



FINAL RESULT-ORIENTED PUBLISHABLE REPORT



Sustainable small-scale biogas from agri-food
waste for energy self-sufficiency



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1. Executive summary

This report provides an overview of BIOGAS3 activities and achievements in seven European countries: Spain, Italy, France, Germany, Sweden Poland and Ireland. It also includes information about sustainable small-scale biogas plants in agro-food sector developed in the frame of the project for involved countries.

The BIOGAS3 project was focused on promotion and setting the ground for new investments in sustainable small-scale biogas production from agro-food waste for energy self-sufficiency in European Union (EU) countries. Therefore, the activities were mainly targeted at the agro-food sector which is at the same time the energy producer and stimulator of the demand-side.

As a first step, the needs of end-users in terms of energy demand were analyzed, as well as the difficulties they encounter when considering installing a biogas production facility. Second, the necessary tools to address these needs were developed according to the gathered information. These tools include business collaboration models that reduce dependency on public subsidies or small-scale process design and promotion based on existing technologies of small-scale anaerobic digestion (AD), software available via web, and professional handbooks on Biogas small-scale implementation for agro-food companies. Third, on-field actions were implemented to promote this small-scale concept and to bring the developed tools to the end-users, including sustainability analysis, training sessions, workshops, webinars, and use of the website resource, etc. Additionally, specific networking activities with the most promising implementation sites were carried out to make it possible to set the ground for new investments.

Among the main achievements, BIOGAS3 provided technical information about the agro-food sector wastes and energy needs through more than 150 replies to the questionnaire and increased policy makers' awareness of the benefits of the proposed scheme, through more than 80 contacts made during the project to inform about its results.

Regarding training and networking achievements, BIOGAS3 was able to increase the awareness and confidence of agro-food companies in the small-scale AD concept for energy self-sufficiency through visit tours to successful small-scale AD implementation; to improve agro-food companies' skills and awareness on small-scale AD for self-sufficiency through workshops, face-to-face training and on-line dissemination activities (more than 1,500 participants). BIOGAS3 facilitated networking between agro-food companies and key actors through workshops with the entire chain, sustainability analyses with a software tool named smallBIOGAS (more than 150 sustainability analyses), one-to-one meetings (more than 300 first round meetings) and face-to-face meetings (45 meetings); and assisted in getting signed agreements of initiation of small-scale plants between agro-food industries and biogas plant providers as a final achievement of networking activities.

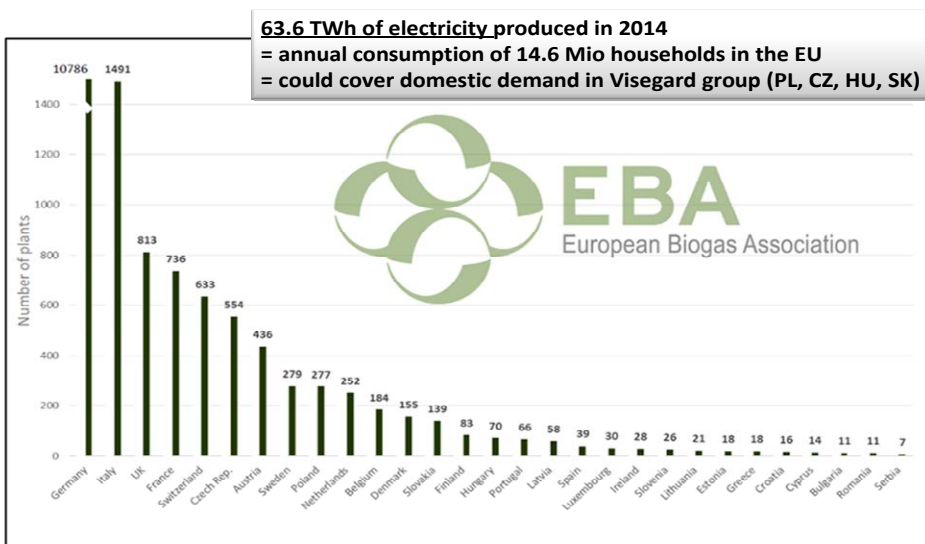
In addition a change in behaviour and understanding of policy among stakeholders took place through direct contacts in workshops, training and networking events, and also in dissemination events at national level (2-3 national events per country). BIOGAS3 dissemination materials as well as professional handbooks and videos of the project were promoted using publications in technical magazines, through European Enterprise Network, FoodDrinkEurope, press releases, website, Twitter®, Facebook® and LinkedIn®, among others.

2. Introduction

The BIOGAS3 project was approved in the context of the European Union energy policy having and its 20-20-20 goals, meaning a 20% increase in energy efficiency, 20% reduction of CO₂ emissions and 20% renewable energy by the year 2020.

The agro-food industry is a diverse sector with a wide range of company sizes, producing large amounts of organic waste, with high demands for transportation and management of waste, subject to national regulations and food safety constraints, specific energy needs and, frequently, high costs related to waste management. In terms of opportunities, it is widely acknowledged that considerable benefits can be achieved for agro-food companies through better management of waste streams for energy.

The organic waste generated in agro-food industries is usually able to be processed by microbial action under mild operating conditions through anaerobic digestion (AD). In recent years AD has become a prevailing treatment choice for sustainable organic waste management all over the world. It is well suited for various wet biodegradable organic wastes of high water content (over 80%), yielding methane-rich biogas for renewable energy production and use. AD for biogas production is a proven technology that is well known in the municipal waste and wastewater treatment plants to treat organic wastes. It is commercially ready to use and has multiple benefits such as energy savings, waste management cost savings, reduction of environmental impact and reduction of carbon footprint. The same technology can be applied to other organic waste such as agro-food waste. Despite its multiple benefits, AD is not yet widely used in the agro-food sector and its implementation varies considerably between the EU-28 Member States. Disparities between EU countries are largely due to differences in national laws as regards support for renewable energy production. Well-designed regulations may facilitate and stimulate growth, as exemplified in Germany, where the introduction of feed-in tariffs led to a significant growth of the industry - currently the country has more than 10,000 operating biogas plants, including small-scale plants (≤ 100 kW).

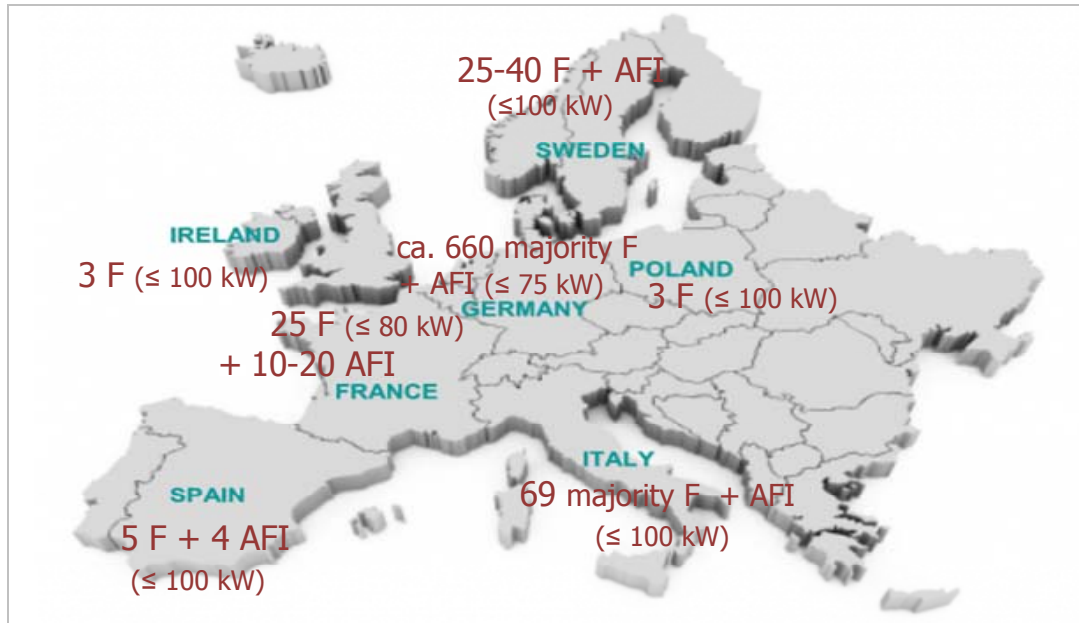


17 240 biogas plants in Europe (31/12/2014)

Total installed capacity of 8 293 MW_{el}

Courtesy: EBA, 2015

Currently, Germany and Italy have achieved the most small-scale AD development in the EU. However, even for those countries, small-scale biogas plants (≤ 100 kW) represented less than 10% of the total number of biogas plants installed in 2015. The following figure presents indicative data on the current development of the market of small-scale biogas plants in agro-food sector in BIOGAS3 partner countries (data collected on February 2015; biogas farm plants "F" or agro-industrial plants "AFI". Non-exhaustive list for involved countries in BIOGAS3 project).



Regarding substrates in existing small-scale plants, in Spain around half of the plants installed are associated with farms and the other half are linked to food industries, whereas in most of small-scale plants from other countries like Germany, Italy, Sweden, Ireland or Poland manure is the main substrate.

In this context, the BIOGAS3 project, co-funded by the IEE Programme, was intended to foster renewable energy production through small-scale biogas plants in the agro-food sector in seven European countries (Spain, Italy, Poland, France, Germany, Sweden and Ireland). It would identify and provide analysis, train and help farms and food and beverage processors to manage organic waste through small-scale biogas technology for energy self-sufficiency.

At the same time, different challenges were under the scope of the project. The table below summarises the relationship between the non-technical barriers to uptake of AD in the agro-food sector and the specific objectives of the BIOGAS3 project to address the barriers.

Non-technical barriers to AD identified	Specific Objectives of BIOGAS3
Why AD is not widely implemented in agro-food sector?	Identify end-user needs and difficulties (country specific)
High dependency on governmental support to renewable energy	Develop sustainable business collaboration models
Small amounts of waste – bigger plants is more common	Develop and promote small-scale AD models (≤ 100 kW) including energy demand management models
Energy consumption is not constant (day–week–month–year)	
Lack of knowledge, skills and confidence in small AD technology	Build-up skills, awareness and networking
AD not widely implemented	Set the ground for new investments

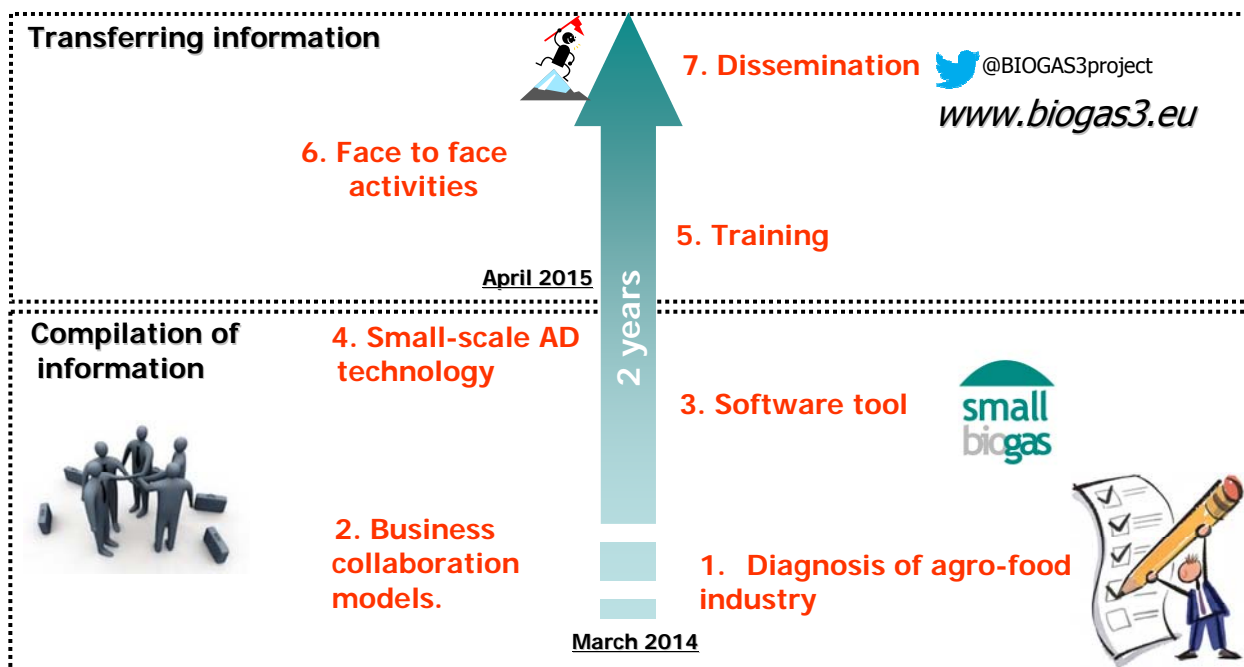
All these specific objectives were taken into consideration in the frame of the project and all BIOGAS3 project activities were targeted at agro-food companies with the proposal that new small-scale biogas installations fed with agro-food waste are being constructed in the future with the aim of increasing renewable energy production and contributing to reduction of CO₂ emissions in this sector.

3. Applied approach and methodology

The Figure below provides an overview of the applied approach and methodology followed in BIOGAS3 activities targeted at the agro-food sector. The project was implemented from March 2014 to February 2016. All the activities were free of charge and all the materials developed are available on the website. This resource includes some materials translated into all six languages of participating countries.

As a first step, preparatory actions and development of supporting materials were elaborated with the collaboration of all the consortium of the project. All the materials were focused on promotion of the equally effective but less promoted option of small-scale digesters suitable for food and beverage plant waste on site and agricultural by-products, without affecting the current operations of producing food.

As a second step, specific actions with the agro-food industries and other target groups were carried out in the partner countries, including on-line training, face-to-face training, webinars, workshops and face-to-face meetings to promote at total of 10 new small-scale biogas plants. In parallel, general communication activities were developed in the partner countries.



Development of materials

Among the materials elaborated in the frame of the project was a diagnosis of implementation of AD in agro-food industry through surveys in participating countries (contact by mail and phone with agro-food industries), several handbooks (small-scale technology, business collaboration models, financing opportunities, etc.) and a software tool for sustainability analysis of small plants. A train-the-trainer seminar to instruct the project partners ensured impacts beyond the actual project duration. The project activities were coordinated by AINIA/FIAB (diagnosis, software tool, handbooks) and DEIAFA (handbook small-scale technology) with support from all the BIOGAS3 partners in order to collect information about all the participating countries.

Implementation

Implementation activities using the developed materials included on-line training, face-to-face training, webinars, workshops and face-to-face meetings with the agro-food industries and other target groups to promote the initiation of 10 new small-scale biogas plants. Additionally, national stakeholders were involved in some activities of the project such as workshops and networking activities collaborating in the promotion of small-scale technology commercially ready.

At the same time, communication activities focused on informing target groups about opportunities for small-scale biogas plants to use on-site the energy and how to implement in the agro-food sector. These included events and meetings for policy makers, the project website www.biogas3.eu, press releases and radio, social networks (Twitter®, Facebook®), promotional materials (leaflet, roll-up banners), video promotion with successful small-scale cases, communication at EU level through European Enterprise Network (dissemination of small-scale technology profiles offers) and FoodDrinkEurope, participation in national events and the final conference of the project in Brussels with the support of European Biogas Association. Some of these activities were done in collaboration with other EU projects (including Bioenergy Farm II, FabBiogas, Synergia, DELOS, PROVALUE or WOGAnMBR, among others) making it possible to reach a wider audience for the events and for greater impact as well.

While each national partner carried out specific national activities, each group of activities was coordinated by an expert in the field. Specifically, training activities (workshops, webinars, etc.) were coordinated by RENAC of Germany, face-to-face meeting were coordinated by IrBEA in Ireland while communication activities were guided by ACTIA of France. AINIA coordinated all the activities and provided technical support to address any questions raised.

4. Results and impacts achieved








A series of actions were planned and conducted which contributed towards achieving the objectives and related target outputs and results. These are briefly outlined here, including main quantifiable targets and achievements.

Initial diagnosis of the agro-food processors in the EU countries involved

Target groups were identified through known channels and events, and initial diagnosis was conducted to identify their energy and waste management needs, success stories and keys of success including legislative and financial frameworks. The table below summaries target groups identified in participating countries. In addition, information from the diagnosis was used to design the small-scale business collaboration models including preparation of a handbook and a software tool smallBIOGAS as a sustainability analyser.

Country / Level	Type of agro-food industry
Spain. National with special focus in Catalonia and centre Spain	Meat processing and slaughterhouses (cow, pig and poultry)
Spain. Northern Spain	Fish processing: cannery, frozen
Spain. East and southern Spain	Fruit and vegetable processing industries
Italy. National with main focus on Northern Italy	Fruit and vegetable processing; Chicken for eggs production; Wheat and cereals; Meat processing; Dairy products; Wineries, breweries and distilleries
France. National with special focus on Brittany and Lorraine regions	Meat processing and slaughterhouse; Dairy products; Farms; Oil production; Fruit and vegetable processing; Bakery; Breweries
Poland. National with main focus on Lublin and Mazovian voivodships	Farms; Meat processing; Dairy; Bakery; Breweries; Cereal and Starch processing; Fruit and vegetable processing
Sweden. Southern and central Sweden	Organic farms with on-farm food processing; Dairy and hog farms; Larger horse operations; Small to medium sized poultry operations; Fish processing
Ireland. National	Dairy farms and dairy processing; Meat processing and slaughterhouses (cow, pig, poultry); Fruit and vegetable processing
Germany. National, special focus on lower Saxony	Meat and fish processing
Germany. National	Bread, grain and sugar; Organic processed products
Germany. Bavaria, North-Rhine Westphalia	Dairy
Germany. Southern states	Beverages, breweries and wineries. Non-alcoholic

As a result of the conducted survey, it was possible to identify most common amount of organic waste produced as well as energy consumption among the companies that responded to the questionnaire. The next table summarizes the results of the survey in participating countries. More information is available in the website of the project including all the results of the survey conducted ("Report small-scale AD in agro-food companies: potential and barriers").

Country (Total number of questionnaires answered)		Amount of organic waste (t/year)	Electric energy consumption (kWh/year)	Thermal energy consumption (kWh/year)	Current energy sources	Main barrier
	Spain (49)	1,000 – 5,000 (29%)*	>1,000,000 (69%)*	>25,000 (25%)*	Natural gas (58%)*	Residues quality or quantity (37%)*
	Italy (24)	<50 (45%)*	25,000-2,500,000 (41%)*	NA	Fossil fuels	Plants too big to their needs
	France (19)	100-500 (38%)*	>1,000,000 (78%)*	>10,000,000 (45%)*	Natural gas (77%)*	Residues quality or quantity (not enough waste, seasonal production, packed waste)
	Poland (33)	100-500 (55%)*	<25,000 (50%)*	<25,000 (63%)*	Gas/oil (55%)*	No incentives (80%)*
	Sweden (23)	1,000-5,000 (52%)*	100,000-250,000 (39%)*	400,000-550,000 (34%)*	Solid biomass (pellets)	Capital cost and financial viability
	Ireland (7)	400-29,000 (100%)*	NA	NA	NA	Capital cost and financial viability
	Germany (7)	<50 (37%)* 1,000-5,000 (25%)*	<25,000 (50%)*	<25,000 (75%)*	Natural gas (50%)*	Too big plant according to company's needs (41%)*

* Percentage of companies interviewed having this value of amount of waste, energy consumption, etc. For each aspect evaluated is included the most frequent value.

The survey showed that Spain and Sweden had more than 25% of companies in a range of 1,000-5,000 tones of organic waste produced yearly. These amounts of waste along with stated energy needs range points to more favourable conditions for small-scale (≤ 100 kW) development in certain agro-food sector section for the mentioned countries. Taken into consideration were not only the amounts of waste and energy needs but also the number of surveys completed for each country. Specific barriers were identified for each country that reduces the potential of implementation.

European legislative and financial framework for the implementation of small-scale biogas plants in agro-food & beverage companies

An assessment of the legislative and financial framework for small-scale AD in Europe and specifically in the participating countries was elaborated within the project. This information was compiled in a handbook which includes a summary of the regulations to be fulfilled related to biogas. In addition, it provided an overview of public and private financing institutions and programs. It is possible to see in detail different support systems for small-scale biogas production in the involved countries. Among the different options, Feed-in-Tariff measures are the most common type of policy supports to AD. Germany, Italy and France have these policy supports. In particular, Germany introduced a maximum Feed-in-Tariff for plants up to 75 kW using at least 80% of manure in the mixture of substrates introduced in the digester. France fixed a maximum Feed-in-Tariff for plants below 150 kW and over 60% manure as substrate, having 70% of energy efficiency in the valorisation system of the biogas. Italy included a maximum Feed-in-Tariff for plants below 300 kW and which use organic waste, with a bonus for high efficiency in cogeneration and nitrogen use.

Handbook: Small-scale anaerobic digestion (AD) Business Collaboration Models (BCMs)

This material included business collaboration models and successful implementations of small-scale AD plants which were identified and analyzed in all countries. Having details of the success stories made it possible to increase awareness about the technology among agro-food industries and was very useful for conducting the webinars, workshops and Face-to-Face training. Each involved country included several examples and elaborated a map of successful small-scale AD plants treating agro-food waste. The table shows a success case included in mentioned material.

Description	Characteristics
Business Collaboration Model: Private investment. Operator: Santibáñez Energy operates an anaerobic digestion plant (wet process) Customer: Grupo Hidalgo	A synergic model is applied for operation of the biogas plant between agro-food companies close to the biogas plant. Biogas produced during the day and consumed in the poultry processing industry from 0 a.m. to 8 a.m.
Biogas plant located in Íscar (Spain) This plant treats agro-food by-products from vegetable processing industries and sludge from wastewater treatment plant The thermal energy produced is used for heating the digesters and self-consumption in poultry processing company located close to the biogas plant.	Substrate treated: approx. 6,700 t per year of by products from processing industries of vegetables and potatoes and sludge Installation: Digester 570 m ³ ; Postdigester 300 m ³ ; Gasholder 533 m ³ ; Digestate storage tank: 900 m ³ Biogas valorisation unit: 1 hot-water boiler of 80 kW and 1 steam boiler of 1,000 kW
Strong points for success: Valorisation of thermal energy for self-consumption Digestate is used as fertilizer in agricultural activities Reducing cost of waste treatment	Investment: 410,000 €. Estimated payback: 6 years Funding by: own resources

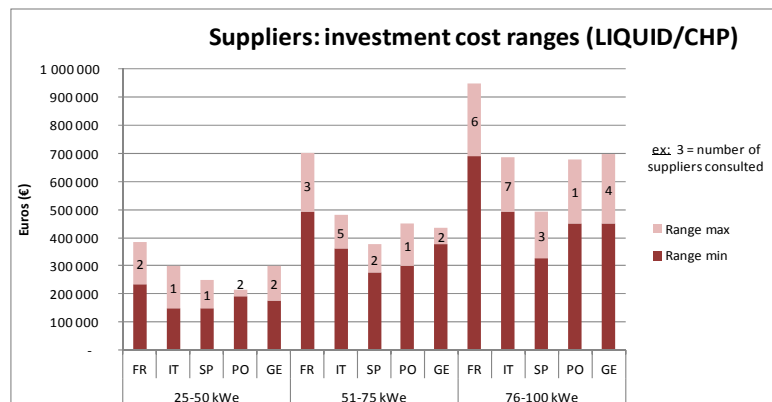
Handbook of small-scale AD technology

This Handbook is a tool to promote sustainable production of renewable energy from small-scale plants for self-sufficiency and includes 8 sections: introduction, biogas substrates, technology, companies, models, implementation, and legislation. The Handbook is focused on promotion of the concept of small biogas plants which produce electricity and heat from waste generated by small or medium-sized agro-food enterprises for their own needs, not just for sale - an innovation which aims at making the biogas sector more independent from existing public support schemes. The small-scale AD technology is commercially ready to use and has multiple benefits.

The small-scale AD concept (≤ 100 kW) applied soundly in the appropriate locations, is a high sustainable solution not only from an environmental point of view (reduced or zero transport costs for raw materials and digestate, CO₂ emission abatement), but also from an economic (energy savings due to self-consumption, waste management savings) and energy (self-consumption and reduced losses due to near use) point of view. In addition, for agro-food companies, this activity could contribute to “greening” of their products (e.g. lower use of fossil fuels in the production process), that could also provide a marketing and competitiveness advantage for a company. More than 60 biogas plant providers from all participating countries were involved in the development of the biogas small-scale concept in the BIOGAS3 project. Based on existing technologies, the models identified include all the necessary components of small-scale plants (raw materials pre-treatment, AD, biogas valorisation, digestate conditioning, etc). The energy demand management, adapting the energy production to the demand of the agro-food business for energy self-sufficiency, although interesting, was simply described in the manual since is too expensive compared to the actual price of energy to implement it on a small-scale and the biogas plants have to run as many hours as possible to be feasible. The sustainability of the proposed model was assessed with the smallBIOGAS software along with the Handbook. Among the information included in the Handbook, below are some of the most notable available.

a) Technology and providers of small-scale technology in participating countries provided orientation on investment costs for small-scale plants as well as information of plants commercialised by them. The companies listed were the ones who have the capacity for supply-assembly of the whole biogas plant and which already have installations running in the partner countries to this project.

There is a very large variability in investments as it can be seen in the this figure which includes an estimation of investment in participating countries for plants between 25 and 100 kW (data compiled in February 2015 by IFIP within the project life and with the collaboration of the entire consortium, wet digestion).



b) Best cases of small-scale in participating countries were included in the handbook making it possible to increase the confidence of agro-food industries in small-scale biogas technology. Examples shown are small-biogas plants cases suggested by partners. The choice of the companies was not involved in any kind with partner's business activities. Note that each country has a different subsidy policy management approach for biogas plants. Best case offered below may have received subsidies different from the ones you can get in your country or may have received subsidies from previous policies.



Farm in Gießen (Germany) - Liquid technology – 75 kW CHP engine

Supplier: Bio4Gas Express GmbH

Using renewable energies for self sufficiency is part of the concept of two farmers in Gießen, Germany. They farm 420 dairy cattle.

The livestock units consist of 290 dairy cows, 300 young cattle and 50 breeding bulls, placed in three stalls. Additionally the farm cultivates 400 ha arable land and 200 ha grassland. The farm is run by both brothers together with their families, five employees and one trainee.

Since September 2013, the farm owns a small-scale biogas plant. The digester of the plant holds 600 m³, CHP engine has an installed capacity of 75 kW. Each year almost 11,000 m³ of slurry are introduced in the digester.

With the CHP engine, the heat is used in three residential buildings on the farm and is sufficient for the German winter. Therefore it is possible to save around 10,000 litres of heating oil every winter. In future one of their neighbours will be provided with the surplus heat. All of the produced electricity is fed into the national grid.

The total investment for this plant was around 500,000 €, the investment was funded by farmer resources, with an estimated payback period of 6 years.

This biogas plant has notable points:

- Large amount of land where to spread digestate
- thermal energy is valorised for household heating
- All substrates are produced on the farm

c) Energy model was checked with technology and national providers of small-scale technology in participating countries.

The issue of fluctuation in biogas production can be solved through a biogas storage system. Storage can be used when production and consumption of biogas do not overlap. For example the agro-food industry may not need electrical energy during all day and actually cannot store economically the surplus produced. Likewise biogas can be stored when the digester produces more gas that can be used, instead of burning it by flaring. Storage systems can be temporary installations, so they are flexible solutions however very expensive and not usable especially for small scale installation. The most common available technology is "Low pressure storage" which

is the most used solution. Floating gas holders, gas bag and floating roofs are typical of this technology and operate at very low pressure (usually <138 mbar).

smallBIOGAS tool

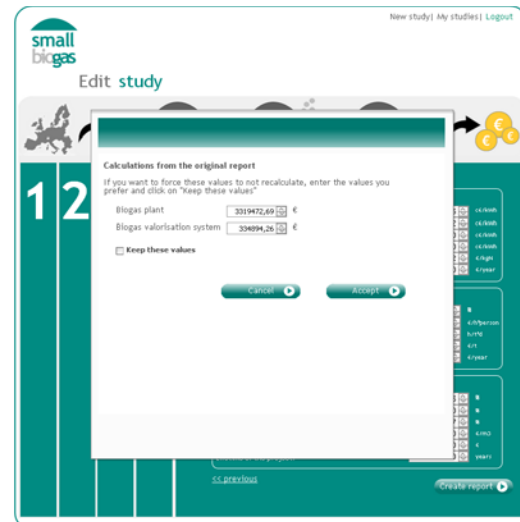
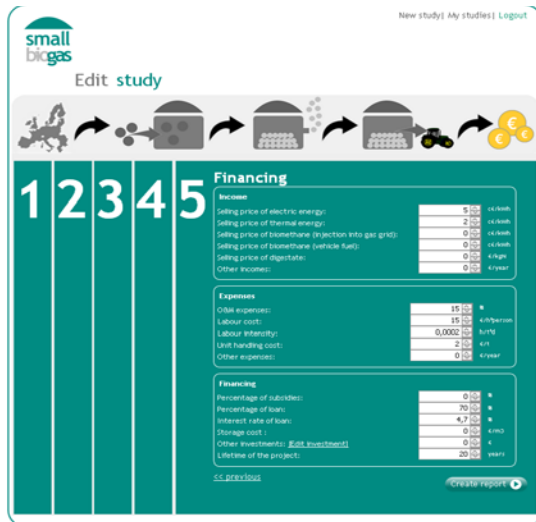
A specific software tool was developed within the project in order to provide a first estimation of the feasibility, or not, to install a biogas plant for certain agro-food company. This tool was adapted to the concept promoted by the BIOGAS3 project of small biogas plants which produce electricity and heat from waste generated by small or medium-sized agro-food enterprises for their own use. The smallBIOGAS tool has been developed for small biogas plants (or an investment project of a small-scale biogas plant) of up to 100 kW installed.

The tool is available on the website of the project and includes a user guide in all the languages of the partner countries. It's not necessary to download any program and it is possible to use the tool only with an internet connection in a PC, Tablet or Smartphone. It is an intuitive tool which includes information about each concept on the interface of the tool if the user puts the cursor of the mouse on the word that you want to know the meaning.



The tool is able to carry out feasibility studies in the 7 participating countries (Sweden, France, Italy, Germany, Poland, Spain and Ireland) and in the main official languages of those countries. Therefore, smallBIOGAS is able to create national scenarios for those European countries. It includes consideration of self-consumption as well as mixed use of energy (self-consumption and sale) as options of use of the biogas.

The tool is optimized for small-scale anaerobic digestion. Therefore, the investment, incomes and outcomes have been adapted to small installations. In addition, it is possible to edit the "Investment" and to adapt to each specific case, if it is needed (see figure below about Financing adapted to small-scale and option of editing the Investment).



Regarding display of results, it is possible to view previous studies or reports, copy and edit. It can facilitate the use of previous studies and the possibility to consider different situations related to digestate use or substrates, among others. The assessment of sustainability of biogas on small scale for different electric countries indicates that the profitability of the technology relies heavily on regulations and incentives.

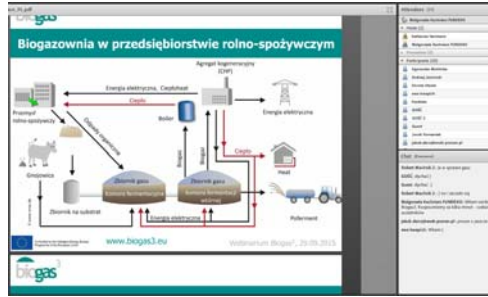
Capacity building activities

Shortly after the start of BIOGAS3 a train-the-trainer seminar was conducted in order to prepare and enable the project consortium to carry out the upcoming BIOGAS3 face-to-face training activities.

The actual training activities within BIOGAS3 were aimed at food/beverage processors as well as farms that did not yet have an AD plant for the disposal of their organic residues. A set of actions provided information, networking and training to build up the awareness and capacity for informed decision-making by those interested in small-scale AD possibilities for their businesses. Activities included workshops, visit tours and live webinars, face-to-face and online trainings for the seven partner countries.

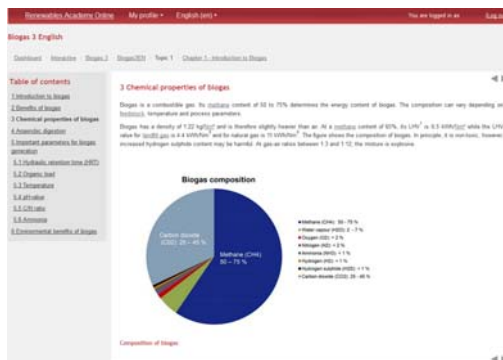
Altogether over 1,500 interested stakeholders were trained through the capacity building activities of BIOGAS3. The numbers of participants in each of the four types of trainings far exceeded the targets in all seven of the BIOGAS3 partner countries. Not only the high resonance in attendance of the BIOGAS3 training activities but also the overall positive feedback of participants of the trainings shows the high interest and demand for small-scale AD technologies for production of biogas in agro-food companies in Europe. This can also be seen as a strong indicator that the potential for significant investments in this area is high. The Figure below includes an overview of capacity building activities provided free of charge for involved countries.

Webinars



- Online seminars carried out in seven languages
- Presentation of the project and activities
- Introduction to small-scale AD and updated state for each involved country
- Examples of small-scale biogas plants
- Discussion after the session and starting point for further interaction with agro-food companies

On-line training



- Overview of biogas and how small-scale biogas plants can be integrated to the agro-food production
- Main aspects of technology for small-scale biogas plants
- Economics of small-scale biogas plants and different aspects to include in a feasibility study
- Legislative framework and financing possibilities
- Best case examples of small-scale biogas plants in all partner countries

Workshops & Networking



- Presentations held by respective project partners and local external experts.
- Activities to share knowledge, spread information and discuss topics with the general public and specific target groups.
- Workshops aimed at providing the ground for business to business meetings between agro-food companies and biogas plant providers and other key actors to facilitate business collaboration models.

Face-to-Face Training & Visits



- Face-to-Face Trainings included theoretical training with presentations and debate, followed by a visit tour to biogas plants around the respective countries, aiming at enhancing the focus on the technical features that diverse industries entail for the deploy of biogas technology.
- To impart a deeper insight into the biogas technology and functionality of the biogas process, one-day visit tours to small-scale biogas plants treating agro-food waste were organized.

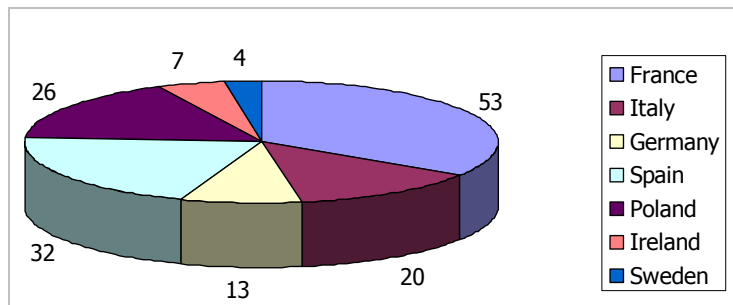
Face-to-face activities

Face-to-face activities included identifying the agro-food companies and farms with the most favourable conditions to implement small-scale AD in each partner country, meeting these businesses and performing viability and sustainability analyses, involving them in the capacity building activities described above, and conducting final round(s) of meetings aimed at setting up business agreements for new investments in small-scale AD.

More than 300 European agro-food industries participated in the programme of one-to-one meetings of the BIOGAS3 project. And more than 150 sustainability analyses have been performed for small-scale anaerobic digesters by BIOGAS3 partners in the seven countries – see Figure below. Both these achievements far exceeded the target numbers for these activities. These results are positive indicators of considerable interest among agro-food producers about the opportunities for investments in small-scale AD plants to produce biogas for own use.

In addition, numerous meetings were held between agro-food companies, national biogas plant providers and other key stakeholders such as co-substrate suppliers. Those meetings were important steps along the way to setting the conditions to promote new investments in anaerobic digestion on farms and in agro-food production companies.

Sustainability analysis in agro-food companies for involved countries (total number)



- 155 sustainability analysis in agro-food companies for all the involved countries
- 45 face-to-face meetings between most promising agro-food companies and biogas plant providers in all the involved countries

Consortium partners in the seven countries used a variety of approaches and platforms in imaginative ways with local industry counterparts to identify potential participants. Guidelines on procedures and criteria for selection and the tool developed for conducting and recording the one-to-one meetings proved useful.

All agro-food companies contacted by the project partners were offered to participate in all the activities of the project and some of these showed positive possibilities in relation to the implementation of a small-scale plant into their facilities in the short term.

Communication and dissemination

The set of tools and activities provided included website, social networks, articles in technical publications, press releases, final conference, leaflets and banners, merchandise materials, promotional video and communication to policy makers. In addition, wide dissemination has been possible thanks to national events linked to agro-food/biogas events where it was possible to provide to the participants all the materials elaborated as well as contact data with partners. All the communication targets of the project were successfully achieved.

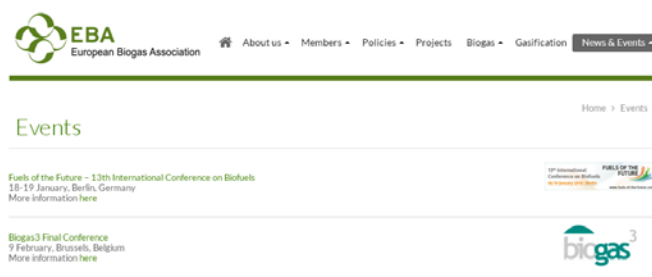
Dissemination at EU level included contributions to the development of EU information material, inputs to European portals and databases, training events, and how the project has contributed to Intelligent Energy Europe's (IEE, an EU funding programme) performance indicators so the effectiveness of the project can be monitored and assessed.

Regarding involvement of the European Enterprise Network (EEN), it was offered to all the involved national biogas plant providers the possibility to inform about their technical profile through regional contacts of the EEN. Some made use of this opportunity, helping them with their promotion of small-scale technology at EU level.

FIAB was in contact with FoodDrinkEurope during the whole project developing several EU dissemination activities: presenting the project in the meetings at FoodDrinkEurope in Brussels, into Science, Research & Development Groups in which members have the possibility to present the projects they are involved in.

The collaboration of the European Biogas Association (EBA) during the promotion of the Final Conference and participation on the event itself made it possible to create an effective event for the discussion and interaction between stakeholders at EU level, in particular, with policy makers from different regions across Europe.

EBA website



EBA presentation



Additional achievements of the project have been possible due to the interaction with national stakeholders and with other EU projects. High levels of dissemination of BIOGAS3 project materials such as the video was achieved through different channels of mentioned stakeholders such as blogs, websites or social media. The Figure below includes the main results of the communication and dissemination activities.

Website www.biogas3.eu > 8,000 visits



Video > 2,000 watchers



National events > 20 national events

All countries attended at least 2 national events within the project life.

Press releases > 100 press releases

Each country promoted project activities through press releases, radio and TV

Social networks > 1,000 followers



Flyers and roll-up for each country



Each country EU dissemination: EEN and FoodDrinkEurope

Publications: 2 technical articles + additional publications



Policy makers communication > 80 meetings

BIOGAS3 project aimed at embarking on a dialogue with policy makers, in order to raise their awareness of the benefits of small-scale biogas production in the agro-food industry, to point out the barriers that hinder the development of this sector, to foster the development of new regulations and to facilitate the authorisation procedures for new installations.

Policy makers' dissemination activities were directed at public bodies and institutions dealing with the promotion of bioenergy technologies, organic waste management and valorisation, as well as those responsible for the programming and distribution of EU and national funds – on both national and regional levels. Some of the meetings were conducted directly through Face-to-Face meetings while others were dissemination events that the policy makers attended.

As part of the different meetings, a wide explanation of the benefits related to small-scale was tackled. The following aspects have been identified as the main advantages of the proposed small-scale self-sufficiency AD concept for investors or general public and were included in most of mentioned meetings:

- Savings of expenses on electrical and thermal energy;
- Savings of expenses on waste management;
- Savings of expenses on artificial fertilizers (in case of farms using digestate as fertilizer);
- Independence from external substrates providers;
- Improvement of the company's environmental performance, including carbon footprint reduction;
- Reduction of CO₂ and CH₄ emissions, thanks to fossil fuels substitution, reduction of waste transport and digestion of animal manure;
- On-site organic waste treatment;
- Stability of energy generation (independence from weather conditions in contrast to photovoltaic and wind);
- Creation of green jobs.

Details of the messages directed to policy makers were adjusted each time by the project partners to country-specific conditions, and it is possible to review in the corresponding specific report uploaded in the website of the project. This involved referring to specific legal provisions or administrative procedures that constituted barriers to the development of small-scale plants, to new regulations under development, to the existing and planned systems of incentives, to the programming and distribution of EU and national funds.

As an example of interaction with policy makers, IrBEA participated in regular meetings with the Department of Agriculture (DAFM) through the Animal By-Product (ABP) Regulations Forum to develop ABP regulations around farm scale digesters and made important policy progress. IrBEA's proposal was for ABP rules to be established specifically for on-farm biogas plants using only on-farm material – avoiding the highly regulated ABP for industrial plants involving separation from farm and pasteurization. The proposal was accepted and the DAFM drew up a

very simplified regulation for on-farm plants. Subsequently, IrBEA proposed and the Department of Agriculture accepted that “type 9” biogas plants (previously on-farm using only own ABPs) also be allowed to use imported non-ABPs, e.g. energy crops. These changes, agreed through the ABP Forum, have resulted in a modified regulation document which is now in force.

Promotion of real investment possibilities with agro-food industries companies and farms

To achieve the specific objectives of the project and have effective project delivery, the key stakeholders engaged with via the implementation activities were: a) agro-food industry associations who represent the target group; b) associations representing the biogas sector; c) biogas plant providers and waste management companies who are technology and service providers; and d) stakeholders in public authorities responsible for policy and administration; e) others such as investors.

More than 30 national stakeholders including national biogas plant providers, biogas associations or agro-food industry associations were very engaged with the BIOGAS3 project from the beginning of the project. Most of them collaborated with presentations in BIOGAS3 workshops, contributing to discuss the financial framework conditions, main barriers to small-scale implementation, examples in partner's countries and possibilities for small-scale biogas plants in their respective countries. As examples of cooperation of national stakeholders from involved countries, it is provided below further details about involvement of them in Spain and Ireland.



Courtesy: BIOVEC. Small-scale AD plant in Zaragoza (Spain)

SPAIN. Active cooperation of national biogas plant providers.

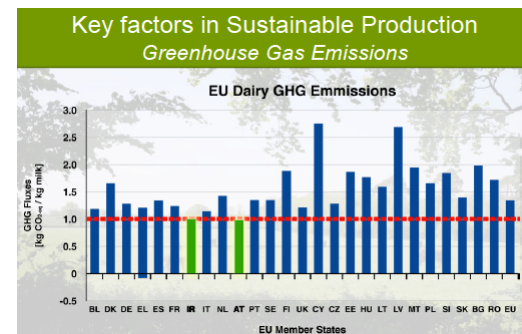
Guide of visits, collaboration in the definition of small-scale models for Spanish situation, validation on real financing possibilities for small-scale.

Collaboration of the Spanish Biogas Association with the dissemination of information about/from events such as Webinars among their members and participation in a joint event where they promoted the BIOGAS3 concept.

Contribution in defining the small-scale model which is country specific:

- a) Identification of feasible scenarios for small-scale, most suitable use of the energy and type of farms that could find a suitable solution to implement biogas technology.
- b) Small-scale digesters to produce biofertilizers. Incomes also from selling the digestate.

Other data provided to the project: updated prices for microcogeneration systems in Spain, in particular, for installations with a power of less than 10 kW. Technical solutions in case low electrical power required and low cost solutions.



IRELAND. Programme facilitating networking activities.

The “Origin Green” farm/food sustainability programme administered by Bord Bia (Irish Food Board) sets specific production and processing parameters and commits farmer and food processor participants to engage directly with the challenges of sustainability, including reducing energy inputs, minimising overall carbon footprint and lessening impact on the environment to increase efficiency and competitiveness.

By liaising with this programme, including Origin Green contribution to a BIOGAS3 workshop (see images on left), IrBEA was able to identify farmers/food companies potentially interested in small-scale biogas systems, and follow up with direct contact.

This framework facilitated networking activities in the project, and, as well, the meetings with the most promising agro-food cases previously analyzed with smallBIOGAS tool. As a result, 4 pre-contracts were signed at the end of the project (2 in Spain, 1 in Italy and 1 in Ireland). Those signing business agreements to build small-scale biogas plants were signed between agro-food industries from participating countries and biogas plant providers.

As an example, one pre-contract achieved in Ireland was with a vertically integrated enterprise with vegetable, cereals and meat production and prepared foods for sale in supermarkets and convenience foods. The company attended the first project workshop in 2015, with follow-up contact by IrBEA along with a biogas plant provider resulted in agreement to proceed with a biogas plant tailored to the waste management and energy needs of this farm and food business based in County Dublin.

Besides the pre-contract achieved in Ireland, three Irish small-scale cheese manufacturers who participated in BIOGAS3 events (workshops and/or study tours) and first- and second-round meetings are very keen to conclude agreements and proceed with plant investments in the short term – probably within 6 to 12 months. This is an example of positive legacy and medium- to longer-term impacts of BIOGAS3. The involved partner provided these producers with technical information and facilitated meetings with biogas plant providers and financiers.

These achievements were realised despite there being considerable uncertainty about the details of planned legal and financial reforms for incentivising production of renewable heat and electricity in Ireland. Policy development in these areas is ongoing, and agro-food producers are watching developments closely before deciding about investments in renewable energy including biogas.

While three more pre-contracts were achieved by project partners (2 in Spain, 1 in Italy), market uncertainty in the other partner countries meant that pre-contracts were not achieved by the end of the project period. In Germany, the Renewable Energy Law was amended in August 2014 which shifted support from biogas to other cost-competitive renewable forms and as a response to the food versus fuel debate. This change removed considerable incentive for new biogas installations and made it much more difficult to engage potential new entrants.

Sweden already has strong competition for substrates at co-digestion plants making vehicle fuel, and therefore many small agro-food companies still prefer to use this option for management of waste streams as it doesn't involve high capital expenditure. Farms in Sweden still do not have access to public funds for AD development, there are low electricity prices, options for purchasing heat are well developed, and it was difficult to find farming enterprises of sufficient scale to interest them in on-farm biogas.

Poland also has market and regulatory challenges which limited the results. There are currently limited technology options for small-scale biogas, but the main barrier has been the delay finalising and implementing the Renewable Energy Sources law which may or may not provide incentives for biogas production. However, the project has helped in bringing one cattle farmer to sign a letter of intent with a plant provider, although until there is further clarity on public funds for investments support it is not yet a pre-contract.

In the case of France, despite a clear goal at policy level about biogas plants to be built by 2020, incentives and a wide number of national plant providers available as well as existing plants, it was not possible to achieve the target of 2 pre-contracts. One of the main barriers encountered has been the delay in clarifications from government on new incentives planned after October 2015. This has strongly impacted on market development of new small-scale plants during the last months of 2015 and early 2016.

Impacts

Enabling policy due to diagnosis of the agro-food sector (150 replies to the questionnaire) and improvement of policy maker’s awareness on the benefits of the proposed scheme, through more than 80 contacts made during the project to inform about its results.

Building capacities and skills. Improvement of target group’s skills and awareness on small-scale AD for self-sufficiency through workshops, face-to-face training and on-line dissemination activities (more than 1,500 participants).

- a. Visit tours to successful small-scale AD implementation and face-to-face trainings (more than 300 participants).
- b. Improved networking between target group and key actors, thanks to the workshops with the entire chain (more than 300 participants).

Changing behaviour and informing stakeholders through direct contacts not only in workshops, training and networking events, but also in dissemination events at national level developed in involved countries (more than 2 national events per country).



Preparing the ground for investment. Increase of the confidence in the small-scale AD concept for energy self-sufficiency through:

- a. New business collaboration models and contacts to financial entities to raise awareness on the viability of the concept.
- b. More than 150 sustainability analysis with smallBIOGAS software tool.
- c. More than 300 one-to-one meetings (first round, phone and videoconference used), 45 meetings (second round, face-to-face meetings) and 4 pre-contracts signed between agro-food industries and small-scale biogas plant providers.

5. Conclusions and recommendations

From the range of BIOGAS3 actions undertaken with the target group and the outputs and results achieved, clear evidence exists to conclude the following points:

- Agro-food companies were hard to involve in a high number. However, the ones interested were very engaged in the project. Interest in AD among agro-food sector is driven by the possibilities for more efficient energy use, cheaper energy, more cost-effective waste management, diversification of economic activity, quality production of organic fertiliser as a by-product and greening of food products.
- High interest in BIOGAS3 project activities from biogas plant providers as expected and good involvement of them in the activities of the project facilitating networking.
- It is also necessary for technology providers to work on providing truly small scale technology. This could lead to less costly technologies that make the biogas more interesting for agro-food companies.
- More activities are needed to involve policy makers and facilitate the use of waste products in the biogas production and reuse of the wastes after digestion. This could yield to better regulation and incentives for the sector.
- The BIOGAS3 consortium included representatives of all key actors: agro-food industry associations (FIAB, ACTIA, TCA), research centres dedicated to agro-food industry and bioenergy (AINIA, JTI, DEIAFA, IFIP), bioenergy associations (IrBEA) and training and dissemination specialists oriented to renewable energies (RENAC, FUNDEKO). The high relevance of the participants and their dissemination capacity assured a high visibility of the actions, making intelligent energy technologies as widely available as possible.
- Cross-collaboration between European countries allowed the target group to learn and benefit from the experiences of other countries through dissemination and promotion throughout the rest of participating countries, thus reaching maximum synergy. Moreover, the project provided valuable information to national and European policy makers and has helped to develop renewable energy policies and legislation in particular in Ireland.
- As a result of project activities, it was possible to achieve 4 pre-contract agreements for the initiation of small-scales biogas plants in agro-food sector. However, due to the duration of the project (2 years) and policy changes, it was not possible to fulfil the target of pre-contracts agreements. For that reason, it is advisable for other similar promotion project to increase the duration of activities up to 3 years at least.
- Although the BIOGAS3 project has ended in February 2016, the awareness and capacity built up and the tools developed will continue to achieve results and impact beyond the life of this two-year project. All the public materials developed within the project and included in the website will be available until February 2018.

- On the wider horizon, as the EU legal framework is further developed in the coming years and as Member States enact related national legislation, commit to renewable energy and emissions reductions targets and develop plans and incentives to achieve the targets, then the market will respond, including small scale agro-food producers. BIOGAS3 has produced tools and supporting information which are legacy tools useful to stakeholders well beyond the life of the project.







Sustainable small-scale
biogas from agri-food
waste for energy
self-sufficiency

More information:



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