kW el and the smallest 43 kW el.). It should be underlined however, that the legal environment of small installations will fundamentally change in the nearest future (Act on RES) and certainly will have an impact on their cost-effectiveness. According to the official announcements, the new Act will promote small-scale installation through introducing fixed energy purchase prices and simplifying procedures for energy trading and acquiring permits. Cases where the scan result was clearly positive most often fulfilled one of the following conditions: availability of substrates produced at the spot (big farms), small distances from the field and heat recipients (ex. production facility), possibility of utilising a lot of the heat, access to the power grid, large and constant power demand by the farm itself (or a production facility). Currently, on the biogas market the investments are being withheld, waiting for the final version of the Act on RES and its implementation. It should be noticed that the new legal environment and subsidy rules will have a major influence on the profitability of investments and exploitation of RES installations.
4. Summary scan results Belgium

The Flemish Biogas sector has grown in capacity from 2010 to 2012 with 22MWe. This is significantly less than the two year period before, in which a growth could be noticed by 32MWe. Does this mean that the full market potential has been reached? Not yet according to the Flemisch Energy Agency. Their preliminary prognosis gives an average yearly added capacity of 4MWe till 2020, hence a clear diminishing of growth speed. Changes to the Energy Decree in 2012 are experienced as very negative for the sector. The times of plenty are over. Innovation, creativity and pioneering are key factors to success in the future.

How the project BioEnergy Farm has contributed to sectorial progress is difficult to put into exact numbers. The outcome and amount of scans and business plans can be an indicator for present and future investments. In general one can conclude that there is enough interest in anaerobic fermentation (and wood combustion too), but that significant investments are postponed mostly by an indecisive support climate. Response on the project met the set targets of 80 profitability scans and 20 business plans. Biogas-E will still use the tools to aid farmers and anyone who wishes.

Policy Change

The Decree of 8 May 2009 laying down the general provisions on energy states in Title VII the matters concerning environmentally friendly energy production and rational energy use. In the last two years, six changes were made to this decree, one larges than the other. The most significant changes are the introduced finiteness of the granting of green certificates, the introduction of a banding factor and the rapid elimination of support for photovoltaic panels.

General stakeholder consultation and sector survey indicates consistently that these changes entail great uncertainty. The project BioEnergy Farm ran during a period where the investment climate was negative and according to Biogas-E the output of the project would be a lot higher above the targets in a "normal" situation.

Sectorial overview

Of the 80 scans performed, there were 69 biogas scans and 11 wood scans. Eight of the 69 cases for biogas were not profitable, because they had a payback time longer than 10 years. Figure 1 illustrates the theoretical capacities for biogas CHP’s feasible in the studied companies. This figure is rather illustrative. Drawing conclusions about the entire industry seems premature, because the scans were made on farms owned by intrinsically interested farmers. However, we notice an mean potential of about the 15kWe and a median of 10.5 kWe at the surveyed companies. The fact that many companies in the scans have a capacity of around the 10kWe has to do with the use of a running back counter. This means that these companies do not sell cheap electricity to just buy it back at a more expensive price when they need it.

The BioEnergy Farm project has especially revealed that investments in large installations will greatly decrease on one hand, but that the market for small-scale fermentation applications still has an optimistic market potential on the other hand. For the current major exploitations may be expected that they will need to reinvent themselves in the coming years. This can be
done by more efficient process control, investments in performance enhancing techniques (e.g., Organic Rankine machine) or by moving away from electricity and heat production and instead looking for biomethane applications.

Figure 1. Spread of the theoretical electric power; 1 outlier of 484kWe has been deleted. A zero value means a negative scan.

Figure 2 gives a representation of the geographical distribution of the scanned businesses. West Flanders is well over-represented. This is due to the location of the partner Biogas-E, and partly by the fact that the nutrient surplus in West Flanders is very acute. Also this province is known as the main agricultural province in Belgium.

Successes and challenges during the project

The achievements are in line with the described overview of the sector. One can see that the most progress is made in small-scale fermentation. Philippe Jans, who was trained as an expert successfully started his own company called Biolectric SA, which currently has 45
small plants built. Given that a plant costs € 95,000, this means an investment of 4.2 million euro has been made in the biogas sector. Of past scans are already two are realized and there is a good chance that a dozen projects will follow within two years.

Below are a set of reflections about the project, the focus is primarily on the use of the tools and the running of the scans.

• The tools are designed to work for several support mechanisms.
• With the tool multiple scenarios can be calculated quickly.
• The availability in the mother language is very useful.
• Substrates can be added to the database, but the pre-programmed data is somewhat insufficient.
• Direct and personal contact with farmers is the most effective method of consultancy.
• Specific workshops and exhibitions attract a large audience, but makes for less company-specific consultancy.
• Farmers do not easily find their way to the online portal.

Conclusion
For several months now gloomy clouds are hanging above the biogas sector, but by beein inventive it still will pay to invest in this renewable energy production. The project BioEnergy Farm has played his part by focusing on small-scale production in Belgium and delivered the knowledge and resources for future work and investments in the biogas sector.
5. Summary scan results Italy

During the project Bioenergy Farm 132 scans were carried out with the off-line tool with the Anaerobic Digestion Profit Calculator (ADPC) and two were carried out with the off-line wood combustion tool WCPC. In this document you can find a summary of the results of scans performed during the project, allowing you to better understand the circumstances in which Bioenergy can be more or less profitable and why. The positive outcome of the scans is related to Italian incentives and regulations.

Anaerobic Digestion scans (ADPC)

The scans for biogas production were made for digesters with an installed capacity of less than 100 kW_e to digesters with an installed capacity up to 1 MW. In Italy the type of contribution allowed to get the best economic return for installations that are around one MW_e below one MW_e. The average capacity of the plants that have made a scan was of 590 kW_e, for a total of 77.99 MW_e.

Of scans performed 14 had a payback less than 6 years (listed as profitable by the tool) and 21 gave positive outcomes a result close to economic viability (payback of 6-7 years). For these 14 plants (those with positive outcome) the business plan was made.

In most cases, companies are located in Northern Italy. Are also present a number of companies in Central Italy and some are located in Southern Italy.

The scans were performed on farms that mainly raise crops, with some livestock (cattle and pig in rare cases), with surfaces ranging from 20 ha to 100 ha. In the case of livestock farms the interest has been generated by the possibility to use the manure to produce energy and lower its odor, and then still use it as a fertilizer. In many of the positive scans, the feedstock was represented also by maize silage or forage. This feedstock can provide the best performance for the production of biogas, especially for biogas plants with 1 MW_e of installed capacity, where it is difficult to find nearby the manure needed to run the plant. Due the flat feed-in tariff of 0, 28 €/kWh up to 1 MW_e power, all the plants nearby this power got the lowest payback time.

The Italian contribution has thus made unprofitable plants of medium-small size, resulting in non-interest by farmers for the implementation. The installation of a denitrification downstream of the biodigester resulted was often impractical because of the high costs and the relatively small size of the plant.

Another problem has been the availability of biomass: farmers are in a position to choose between the sowing of land for the purpose of livestock or feed the digester. Due to the reduced availability of surfaces the livestock prevails.

For these reasons, plants under construction up to Dec 31, 2013 are own by companies, cooperatives, corporations that can provide the great amount of biomass needed.

In Italy the incentive system does not reward the production of heat, and in the scans for biogas thermal energy is substantially dispersed or in most cases only used for heating the
digester. In addition, the district heating networks are expensive and rarely in the neighborhood of the biogas are plants there structures (government agencies, hospitals, swimming pools ...) large enough to absorb and use the heat.

**Wood combustion scan (WCPC)**
Considering the regulations in force in Italy up to 31 of December 2012, it was not convenient to use biomass to produce heat. Up to then, there were any scans made with the Wood Combustion Profit Calculator.

Since 1 January 2013, tank to a new law, the situation improve. The DM of 28 December 2012 - Stimulation of production of thermal energy from renewable sources and energy efficiency measures – provide some contribution under the name of “Thermal account”. Aimed at small biomass boilers with power less than 1 MW (incentive up to 40% of the costs incurred, paid in 2-4 years). The incentives can reduce about one year the payback of system (contribution of about € 80,000 for boiler of 500 kith, which could cost about 250-300 k€).

Two scan have been made with an average power of 500 kW$_{th}$, for a total of 1 MW$_{th}$. Both scan gave positive outcomes.

**Remarks on tool and impressions**
The program requires basic knowledge that is not so common in the panorama of Italian farms, moreover, little accustomed to the use of Information Technology in general. With the guidance of an expert, however, the tools provide a first indication of the realistic feasibility of the system. The comparison on the use of only biogas or heat is not relevant in Italy because of the lack of widespread distribution networks and poor remuneration arising from these opportunities against the high amount given by the contribution of electricity.

However, the scenarios available through the software could be of interest for the future.

Generally the tools helped to widespread the knowledge of farmers on the issue related to biogas. Also the people who made the scans, which were participating in the International and National training, increase a lot their knowledge and experience about biogas plant. The availability of the wood combustion tool we believe will be of great help with the thermal bill, just available as a subsidy from January 2013. We will continue the use of both tools and of the biomass tool, which we believe are all very useful to do a quick assessment of farm profitability to produce Bioenergy.
6. Summary Scan results Germany

GERBIO made 40 offline scans. The Biogas-Program Anaerobic Digestion Profit Calculator (offline scan for biogas production) was used in 38 scans. Unluckily, none of scans has been processed with the Wood Combustion Profit Calculator (WCPC), the offline scan for wood combustion. Two scans were made applying the GERBIO own-developed tool to calculate the Wood Combustion Profit. There is a difference between the GERBIO-tool and the WCPC. Unfortunately the two projects are very small and none of them use totally the heat produced. The two projects were difficult to represent commercially. Both of them where adapted to the conditions of the EEG 2009. During the project’s life span fell at the end of 2011, the change in the statutory eligibility requirements. The new law EEG 2012, which is now a little more than a year valid, establishes for pyrolysis gas a less energy compensation.

As here in Germany it was hard from the beginning to find the experts, we start implementing a little bit late the offline scans. In the performed biogas scans selected cases were considered, which have between 30-50% animal manure (slurry and solid manure).

According to the new EEG (Renewable Energy Law) of 2012 biogas plants must now demonstrate a mass fraction of animal substrates of at least 60% or a meaningful degree of utilization of the CHP generated heat at least 60% (inclusive 25% for the digester heating system) get a legal guaranteed compensation claim.
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