NEWSLETTER 04

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GERONIMO 2 BIOGAS

UNLOCK THE BIOGAS POTENTIAL

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EDITORIAL

The Geronimo II – BIOGAS project aims to unlock the potential that biogas can offer as a cost effective and environmentally friendly means of managing manure. The 2.5 years initiative is supported by the Intelligent Energy Europe Programme of the European Union. The 13 partners from across Europe are working closely with:

- Farmers at grassroots level to determine the viability of biogas as a feasible investment for their farms, through supporting them in getting promising biogas business plans off the ground.
- Policy makers to ensure that identified potential barriers to the uptake of Biogas can be broken down.

The GERONIMO 2 project is coming to an end. During the past two and a half years, the project team has performed energy audits in 76 European dairy and pig farms across Europe, training sessions for farmers have taken place in the 11 countries of the project, some of them accompanied with study visits to interesting biogas projects and 3 web seminars have taken place to discuss online all aspects of biogas technology. Furthermore, an e-learning module has been implemented in the project website (www.energy4farms.eu/elearning) through which farmers across Europe can learn about the benefits of biogas technology in an online training session.

Simultaneously, a round of meetings with regional policy makers have taken place across Europe in order to discuss the current biogas framework and suggest new probiogas polices. This has led to the organization of the Pro-biogas Workshop event in Birmingham on July 2nd 2013 where policy makers from all across Europe gathered to share experiences about the biogas regulatory framework. This was accompanied by the Biogas Event in the Livestock Show the following day, where GERONIMO 2 had a stand.
Finally, pilot biogas projects on farms have been selected among the most promising audited ones and have developed a business plan together with their regional Geronimo 2 partner to evaluate the feasibility of the creation of a biogas plant in their farms. Some of these projects show clear evidence of going into the construction phase while others are seeking for a better regulatory and financial framework in which to develop their project although are commited to its construction in the future.

All activities and materials of the project can be found in the project's website www.energy4farms.eu along with information regarding biogas technology. Also in the website you will find a biogas calculator that will help you estimate your biogas potential to make profit of your manure. The project website will be active even after the end of the project in October 2013.

Mirta Rodriguez Pinilla
IRIS, Project Coordinator, Spain

Co-funded by the Intelligent Energy Europe Programme of the European Union

INTERVIEW

Stephen Temple
farmer, Norfolk, UK

Stephen Temple is among Britain's pioneers of alternative energy from dairy farm waste, and despite enduring the risks, he remains totally passionate about the concept. "I simply don't like to see valuable energy disappearing when it can be put to good use," he says of the biogas venture which is enabling the farming business and domestic requirement towards energy self-sufficiency. Costing £800,000 and with a nine year projected payback, he rates the return on investment to be 'reasonable'.

Slurry from the family's 100 cow dairy unit, together with grass and maize silage, root crops and whey from a farmhouse cheese making business are fed in to the facility producing biogas. Methane generated from the AD produces up to 170kW of electricity for the Temple's own use - heating for cheesemaking, dairy wash down and cow drinking water, a grain dryer, the farmhouse, office and three neighbouring cottages. Heat is also used to maintain the AD's own temperature.

Surplus energy is sold to the national grid – a volume measured as more than twice the amount of energy bought as diesel fuel for the farming business, whilst the digestate by-product applied by a trailing shoe has reduced the fertiliser bill by 50%.The environment also benefits - the potential for diffuse pollution has been reduced along with slurry odour.

The venture has earned Stephen a number of accolades including the Royal Association of British Dairy Farmers' Energy Efficiency Award for demonstrating best farm energy savings. The award took him through to the Geronimo finals staged in Spain and overall reserve place. "The occasion provided a great opportunity to engage with other like mind farmers and also pick up ideas on farm visits," he said.

Stephen admits first and foremost to being an engineer with 22 years of experience working in Malawi where he helped to construct his first AD plant. "I had the opportunity to return to the family farm in the late 1990s, and developing energy efficient systems was among my priorities. Work on the AD was eventually started in 2008, however various teething issues hindered the first energy commissioned into the national grid for 2.5 years," he explains. "Since then, we have experimented with different feeds and found a combination of slurry plus energy crops, for example poorer quality silage taken from the sides and top of the clamp, to be the best mix, as well as a best use of waste on the farm.

"The facility is providing us with a reasonable rate of return on investment, as well as a solution to slurry disposal. While AD to the majority of farmers is an alien beast, I believe it's one that we've shown can be tamed. I can recommend to dairy farmers who have critical mass, a minimum 500 cow herd. I suggest they spend quality time investigating as many different systems as possible to see which will benefit the most. I also recommend they try and use a technology provider with plenty of experience of conditions in their own country."

Fact file

Copys Green Farm, Wighton, Norfolk

500 acre mixed unit
100 cow dairy herd, arable and cheesemaking enterprises
£800,000 installation cost; projected nine year payback

- Digester tank 800m3, residence time of 40 to 50 days, temperature 37°C to 42°C
- Digester agitation by gas mixing, 36 pipes in digester floor
- Gas holder capacity 350m3 at low pressure (20m Bar)
- Digester feed daily approximately seven tonnes slurry, seven tonnes maize silage or fodder beet plus cheesemaking whey
- Digestate separated into solid and liquid components
- Liquor stored in two lagoons with a total of 4000m3 - 10 months storage; solids carted to field for land spreading
- Gas utilised in IET combined heat and power unit, based on MAN six cylinder engine adapted to spark ignition; during engine service heat provided by gas boiler

RABDF
Working for British Dairy Farmers

OVERVIEW

50kW Biogas Plant.
Xustás (Lugo, Spain)

This article is a short approximation to the experimental Biogas Plant in Lugo (Spain) with 50kw. Perhaps this approach would be a real option for many farms and its future viability.

This plant of 50 kW of electrical power is conceived as an experimental facility linked to a farm which in its beginning was not designed to spend their electricity consumption on the farm. In that case, a 30 kW plant would be enough to supply the electricity consumption of the farm and the plant.

The project of this plant was developed under the regulatory framework established by Royal Decree 661/2007, which assigned a feed-in tariff of 14.5 c € / kWh for electricity production from agricultural biogas.

In this economical context with no specific rules for own consumption, the sale of electricity at the regulated tariff was the only economically viable option. Therefore, in order to maximize revenues from electricity generation, it settled the maximum power level that could be reached with only the resources available from managing the farm and its surrounding area (50 kW).

The plant is located in Lugo (Galicia) on a farm of 114 dairy cattle which generate 2,900 tons of manure per year and over 75 tons per year of crop residues unsuitable for livestock feed. Additionally, there is the contribution of 150-200 ton / year of winter forage crops.

The biogas produced during the fermentation of manure and co-substrates above is enough to power a cogeneration engine of 50 kW electric power and 82 kW thermal power. Using only the manure and plant residues the farm could generate around 30 kWe.

The plant was developed under a favourable legislative and economic environment. On the one hand, had a grant that covered around 30% of the initial investment and, secondly, the premiums were reciprocated 14.5 c € / kWh.

The plant investment and the grid connection cost 300,000 €. Estimated revenue from electricity generation would amount to 50,000 € / year, while the costs of operating, maintaining, leasing of land, transfer of slurry and getting crops to feed the plant gave an index of return over 10%.

However, in January 2012 bonuses for renewable energy generation were suspended forcing them to sell electricity at about 5 c € / kWh.

Subsequently the Act 15/2012 was also approved which involved the implementation of a new tax of 7% on the revenues from electricity generation. Both measures affected the plant income and reduced dangerously its viability.

In this context, and given the continued increase in the total cost of the electric bill arriving at 19 c € / kWh, self electricity consumption seemed the most profitable alternative.

Finally, in the third quarter of 2013, there were released the preliminaries of a new regulation that will rule, on the one hand, the activity of electricity production from renewable sources, and on the other, the supply and production of electric energy self-consumption.
While it is still pending to know, firstly, the new renewable electricity generation funding scheme which will modify the moratorium imposed by the Royal Decree Law 1/2012, and secondly, the established economic terms governing self-consumption; it is difficult to know whether it is more profitable to qualify for the new premium scheme to sell electricity to the grid or to use the produced electricity for self-consumption and estimate what will be the economic feasibility.

GRUP DE SANEJAMENT PORCÍ DE GIRONA

Som Energia,

the renewable energy cooperative, also supports Biogas

Of all the renewable energy production projects undertaken by Som Energia, one involves Biogas. The project is already underway in Torregrossa – Catalunya (Spain), with a recovery plant for manure and other organic by-products - or biogas plant - in a pig farm.

Technical specifications for the project

1. Location

The facility is located in the town of Torregrossa (Pla d'Urgell, Lleida. Catalonia).

2. General description

This is a recovery plant for manure and other organic by-products or biogas plant in a pig farm. The facility mixes manure and industrial organic matter (basically involving controlled anaerobic digestion) to obtain biogas and a digested biomass.

The biogas is used in a cogeneration unit to give renewable electrical and thermal power. Most of the electricity generated is fed into the electricity grid.

The thermal energy or heat produced is to be used to heat the digesters and the pasteurisation system and part of the remainder is used to heat the farm.

3. Construction company

Two local construction companies are involved in this project:

The main contractor of the project is ALTERNATIVA ENERGÈTICA 3000, SL with the technical support of ECOBIOGÀS SL

AE 3000 has experience in the development of facilities producing renewable energy, particularly photovoltaic facilities, and its sale in the electricity market. Furthermore, Ecobiogas has extensive experience as a developer and manager of biogas plants in Catalonia.

4. Technical specifications

The following zones are specified:

- **Reception zone**, formed by concrete pre-bases (covered bases) and metal tanks for storage of the manure and organic waste at the entry to the plant. The vehicle control and cleaning zone is also located here.

- **Digestion zone**. The facility consists of 3 digesters that operate in series, a primary digester, a secondary digester and a storage digester measuring 6 metres in height, each with an individual capacity of 1,700 m^3. The minimum retention time is 21 days. The digesters are made of reinforced concrete and include a domed gas holder, each with an individual storage capacity of 690 Nm^3.

- **Storage and conditioning zone**. Prior to storage, the digestate is sent through a solid-liquid separator so that the phases obtained can be processed differently.
The liquid phase is sent to accumulation pools: one existing on the farm plus a new constructed one (open pools). The solid phase is accumulated on a concrete yard.

- **Electricity co-generation and connection zone**, formed by the co-generation motor and all auxiliary equipment for gas conditioning. It also includes the safety torch in case of motor faults and the entire

electricity grid connection installation.
The total built-on area of the plant is 5,735 m^2.
The plant processes around 27,000 t/year of manure from the farm and other organic substrates from the food industry, supplied by an authorised management company.

After the anaerobic digestion process, around 26,413 t/year of digested biomass is obtained. After the phase separator, the solid fraction will be processed by an authorised management company and the liquid fraction is spread on the field as fertiliser.

5. Energy data

Annual operating hours	8.000 hours per year
Nominal power	499 kW electrical / hour
Annual electricity production	3.992 MWh electrical/year
Electric power annual export	3.504 MWh electrical/year
Rated thermal input	540 kw thermal / hour
Annual production of thermal energy	4.320 MWh thermal /year

6. Financial data

- Total investment in the turnkey project amounts to €2,163,000 (not including the 200,000 subsidy from ICAEN).

- Maintenance costs represent 36% of revenues

- Revenues between €480,000 and €624,000

- Different cases have been studied for analysis of project feasibility. An IRR of over 10% is expected in most cases, although after the recent legal changes the real return is uncertain.

The following was considered as a basis for calculation:

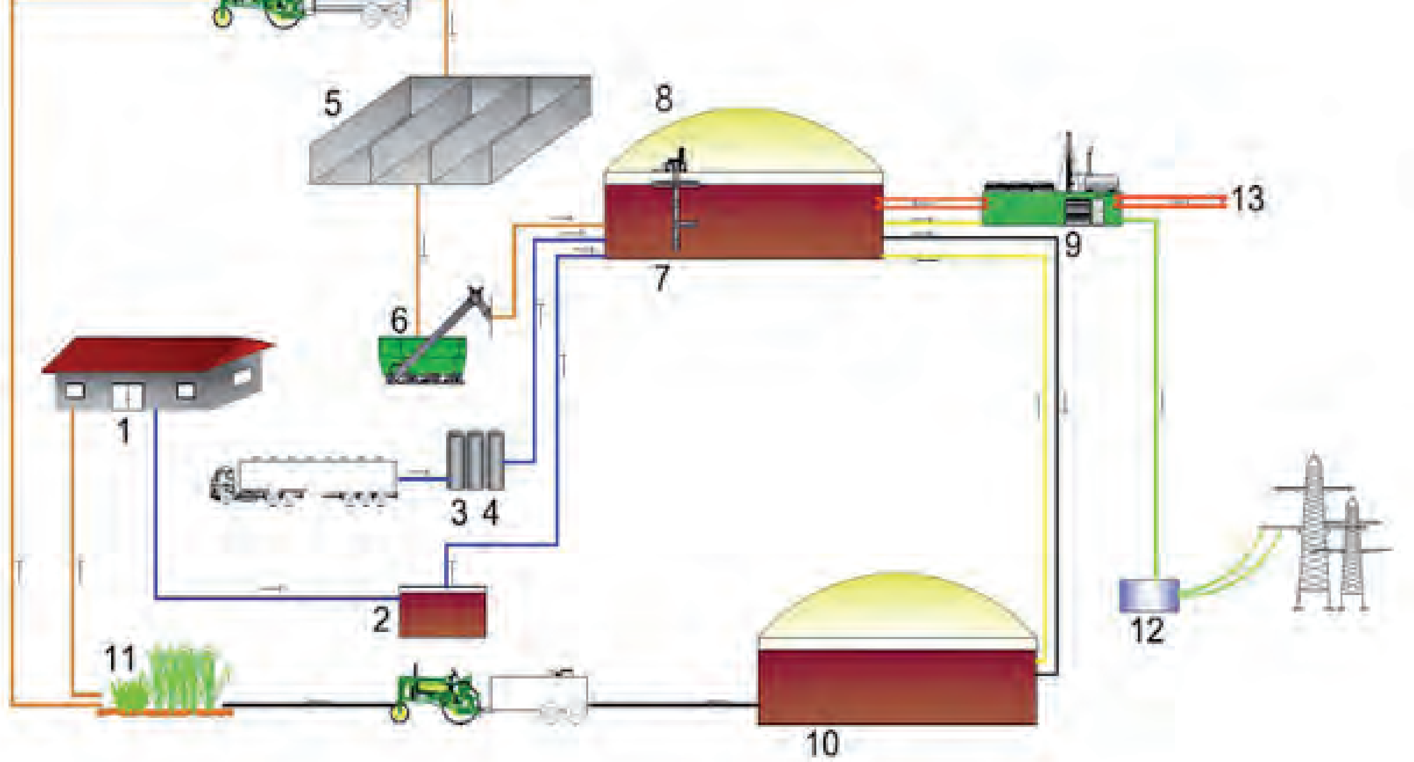
- operating 7,600 hours / year

- feed in tariff price of € 0.145042 / kWh + 2% reactive compensation = 0.1479 kWh, including representation prices and possible deviations.

Sale to the electricity market with a reference premium of 0.113405 kWh + market price + 2% reactive = 0.156 € / kWh (result 1/2 2008-2012) is recommended. However, this has recently changed and is not possible anymore in the new legal framework (2013).

Additional uses of biogas!

Figure 1 – Classic agriculture biogas plant (source: IEE BigEast project)



1 Stalls
2 Liquid Manure Tanks
3 Collection Bins For Biowaste (co-sustrate)
4 Sanitation Tank
5 Drive-in Storage Tanks
6 Solid Feedstock Feed-in System
7 Digester (Biogas Reactor)
8 Biogas Storage Tank
9 CHP Tank
10 Digestate Storage
11 Agricultural Fields
12 Transformer / Power to Greed
13 Heat Utilisation

Until now classical point of view when it comes to biogas utilization was a CHP (combine heat and power) unit using biogas in order to transform its energy to electricity and heat (Figure 1). This approach was the main focus of GERONIMO II project as well. The main reason for this is its possibility for applying it on smaller farms. But there are other ways in utilizing biogas getting more and more popular and economically justified.

One of this is biogas upgrading. This is a process where biogas is "transformed" to a nearly natural gas level. When biogas is produced through classic anaerobic digestion its methane level is around 60%. This percentage can vary depending on different parameters of the anaerobic digestion, for instance substrates going into the fermenter. The rest of the biogas composition is mostly carbon dioxide (CO2) and other trace elements. With this composition biogas can't be used for all machinery due to low quality. The main problems come from the corrosive nature of different trace elements which can destroy certain machinery parts. Through the upgrading process biogas is concentrated (methane wise) in order to comply with the quality and standards of natural gas, which is a fossil fuel. At this stage, after the purification, we can call this product biomethane. At this stage certain gas network operators will accept it and pump it into the natural gas network. The upgrading process is a certain type of purification where the final result is more methane per volume unit of gas. In literature we can identify four main methods when it comes to biogas upgrading; water washing, pressure swing absorption, selexol absorption, and amine gas treating. The most common technology used in biogas upgrading process is water washing (Figure 2). In this procedure the main principle is different solubility of gases in water. When biogas is pushed through cold water dilution of CO2 happens.

Afterwards when the water is heated CO_2 is released again. Although this is the simplest explanation the process itself is quite complex. When comparing it to other, previously mentioned methods, water washing has a low net cost. Also it doesn't require additional reagents for its operation

Figure 2 – Upgrading plant with a water scrubber (source: IEA.org)

In pressure swing adsorption method (Figure 3) separation of CO_2, nitrogen and other elements is done by adsorbing gases which is done at high pressure and then afterwards desorbing them at low pressure. At that stage elements are desorbed as waste. Pressure swing adsorption can be usually done through four different adsorption columns; adsorption, depressurizing, desorption and repressurizing.

Figure 3 – Upgrading plant using PSA technology (source: IEA.org)

Apart from purifying biogas and putting it in the natural gas network, other possibility is using it as a transportation fuel. The EU has recognized certain benefits of natural gas as well as biomethane in transport. Some of the benefits are in biomethane's ability to comply with EURO6 emission standards. This means low NOx as well as lower CO_2 emissions if compared to petrol. One other advantage of biomethane is that it can yield more per a hectare in comparison to bioethanol. Other benefits are the fact that natural gas engine is an already well established technology and is used worldwide. Some countries have gone quite far in utilizing biomethane for transportation. Sweden (Figure 3) is in front with almost 30,000 vehicles using compressed methane as a fuel with the degree of replacement of natural gas with biomethane increasing. In the upcoming years one of the main questions for biomethane uptake will be its sustainability as well as its economics. The EU RES directive is quite clear regarding emission savings. Methane's high impact on global warming will play an important role in its future market uptake. On the other hand, when it comes to economic costs, these will probably go down as production volume increases. Also different subsidies can also play an important role in the overall economic viability of biomethane in transportation sector.

Figure 4 – "Biogastaget Amanda" train in Sweden (source: Wikipedia)

Pro-Biogas
Workshop in Birmingham, UK

The most recent GERONIMO II meeting took place in Birmingham from the 1st to the 3rd of July 2013 and represented a crucial stage for the whole consortium. During one year all partners worked hard cooperating and engaging with policy makers of their countries in order to develop a fruitful collaboration towards an improvement of the biogas national policy framework. The first activities were to analyse the policy framework currently in force and to identify the more relevant barriers to overcome. Geronimo II partners developed a detailed report on regulatory barriers. The results have been deeply discussed during face to face meetings organized with policy and decision makers in each of the project countries. The different problems, initiatives and barriers identified during these meetings were collected, drawn up and compared country by country in a general report entitled: "Mapping the way to pro-biogas for the benefit of farmers and the environment". The next important step was to invite policy makers from different countries to meet each other during a general meeting to discuss and analyse the current situation of Biogas at a national and a European Level. On Tuesday the 2nd of July, in Birmingham, 23 policy and decision makers coming from 12 countries participated to the Pro-Biogas Framework Workshop. Mr. Tim Brigstocke, Policy Director of the Royal Association of British Dairy Farmers (RABDF), organized and presided the meeting.

The event started at 9.30 in a hall of the Hilton Metropole National Exhibition Centre, with the GERONIMO II introduction provided by the project coordinator, Mirta Pinilla (IRIS). Then, the agenda of the event included the contribution of Andrea Salimbeni (EUBIA), who gave a summarizing analysis of the European biogas policy framework identified with the contribution of all project partners. The content of this presentation which underlined the huge differences among EU countries, gave the green light to the contributions of National Policy Makers.

Three papers from the UK opened the debate. A bioeconomy consultant, the Head of AD & Biowaste for the UK government and then the farming view from the National Farmers Union showed a very "joined up" approach and a new mood of optimism which shared the farming organisations' belief that 1000 farm based anaerobic digestion plants by 2020, alongside 100-200 larger waste-linked facilities is still very possible. Then Mr. Peter Cremer presented the general overview on Biogas in Germany, the shining example for a real biogas support policy framework.

The afternoon session started with presentations from Netherlands, Croatia and Malta. Three short presentations about their respective experiences with AD on-farm and some of the problems that they encountered were given. What was interesting is that these three speakers came from different government departments in their respective countries and thus had a quite different approach on the situation. Mr. Zoran Pacandi came from the Department of Energy at the Ministry of Economy in Croatia while Ms. Marjan Botman is a Policy Adviser in the Directorate General for Energy and Telecommunications in the Competition Energy and Sustainability Department as well as working for the Ministry of Economic Affairs, Agriculture and Innovation. Dr. Justin Zahra from the Agricultural Directorate in the Ministry for Sustainable Development, the Environment and Climate Change was particularly interesting as he linked the Maltese experience and future plans around the current changes to the EU Common Agricultural Policy (CAP).

Not all participants projected their presentation on the large screen. Policymakers from Cyprus, Hungary, Ireland, Spain, Czech Republic and Germany contributed with comments and detailed, specific information concerning their countries and the most relevant differences in terms of directives, permits and pro-biogas feed-in tariffs. Here there were very useful contributions in particular from the Czech Republic and Ireland before there was a general discussion on the day's proceedings. The final discussion, which was very interesting for the identification of the real common issues, was loosely based around four common topics:

- Planning permission/grid connection
- Small scale biogas vs. centralised large scale plants
- Biogas upgrading and alternative uses of biogas
- Biofertilizer from digestate as new marketable by-product

It is general consensus that a general pro-biogas pathway can't be identified at a national level as too many differences exist. Every country demonstrated support for a pro-renewable programme, as defined by the EC, but the attitude will lead to different results in relation to the needs of the country and the state of development will be limited by the economic potentials. However, the interest demonstrated by the participants was very encouraging and the debate provided ideas and new cooperation opportunities. It is difficult to obtain a definitive conclusion, but it is certain that differences stimulated new interests around biogas future perspectives. The event has paid off.

EUBIA

INTERVIEW

Biogas:
Growing a sustainable future with renewable biomass resources

George Andreou
Chairman of the Cyprus Biogas Association

The world's financial and energy crisis indicates the need to further explore all the alternative sources of energy and especially the Renewable Energy Sources (RES). Biogas technology from farming wastes can play key role in replacing the imported and polluting fossil fuels.

European Union covers today a great percentage of its energy needs from the utilisation of biomass. The contribution of biomass and the biogas production is expected to be very crucial in the European energy mix. This contribution will lead directly to the reduction of the greenhouses gases, to the reduction of the negative effects of the non rational waste management and to the creation of new job opportunities especially at rural areas.

The growth of the livestock has led to the production of high quantities of farming wastes and created difficulties regarding their management, treatment and disposal to the environment. Biogas technology offers several advantages and environmental benefits:

- Money savings to the farmers
- Production of compost fertilizer and improvement of the fertilization efficiency
- Reduction of the greenhouse gases
- Waste management with financial and environmental benefits
- Reduction of odors
- Potential reduction of the pathogens

A biogas plant is not only a way to use all the available energy potential to produce energy but at the same time it is the most efficient way to treat the farm wastes and reduce the waste load more than 50%.

Biogas which is a renewable energy source, is produced by the anaerobic digestion of mainly farm wastes (wastes from pig farms, dairy farms etc.), wastes and sewage and biodegradable organic wastes. A typical constitution of biogas is 65% methane and 35% dioxide carbon. Biogas can be used to produce heat and electric energy and moreover it can be used as a fuel for the internal combustion engines.
A cubic meter of biogas contains the same energy equal to 0,66 liters of diesel or 0,75 liters of petroleum or 0,85 kilos of coal. When biogas is burned in a cogeneration (combined heat and electricity) engine, it produces green electric energy that can be transferred to the national grid and moreover useful heat to cover the farm thermal needs.

Today, in the European Union there are more than 3.000 biogas plants in operation (for commercial use). In Cyprus today 13 biogas plant units in operation with a total installed capacity of 9,7MW. As a result of these plants in Cyprus, their annual electric energy production is approximately 54GWh and the useful thermal energy production is 25GWh. The electric energy which is produced by these plants represents the 1% of the total electric energy that is produced annually in Cyprus.

Advantages from the installation and operation of a biogas plant in Cyprus:

- Green electricity enters the national grid. The electricity production of the biogas plants has no fluctuations during the whole 24 hours of the day, in contrast with other Renewable Energy Sources.
- A biogas plant can resolve several environmental aspects and reduce odour issues of the farming wastes.
- Reduction of the organic wastes that are being transferred to the landfills (the cost of the transfer per a tonne of wastes to the landfills is estimated to be 100€)
- Reduction of the use of primary fuels for heating

However, the National Support Schemes in Cyprus provide low Feed-in tariffs for biogas plants since the first year of operation. The current Feed-in-Tarriff is Cyprus, which is 0,145€ (2013) per kWh is still low taking into account the avoidance production cost of the Electricity Provider and the high electricity prices in Cyprus. The Support Schemes should be designed to cover the needs also for smaller farms.

Under a favourable government support policy, the installed power of the biogas plants in Cyprus can be expanded up to 30MW and resolve serious environmental issues emerging from the non-proper farming waste management. Furthermore, the urban waste management cost will be reduced significantly (soon this cost will be unbearable for each household).

Under a rational design and programming by the Government, biogas could be the pioneer alternative renewable energy source in Cyprus regarding the electricity production. The viability of a biogas plant relies on the fact that the raw material has a zero or a negative cost but the products of the plant's processes can be undoubtedly sold commercially.

Furthermore, biogas can be use as a transportation fuel, after its purification and upgrading. Examples of countries where biogas is used as a transportation fuel are Sweden, Switzerland, France and Germany. Moreover, in Germany and Sweden the biogas is transferred into the natural gas network.

In Sweden, vehicles using biogas have several privileges: free parking at every city, no transportation fees and free pass at tolls in the Stockholm city is provided for cars and €450 annual tax reduction for commercial vehicles. Additionally, taxis consuming biogas fuel use their own lanes. Moreover, there is a 40% discount on taxes for companies using biogas vehicles.

Finally, the project Geronimo II – Biogas which is implemented now in Cyprus is co-funded by the Intelligent Energy Program and aims to promote the biogas technology as a feasible method for the exploitation and management of farming waste produced by dairy and pig farms. Cyprus Energy Agency participates in this project as a partner with the support of the Cyprus Biogas Association.

More information for the project Geronimo II is available in the website www.energy4farms.eu.

UPCOMING EVENTS

Geronimo II - BIOGAS project will participate to the following events:

- September 24 - 26, 2013 - National and European Ploughing Championships, Ratheniska, Co. Laois, Ireland
- September 24 - Month - 30 Geronimo II - BIOGAS project Final Meeting, Ratheniska, Co. Laois, Ireland

For more information please send an email to the project coordinator **Mirta Rodriguez Pinilla** (mpinilla@iris.cat) or contact her over the phone +34 93 554 25 10.

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Visit the **Energy4Farms** website and discover the benefits of biogas production on farms. Register in the Members Area to get the latest information and tools. You will find technical material, reviews, news and videos of the study visits to biogas facilities and meetings ongoing within the **Geronimo2** project. Go to www.energy4farms.eu and stay tuned!