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

BIOGAS^3

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

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Table of contents

1. Introduction

Small-scale biogas plants in agro-food and beverage companies are not widely implemented. Although food and beverage industry produces high amounts of organic waste, the management of this waste is usually externalised and represents a cost for the companies.

The valorisation of this waste through Anaerobic Digestion (AD) represents multiples advantages:

- Energy savings,
- Reduction of environmental impact and carbon footprint,
- Reduction of waste management cost, etc.

Several barriers exist that impede the broad application of this technology, namely the high dependency of the economic feasibility on the governmental support, the difference on the scale applied in the well-known agriculture applications and the needs of the food and beverage industry and the lack of knowledge, skills and confidence in AD technology by the food and beverage industry engineers.

This document shows the contents of both European Union legislative and financial frameworks, as well as these issues in each EU countries involved in the project BIOGAS^3 (Figure 1): France, Germany, Ireland, Italy, Poland, Spain and Sweden.

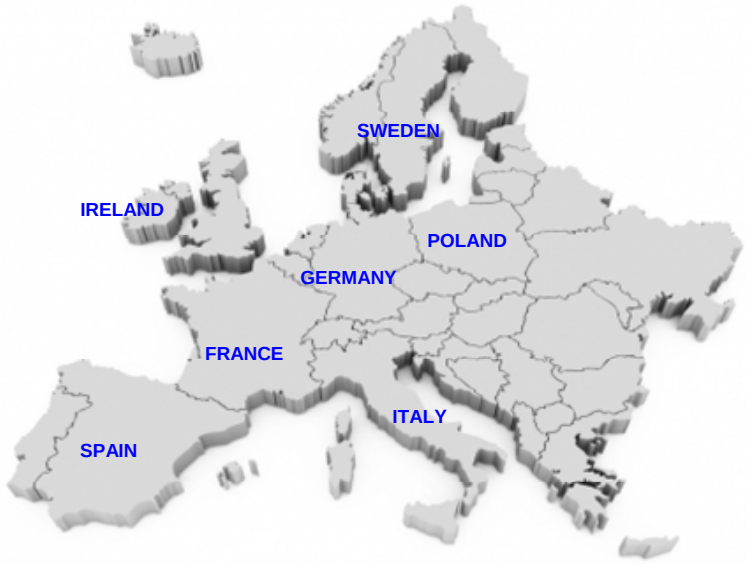

Figure 1. European countries involved in BIOGAS3 project (www.biogas3.eu)

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2. European Union (EU) legislation framework

A compilation of European Union legislation framework related with biogas implementation is shown in Table 1. More details about each Directive as well as Regulations are described as follows:

Directive 2009/28/EC: Promotion and production of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.	This Directive establishes a legislative common framework for the use of energy from renewable sources in order to limit greenhouse gas emissions and to promote cleaner transport.
Directive 2008/98/EC: Wastes	This Directive provides for a general framework of waste management requirements and sets the basic waste management definitions for the EU.
Commission Decision COM 2000/532/EC	*European list of wastes (LoW)*
Regulation Nº 1069/2009	*Health rules as regards animal by-products (ABPs) and derived products not intended for human consumption (SANDACH), and and repealing Commission Regulation (EC) No 1774/2002*
Commission Regulation Nº 142/2011	*Implementing Regulation (EC) No. 1069/2009*
Commission Regulation Nº 92/2005	*implementing Regulation (EC) No 1774/2002*
Commission Regulation Nº 185/2007	*Validity of the transitional measures for composting and biogas plants under Regulation (EC) No 1774/2002*
Commission Regulation Nº 208/2006	*processing standards for biogas and composting plants and requirements for manure*
Directive 1999/31/EC: Landfill	This Directive is intended to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills.
Directive 2008/1/EC: Integrated Pollution Prevention and Control	This Directive defines the obligations with which industrial and agricultural activities with a high pollution potential must comply.
Directive 2009/73/EC: Rules for the internal market in natural gas	This Directive aims at introducing common rules for the transmission, distribution, supply and storage of natural gas. It concerns mainly natural gas, liquefied natural gas (LNG), biogas and gas from biomass.
Directive 2012/27/EC: Energy efficiency	This Directive establishes a common framework of measures for the promotion of energy efficiency within the European Union
Directive 2000/60/EC: Water policy	This Directive establishes a common framework for Community action in the field of water policy, including key instruments in the protection of waters against agricultural pressures related with nitrates.

Table 1. Compilation of European Union Legislation Framework related with the implementation of biogas plants in agro-food & beverage companies.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009: Promotion and production of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

This Directive establishes a legislative common framework for the use of energy from renewable sources in order to limit greenhouse gas emissions and to promote cleaner transport.

The European Union aims to get 20% of its energy from renewable sources by 2020. Renewables include wind, solar, hydro-electric and tidal power as well as geothermal energy and biomass. More renewable energy will enable the European Union to reduce greenhouse emissions and make it less dependent on imported energy.

The fields of action are defined as: energy efficiency, energy consumption from renewable sources, the improvement of energy supply and the economic stimulation in this sector. Legislative framework in this issue includes:

National targets and measures: Each Member State has a target calculated according to the share of energy from renewable sources in its gross final consumption for 2020. This target is in line with the overall '20-20-20' goal for the Community. Moreover, the share of energy from renewable sources in the transport sector must amount to at least 10 % of final energy consumption in the sector by 2020.

National renewable energy action plans: The Member States are to establish national action plans which set the share of energy from renewable sources consumed in transport, as well as in the production of electricity and heating, for 2020. These action plans must take into account the effects of other energy efficiency measures on final energy consumption (the higher the reduction in energy consumption, the less energy from renewable sources will be required to meet the target). These plans will also establish procedures for the reform of planning and pricing schemes and access to electricity networks, promoting energy from renewable sources.

Cooperation between Member States: Member States can "exchange" an amount of energy from renewable sources using a statistical transfer, and set up joint projects concerning the production of electricity and heating from renewable sources. It is also possible to establish cooperation with third countries. The following conditions must be met:

- The electricity must be consumed in the Community;
- The electricity must be produced by a newly constructed installation;
- The quantity of electricity produced and exported must not benefit from any other support.

Guarantee of origin: Each Member State must be able to guarantee the origin of electricity, heating and cooling produced from renewable energy sources.

Access to and operation of the grids: Member States should build the necessary infrastructures for energy from renewable sources in the transport sector. To this end, they should:

- Ensure that operators guarantee the transport and distribution of electricity from renewable sources.
- Provide for priority access for this type of energy.

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Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008: Wastes.

This Directive provides for a general framework of waste management requirements and sets the basic waste management definitions for the EU. It includes concepts and definitions related to waste management, such as definitions of waste, recycling, recovery, and also, it explains when waste ceases to be waste and becomes a secondary raw material, and how to distinguish between waste and by-products.

The Directive defines some basic principles related with waste management, which will be done without endangering human health and harming the environment. Waste legislation of UE Member States shall apply as priority order as follows: prevention, preparing for re-use, recycling, recovery/valorisation and disposal. Indeed, energetic valorisation of wastes is an attractive option included in the Directive above.

With this regards, two important concepts related with the possibility to produce energy from agro-food wastes are bio-wastes and permits related with waste management:

- *Bio-waste* means biodegradable garden and park waste, food and kitchen waste from households, restaurants, caterers and retail premises and comparable waste from food processing plants.

- *Waste management* includes the collection, transport, recovery and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker. In this sense, Member States shall require any establishment or undertaking intending to carry out waste treatment to obtain a permit from the competent authority. However, Member States may exempt from the requirement laid down to undertakings that include the following operations: disposal of their own non-hazardous waste at the place of production or recovery and valorisation of waste.

Biogas plants are affected by requirement to obtain a permit as waste manager for the recovery and valorization of SANDACH products (Animal By-products Not Intended for Human Consumption). Plant promoters must obtain environmental authorization as waste managers, which will describe the amount and type of waste treated, the method used, as well as activities of monitoring and control process.

Several Regulations and Commission Decisions involved in waste management are listed as follows:

- European list of wastes (LoW) is established in the Commission Decision COM 2000/532/EC. This Decision establishes the classification system for wastes, including a distinction between hazardous and non-hazardous wastes. The LoW serves as a common encoding of waste characteristics in a broad variety of purposes like classification of hazardous wastes. Assignment of waste codes has a major impact on the transport of waste, installation permits, and decisions about recyclability of the waste or as a basis for waste statistics.

- Regulation Nº 1069/2009 EC of the European Parliament and of the Council of 21 October 2009: laying down health rules as regards animal by-products (ABPs) and derived products not intended for human consumption and repealing Commission Regulation (EC) No 1774/2002 (Animal by-products Regulation). The Regulation

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categories ABPs into three categories, which is based on their potential risk to animals, the public or the environment. The categories are: Category 1 material (Very High risk) as defined in Article 8; Category 2 material (High risk) as defined in Article 9; and Category 3 material (Low risk) as defined in Article 10.

- Commission Regulation Nº 142/2011 of 25 February 2011: implementing Regulation (EC) No. 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption (SANDACH).

- Commission Regulation Nº 92/2005 EC of 19 January 2005: implementing Regulation (EC) No 1774/2002 regards means of disposal or uses of animal by-products and amending its Annex VI as regards biogas transformation and processing of rendered fats.

- Commission Regulation Nº 185/2007 EC of 20 February 2007: amending Regulations (EC) Nº 809/2003 and (EC) Nº 810/2003 as regards extension of the validity of the transitional measures for composting and biogas plants under Regulation (EC) No 1774/2002.

- Commission Regulation Nº 208/2006 EC of 7 February 2006: amending Annexes VI and VIII to Regulation (EC) No 1774/2002 of the European Parliament and of the Council as regards processing standards for biogas and composting plants and requirements for manure.

Directive 1999/31/EC of the European Parliament and of the Council of 26 April 1999: landfill.

This Directive is intended to prevent or reduce as far as possible negative effects on the environment from the landfilling of waste, by introducing stringent technical requirements for waste and landfills. According to this Directive, biogas production from biodegradable wastes is an attractive alternative to control the pollution.

Directive 2008/1/EC of the European Parliament and of the Council of 15 January 2008: The IPPC Directive (Integrated Pollution Prevention and Control).

This Directive defines the obligations with which industrial and agricultural activities with a high pollution potential must comply. This permit can only be issued if certain environmental conditions are met, so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause. It establishes a procedure for authorising these activities and sets minimum requirements to be included in all permits, particularly in terms of pollutants released. The aim is to prevent or reduce pollution of the atmosphere, water and soil, as well as the quantities of waste arising from industrial and agricultural installations, to ensure a high level of environmental protection.

IPCC concerns new or existing industrial and agricultural activities with a high pollution potential, as energy industries, production and processing of metals, mineral industry, chemical industry, waste management, livestock farming, etc.

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Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009: common rules for the internal market in natural gas.

This Directive aims at introducing common rules for the transmission, distribution, supply and storage of natural gas. *It concerns mainly natural gas, liquefied natural gas (LNG), biogas and gas from biomass.*

The rules for the organisation of the sector are aimed at creating a competitive, secure and environmentally sustainable market in natural gas. This Directive indicates that Member States may impose on undertakings operating in the gas sector public service obligations which cover issues of security and security of supply, regularity and quality of service, price, environmental protection and energy efficiency.

Directive 2012/27/EC of the European Parliament and of the Council of 25 October 2012: on energy efficiency.

This Directive establishes a common framework of measures for the promotion of energy efficiency within the European Union in order to ensure the achievement of the Union's 2020 20% headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

It lays down rules designed to remove barriers in the energy market and overcome market failures that impede efficiency in the supply and use of energy, and provides for the establishment of indicative energy efficiency targets for 2020.

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000: water policy.

This Directive establishes a common framework for Community action in the field of water policy, including key instruments in the protection of waters against agricultural pressures related with nitrates.

The Water Framework Directive (WFD) is a key initiative aimed at improving water quality throughout the EU. It applies to rivers, lakes, groundwater, and coastal waters. The Directive requires an integrated approach to managing water quality, with the aim of maintaining and improving water quality.

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2.1. Legislation frameworks in countries involved in BIOGAS[3]

2.1.1. France

French government decided to promote renewable energy: the aim is **to reach 23% of renewable energy in the final energy consumption in 2020**, which corresponding to a doubling between 2006 and 2020.

Sanitary regulations:

The requirements for sanitation in France follow EU's legislation n°142/2011 (regulation around the treatment of animal by-products).

No products from Class 1 (High sanitary risks) can be converted into biogas. Products from Class 2 (Sanitary risks) can be converted into biogas, only if there is a transformation under pressure (133°C during 20 minutes and 3 bars), excepted for slurry, manure, milk by-products… Product from Class 3 (Low or no sanitary risks) can be converted into biogas if a pretreatment is made (70°C, 60min, 20mm).

A sanitary agreement (regulation CE n° 1069/2009) is necessary for every AD units in France using animal by products.

Environmental regulation and agricultural use of digestate:

French government created a National Plan EMAA *"Energie Méthanisation Autonomie Azote". This plan is based on nitrogen and digestate management in interaction with biogas development.* The aim is to have a better autonomy with organic nitrogen and decrease the need of mineral nitrogen in French agriculture, expensive and highly impacting greenhouse gases emissions and energy consumption.

Organic digestate from biogas units is considered as a waste, which has to be valorized on land fields by spreading. EMAA plan wants to develop a "product status" for digestate with a certification and/or standardization: digestate will be considered as a product which could be sold on the market as a fertilizer, and without the constraint of land spreading. Right now, it exists only 3 ways to manage digestate: land spreading, homologation (long and expensive), and French standard for digestate (or dry part of it) composted with vegetable waste (expensive way of management).

The spreading of the digestate has to follow some rules described by the "Nitrate directive" (period restriction, storage capacity, etc.), as a raw farm effluent.

Currently, a real development of biogas units is limited per the digestate management. The need of lands is essential to spread the digestate.

EMAA plan aims to make biogas units development easier by:

- Developing a French environment specialized in Anaerobic Digestion (AD) to support research and innovation.
- Mobilizing easily available organic waste which could be used in AD units.

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- Developing public tools to help the emergence of investment projects in synergy between public authorities, agricultural professions and banking networks.
- Making easier and more understandable taxation and administrative management.

For biogas units, a regulation has been set up in 2009, called ICPE nomenclature (Classified Installations for Environmental Protection). According to the nature of the waste and the tonnage of waste treated per day, the unit will be under "Declaration", "Registration" or "Authorization". That nomenclature determines the regulatory framework and the procedure to be applied to the project. Small biogas units will be in general under "declaration" which makes easier administrative management.

The biogas combustion is also legislated by the ICPE nomenclature 2910C.

Use of biogas:

Biogas can be used and valorized in a boiler, a CHP engine or injected in a gas grid.

2.1.2. Germany

Sanitary regulations:

In Germany there are high restrictions with regard to animal wastes and residues due to the risk of the spread infections (pathogens) from animal to animal or animal to human during the value chain of production. Therefore, binding legal regulations and technical measurements exist (Nebenprodukte-Vo (EG) Nº. 1774/2002.

If animal by-products are digested in a biogas plant, it has to be secured that the arrears from digestion of biogas plants can be utilized as fertilizer on soils. That means that the digestate cannot contain any other animal products than substrates declared as "animal by-products". Animal by-products are defined in §2 (2) No 2 KrWG and TierNebV Annex 4. According to these laws, animal by-products include manure, contents of stomach, intestine and rumen, milk and colostrum.

Furthermore if animal by-products, non-pasteurized kitchen or food wastes are digested in a biogas plant, the plant is to be located with a complete separation from the feed, litter and stalls were animals are kept, in order to prevent the spreading of diseases (§3-5 TierNebV)

The operators of biogas plants digesting animal by-products have to probe the digestate regularly in order to avoid harms.

Use of biogas:

During the process of producing electricity, also waste heat is generated, that can be utilized for process itself easily. However, the utilization of the self-produced electricity is not yet widely realized. The amount of 15-25% of the heat demand of biogas plants can be produced without additional costs of the biogas plants.

Environmental regulation and agricultural use of digestate:

Regulations for organic wastes include substrates such as the following: any deviant substrates need special assessment and permission from responsible local authority (Annex 1 (1a) BioAbfV):

Substrates	**Examples**	**Add. Regulations**
Plant residues, that are used for own use (distributed on own areas)	- From horticulture - From agriculture - From fisheries	
Animal faeces (except waste water – needs to be collected and treated separately)	- Slurry - Manure (liquid and solid) - Straw	Hygienic regulations for prevention of spreading of infections (Nebenprodukte Vo (EG) Nr. 1069/2009)
Wastes from forestry	- Plant residues from forestry	Material has to be broken up
Wastes from food and feed production, that cannot be consumed further	- Wastes from digestion from starch production, fruit and vegetable processing - Cereal residues - Molasses - Oilseed wastes - Colza cake	Nebenprodukte Vo (EG) Nr. 1069/2009 §10 (1) No1-2 §7 (1) No 1
Wastes from alcoholic distillation	- Mash, brewer grains from fruits, cereals and potatoes - Spent and hop grains	§7 (1) No 1 §10 (1) No1-2
Degradable organic residues from kitchen and canteens	- Organic wastes - Contents of fat separators	Material from fat separators only applicable with anaerobic digestion
Cooking oils and fats Municipal organic wastes	- Separated organic waste - Organic market waste	§7 (1) No 1

Source: BioAbfVo 2013

Products of animal origin, animal by-products are subject to the TierNebV rather than the BioAbfV:

Animal by-products, not meant for the human consumption	- Content of stomach, intestine and rumen - Manure - Milk and colostrum	Only if stomach, intestine and rumen contents originate from by humans edible animals.
Slaughterhouse Wastes	- Slaughterhouse body parts - Skin, hooves, horns etc. - Blood from non-ruminants - Former foodstuff with - animal origin	According to Verordnung (EG) No. 1774/2002

Source: TierNebV, Vo EG No. 1774/2002

Non-hazardous digestate can be distributed to agricultural and horticultural areas with a limitation of 20-30 t DM of organic waste within three years according to §6 (1) BioAbfV) and §8 (1) Düngeverordnung and §3 (1) No 1 Düngegesetz.

Additional requirements are needed for utilizing digested organic wastes for grassland and vegetable gardening: They need to be applied before plants are cultivated (§7 (1-2) BioAbfV)

It is important to know the amounts of toxics in residues as co-substrates, whenever the digestate is utilized as farm fertilizer in the end. Since toxics cannot be separated from the rest of the digestate, they would harm soils and plants (BioAbfV).

Heavy Metal Limitations	Mg/kg DM of digestate
Lead	150
Cadmium	1.5
Chrome	100
Copper	100
Nickel	50
Quicksilver	1
Zinc	400

Source: §4 (3) BioAbfV

There is a need for regularly tests to probe the digestate in terms of pathogens, viruses and bacteria.

The institution managing and utilizing organic wastes is obliged to proof via supporting documents, that organic wastes had a proper disposal and how organic wastes have been treated and utilized (§11 BioAbfV).

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2.1.3. Ireland

Sanitary regulations:

Animal By-Products (ABPs) regulations are one of the principal legislative controls acting on the operation and size of anaerobic digestion plants in Ireland. Currently these regulations are detailed in the 2009 Animal By-Product Regulations (Regulation Nº 1069/2009 EC of the European Parliament and of the Council). However, these regulations will be imminently replaced by two sets of 2014 ABP regulations governing the size, scale, operation, hygienic controls, and setting of biogas plants: Statutory Instruments S.I. Nº 187/2014 European Union (Animal By-Products) Regulations 2014. One set of regulations allow for single on farm plants processing on farm materials. A second set of regulations govern larger industrial plants which use imported feedstocks.

Agricultural use of digestate:

Nitrates regulations restrict the spreading of organic materials onto farmland: Statutory Instruments S.I. Nº 31/2014 European Union (Good Agricultural Practice for Protection of Waters) Regulations 2014. Any digestate going onto farmland must be planned using a nutrient management plan in accordance with the Nitrates Regulations.

Use of biogas:

Small scale anaerobic digestion plants can fall under both set of ABP regulations depending on the substrates used and the location of the plant. In general an on farm plant using only material from that farm will fall under the simplified set of regulations, while any plant using imported feedstocks will fall under the second set of regulations.

Animal by-Product regulations and Nitrate Regulations dictate the use of animal manures and ABPs, they also stipulate the requirements around pasteurisation thermal treatments.

No current legislative requirements around self consumption.

2.1.4. Italy

Sanitary regulation:

The treatment of effluents is subjected to Regulation (EC) n. 1774/2002 of 3 October 2002 of the European Parliament and of the Council which refers to "Health rules concerning animal by-products not intended for human consumption".
It sets specific health standards and appropriate treatments (pasteurisation at 70 ° C for 1 hour with a size maximum of 12 mm).

Application: This Regulation lays down the animal health and public health rules in terms of:

- Collection, transport, storage, handling, processing and use or disposal of animal by-products;
- The placing on the market and, in certain specific cases, the export and transit of animal by-products and products derived from them.

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The biogas and composting plants:
The biogas and composting plants must be approved by the competent authority. The conditions for obtaining the recognition concerning the nature and the equipment of the plant. In addition, these plants have methods of monitoring and checking the critical points. The approval shall be withdrawn immediately in the event of non-compliance of the conditions for obtaining it.

Only the animal by-products listed below can be processed in a plant of production of biogas or composting:

- The category 2 materials subjected to processing method no. 1 in a category 2 processing plant;
- The manure and digestive tract content separated from the latter, the milk and colostrum;
- The category 3 materials,

For the biogas plants and composting are specific measures of hygiene and processing.

Agricultural use of digestate:

NORMS FOR ANAEROBIC DIGESTION OF AGRICULTURAL AND AGRO-INDUSTRIAL BIOMASS IN BIOGAS PLANTS

There is **no specific Italian legislation** to regulate the transport and processing of agricultural and agro-industrial biomass intended for anaerobic digestion, so it is necessary to **refer to the various regulations that often overlap in a legal loop not always easily solvable**.

Depending on the materials source and destination of the digestate, it is necessary to make reference to:

- D.Lgs. 152/06 and D.Lgs. 99/92 when the anaerobic digestion is followed by treatment processes aimed to unloading into surface waters;
- Applicative regional rules of the Decree of the Ministry of Agriculture 7/4/2006, (application of Article 112 of D.Lgs.152/06), and Part IV of D.Lgs. 152/06 (ex D.Lgs. 22/97 on wastes) when the digestate is intended for use in agriculture or exploitation as a commercial fertilizer;
- Regulation EC 1774/2002, when the material for the anaerobic digestion contains animal by-products not intended for human consumption, different from manure and digestive content separated from this latter.

Regarding the application of these rules, the most common cases of anaerobic digestion of agricultural and agro-food biomass are reported, considering that there are quite a few differences of interpretation.

The cases considered are as follows:

1 - anaerobic digestion in plants of **biomass from agriculture and subsequent agronomic use**, case in which the biogas plant is realized in a farm with the purpose to treat the biomass coming from the farm and perform the spreading of the treated material (shovelable liquid and solid fractions) on lands at disposal (right of use and/or land which has availability for explicit statement of the farm).

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A - The case of anaerobic digestion of manure only
The whole sequence of operations about agronomic use, treatments included, assumes that the notice of agronomic use (art. 112 of D.Lgs. 152/06) has been carried out or, in case the farm breeds more than 750 sows or 2,000 fattening pigs, that the AIA permission (Integrated environmental authorization, D.Lgs. 59/2005 of implementation of the Directive 96/61 / EC on the prevention and reduction of pollution) has been obtained.

Within the cycle of use (production, storage, treatment, transportation, land-spreading), also manure transport from a stage to another of the same cycle is subject to the discipline of DM 7/4/2006. In fact, Italy exercised the option granted to EU Member States not to apply the health conditions on the collection, transport and storage of the manure when transported between two points on the same farm or between farms and users located in the same Member State as provided by Regulation EC 1774/2002 (Art. 7). A special agreement between the State and the Regions in July 2004 marked the decision.

B - The case of anaerobic digestion of animal manure, by-products of crop and energy crops like sorghum, maize and fodder, subjected to ensiling process.

The regulatory of the previous case should be valid also in this case, even if the applicative regional rules of DM 7/4/2006 don't recognise expressly the mixtures of sewage and products or residues of crops as materials similar to manure, subject of such Decree. This comparison, however, is implicit since the anaerobic digestion of animal manure mixed with energy crops and residual products of vegetable production is included into the various treatments foreseen in an annex to the same Decree.

A legally confirmation of this interpretation comes from art. 185 of D.Lgs. 152/06 that, even if dimly, excludes non-hazardous natural substances used in agriculture from the field of application of waste legislation.

Also the transport of vegetable biomass and vegetable by-products of the others farms to biogas plant is regulated by the discipline of DM 7/4/2006 when the source firms are linked with the firms in which the biogas plant is located where effluents digested are used into the agronomic cycle, in accordance with a Plan of Agronomic Application (PUA) prepared in accordance with the art.28 of the DM 7/4/2006.

An amendment to Art. 185 of D.Lgs.152/06 approved by committees of the Council of Ministers and in pending approval by the parliamentary commissions will attribute also the vegetal biomass from farms not linked with the firm in which the biogas plant has the seat to the regulations on the agricultural use of DM 7/4/2006. The proposed amendment says:

"... Animal carcases and the following agricultural wastes are excluded from the application of Part IV of L D.Lgs. 152/06 (regulation on wastes): faecal matter, plants and other natural non-dangerous substances used in farming. They are considered by-products in accordance to the terms of the letter p), paragraph 1 of art. 183: faecal and vegetable materials coming from agricultural activities, used in agricultural activities or farm/inter-farms plants to produce energy or heat or biogas. "

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In accordance with the art. 20 of the D.M. 7.4.2006, the transport of the digestate requires an accompanying documentation containing at least the following information:
• The identification data of the firm from which originates the transported material and its legal representative;
• The nature and quantity of effluents;
• Identification of the means of transport;
• The identity of the company addressed (if different from the manufacturer) and its legal representative;
• Details of the notification to the competent authority, prepared by the legal representative of the company from which the material transported originates.

2 - Anaerobic digestion in biogas plants of biomass **from agriculture and food processing and following use in agriculture**

In addition to manure and vegetable biomass produced in the farm or off-farm wastes coming from the preparation and processing of vegetables compote or transformation of animal products could be conferred to the plant.

Delivery of wastes or by-products of the vegetable processing
The agronomic use of digested material is configured as a recovery operation as is provided by the Annex C, recovery operation R10 of this Decree, and can be done according to the regional dispositions on agronomic use of animal manure. However, if the amendment proposed by Ministry of Agriculture and shown in section 10.1 should be accepted, also this type of biomass would escape to the discipline of the wastes to be governed by the DM 7/4/2006 within a Plan of Agronomic Application.

Delivery of animal by-products
In this case, it refers to Regulation EC 1774/2002, quite complex in terms of formal procedures, permissions and auditing. The withdrawal of such materials is considered not feasible by a farm with a biogas plant. An exception could be made for the milk (and reasonably even for the whey) and for the content of the digestive tract, separated from this last, of animals slaughtered, because in this case the plant does not require recognition in accordance with the Regulation above mentioned.

Use of biogas:

The Italian state tackles the biogas production in 2003 with the Legislative Decree DL 29/12/2003 Nº 387: Implementation of Directive 2001/77/EC on the promotion of renewable energy sources.

The main goals are to define national targets in term of renewable energy production and to promote the use of renewable energy sources for the production of electric energy.

Until now, there were minimal changes in the legislative framework for the production of biogas and, at the time, the most important and recent reference is Legislative Decree DL 03/03/2011 Nº 28: Implementation of Directive 2009/28/EC on the promotion of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

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The main goal of this law is to simplify the administrative procedures for the construction of plants of renewable energy production. According to this law, the administrative procedure includes only 3 steps:

1. Single authorization: is an authorization given by a single procedure for all the Administrations concerned and the whole process takes more than 90 days
2. Simplified enabler procedure: it is a detailed report of the plant, it is signed by the designer and it is presented to the City administration
3. Communication of building activities.

2.1.5. Poland

Biogas plants based on agricultural and food waste are installations with three main functions: processing of by-products and/or waste, production of electricity and heat (cold), production of digestate.

The legal framework for designing, constructing and operating biogas plants is defined primarily in the following laws: the Energy Law, the Waste Act, the Act on Fertilizers and Fertilizing, the Law on Spatial Planning and Development, the Construction Law and the Environmental Law.

Sanitary regulations:

Agricultural biogas plants that utilise organic waste should be treated as waste recovery installations, which entails the need to obtain appropriate permits relating to the processing of waste in accordance with the Waste Act.. In addition, agricultural biogas plants specify the types and quantities of substrates used for biogas production in a quarterly report to the President of the Agricultural Market Agency.

Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down health rules as regards animal by-products and derived products not intended for human consumption classifies animal waste into 3 categories, reflecting the degree of risk to human and animal health (more details are included in Deliverable 2.2 available in www.biogas3.eu)

All plants that use by-products of animal origin for biogas production are subject to approval in terms of sanitary-veterinary security by the local veterinarian.

Use of biogas:

According to a definition from the Energy Law **(**Art.3, section 20a), agricultural biogas is a gaseous fuel produced by the anaerobic digestion of agricultural substrates, agricultural by products, liquid or solid manure, by products, waste or residues from the processing of agricultural products or forest biomass, excluding gas fuel derived from raw materials from wastewater treatment plants and landfills.

Economic activity in the field of agricultural biogas production or electricity generation from agricultural biogas is regulated by the provisions of the Business Activities Freedom Act and requires an entry in the register of energy companies involved in the production of agricultural biogas, kept by the President of the Agricultural Market Agency (Art. 9p). Electricity

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generation from agricultural biogas does not require a concession (Art.32), while in the case of biogas plants other than agricultural plants a concession is required.

Companies listed in the register of energy companies engaged in the generation of electricity from agricultural biogas can apply for the issue of certificates of origin for electricity generated from a renewable energy source ("green certificates"), as well as certificates of origin from cogeneration ("yellow certificates" for gas fired energy sources or with power capacity of the source up to 1MW), which specify the source from which the energy has been produced and the date and place of production. These documents can be traded on the stock market of the Polish Power Exchange (TGE) or bilateral agreements. Certificates of origin for energy from renewable sources are issued by the Chairman of the Energy Regulatory Office after submission of a request by a biogas producer through the transmission system operator. These issues are regulated by the Regulation of the Minister of Economy of 18 October 2012, while issues associated with certificates of origin from cogeneration - by the Regulation of the Minister of Economy of 26 July 2011.

Electricity companies are required to purchase electricity from renewable sources and demonstrate a sufficient amount of certificates of origin. In accordance with the Energy Law, certificates of origin are transferable and constitute a commodity (and hence their prices are not fixed and it is not possible to predict their exact levels in subsequent years). In 2013, the average selling price of electricity generated from high efficiency cogeneration in a gas-fired cogeneration unit or with power capacity of the source below 1 MW amounted to 193.86 PLN / MWh (Energy Regulatory Office 12/2014). The average price of green certificates of origin in 2013 was 209.22 PLN/MWh (based on Polish Power Exchange data for PMOZE_A). The average value of yellow certificates of origin in 2013 was 122.67 PLN (based on Polish Power Exchange data for PMGM). Therefore, a producer of electricity from high-efficiency cogeneration plants using renewable energy sources can count on a total revenue of approx. 525.75 PLN / MWh (about 12.5 c€/kWh).

The amendment to the Energy Law entered into force on 11 September 2013 introduced the definition of a micro-installation - a renewable energy source with a total installed electricity capacity of 40 kW or less, connected to an electricity grid of rated voltage below 110 kV, or with a total installed heat capacity of 120 kW or less; and the definition of a small installation- a renewable energy source, with a total installed electricity capacity greater than 40 kW but no greater than 200 kW, connected to an electricity grid of rated voltage below 110 kV, or with a total installed heat capacity greater than 120 kW but no greater than 600 kW.

The above-mentioned amendment has abolished the obligation to pay a fee for connecting a micro-installation to the grid (Art.7 paragraph 8 point 3). Moreover, the costs of installing a security system, as well as a measurement and settlement system, have been passed on to the electricity distribution system operator, in cases where the operator applying for connection of a micro-installation to the distribution network is connected to the network as a final recipient and the installed capacity of the micro-installation is not greater than that specified in the issued connection conditions (Art. 7 paragraph 8d[4]). In addition, owners of micro-installations have been released from the obligation to conduct a business activity (article 9u). Article 9v introduced the obligation to purchase electricity from micro-installations belonging to people not engaged in business activities at a price equal to 80% of the average selling price of electricity in the previous calendar year. At the same time these people are not covered by the system of certificates of origin. The determining of the selling price of electricity from prosumer installations below the average real price was intended by the legislator to cause its use primarily for the owners' own needs.

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On April 8 2014, the Council of Ministers adopted the draft Law on renewable energy sources. The project provides solutions regarding the pursuit of energy production business activities with micro- (<40kW$_{el}$) and small (<200kW$_{el}$) RES installations. In the case of micro-installations, the draft RES Law provides for the continuation of the existing solutions contained in the Energy Law, i.e. the exemption of individuals producing electricity in micro-scale RES utilities from the obligation to conduct a business and the exemption of all electricity producers in these utilities from the obligation to obtain concessions. The draft RES Law also includes the obligation to purchase surplus electricity that is generated in the micro-installations for a further 15 years, at a price of 80% of the average selling price of electricity on the competitive market, announced by the President of ERO. For small RES installations the draft RES Law exempts producers from the obligation to obtain a concession and introduces a milder form of regulated activities, i.e. the duty of registration (entry in the register kept by the President of URE). In addition, the draft RES Law maintains the current system of support for the existing RES installations (electricity producers will have the choice between keeping the current rules of support and declaring to join the new auction system) and introduces a system of auctions for new and upgraded RES installations. It is anticipated that the Law will not enter into force before 2016.

Agricultural use of digestate:

According to the Polish law digestate is classified as waste. In the Regulation of the Minister of the Environment of 27 September 2001 on the catalogue of waste, 19 06 06 is defined as "digestate from anaerobic treatment of animal and vegetable waste". In the case of separating the digestate into liquid and solid fractions, the liquid fraction is classified as 19 06 05 or "liquor from anaerobic treatment of animal and vegetable waste", and as a solid fraction - as 19 06 06.

Digestate, as waste, may be subjected to disposal (e.g. by depositing in a landfill), but it is recommended to carry out the process of recovery. Possibilities of recovery of wastes are listed in Annex 1 to the Waste Act. In the case of digestate, the following recovery methods are applicable:

- R3 activities: Recycling or regeneration of organic substances which are not used as solvents (including composting and other biotransformation)
- R10 activities: Land treatment resulting in benefit to agriculture or ecological improvement *of the state of environment*.
- In the case of separation and drying of the solid fraction, for the resultant waste it is also possible to use R1 activities - "Use as a fuel (other than in direct incineration) or other means to generate energy".

The most common way to use the digestate is the R10 reclamation method, i.e. the use of digestate as an agricultural fertilizer. In order to complete the recovery of digestate with the R10 method, a number of requirements contained in the Regulation of the Minister of Environment of 5 April 2011 on R10 recovery process must be met. Requirements for all substances with codes 19 06 05 and 19 06 06:

- Manure rules laid down in the Act on fertilizers and fertilization are met (eg Article 17 parag. 3: the amount of manure applied during the year shall not contain more than 170 kg of nitrogen (N) in the pure component per 1 ha of agricultural land, Art.20: the use of fertilizers on soils flooded with water, covered with snow, frozen to the depth of 30 cm and during rainfall is prohibited: in liquid form - on soils without plant cover located on slopes exceeding

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10%, in liquid form - during the growing season of plants intended for direct human consumption).
- Material of animal origin having undergone fermentation meets the requirements of the Regulation of the European Parliament and Council Regulation (EC) No 1069/2009
- Waste is applied uniformly over the surface of the soil - to a depth of only 30 cm.

Important from the point of view of digestate management is also a recommendation included in the Regulation of the Minister of Agriculture and Rural Development of 16 April 2008 on the detailed method of application of fertilizers and training on their application: "Natural and organic fertilizers in solid or liquid forms shall be applied in the period from 1 March to 30 November (...) ". Thus in agricultural biogas plants suitable storage space, sufficient to collect the produced digestate for a minimum of three months, must be ensured. The Regulation also specifies permitted methods of distributing fertilizers on crops.

The sale of digestate to other farmers is possible after obtaining marketing authorization for plant conditioning products. Such authorisation is issued by decision of the Minister responsible for agriculture. All terms to be met by the manufacturer of a crop-enhancing product are listed in Art.4 of the Act on fertilizers and fertilization, and the Regulation of the Minister of Agriculture and Rural Development of 18 June 2008 on the implementation of certain provisions on fertilizers and fertilization.

2.1.6. Spain

In this section, the main Spanish regulations directly or indirectly affecting the development of small scale biogas plants are presented. The following sub-sections have been included: sanitary regulations, environmental regulations including climatic change and greenhouse effect gases (GHG) abatement, biogas use and digestate use. The main regulations of each are summarized below:

- Environmental regulations: Law 22/2011 on waste, Law 1481/2001 on landfills, Law 16/2002 on IPPC, plan for biodigestion of animal slurry.
- Use of biogas: Royal Decree 413/2014 on electricity production from renewable sources, Order IET/1045/2014.
- Agricultural use of digestate: Royal Decree 506/2013 on fertilizers, Royal Decree 261/1996 on nitrogen from agricultural sources.
- Sanitary regulations: Royal Decree 1528/2012 on animal by-products.

Sanitary regulations:

The Royal Decree 1528/2012 establishes the conditions for the application of the EU regulation on animal by-products (ABP). It does not modify the restrictions imposed by the Regulation EC 1069/2009. These restrictions are mainly related to the kind of materials allowed to enter the biogas plants and the required pre-treatment and hygienic measures of the biogas plant using ABP.

Environmental regulations:

Law 22/2011 on waste:

The objective of this law is to establish the legal framework for the production and management of waste, as well as the measures to prevent its generation and to avoid or reduce their negative impacts on human health and the environment.

The following materials are not considered as waste: straw and other natural material, agricultural or forestry, non dangerous, used in farms, forestry or bioenergy production.

There is a specific section in this law dedicated to the biowaste, promoting its segregated collection in order to use them in anaerobic digestion of composting processes.

Royal Decree 1481/2001 on landfills:

This Royal Decree limits the amount of biodegradable municipal waste allowed to be disposed in landfills. The maximum amount in 2016 is 35% of the amount of 1995 (4.071.550 t)

Law 16/2002 on IPPC:

The law on integrated pollution prevention and control (IPPC) establishes the obligation for the facilities included in the Annex to obtain a unified permit (Integrated Environmental Authorization) that includes all environmental permits: environmental impact, waste management, water use and treatment, air emissions, etc.). The small scale biogas plants will probably not affected by this law, since the regulation establishes the limit in 50 tons per day, which is probably more than the daily feed of these plants.

Plan for biodigestion of animal slurry:

The Spanish Ministry of Environment launched this initiative in 2008 with the main objective to reduce the GHG emissions from the farming sector. It is regulated by the Royal Decree 949/2009. It is intended to give grants for the investment in facilities to biodigest the animal slurries, even with low-tech schemes. The co-digestion with other types of waste is limited, and therefore farms are the main beneficiaries of this initiative.

Use of biogas:

Royal Decree 413/2014 on electricity production from renewable sources:

This Royal Decree regulates the calculation of the feed-in-tariffs (FIT) for the electricity production from biogas. This applies to the biogas plants that are producing electricity and selling it to the grid. The FIT is composed by two parts: one to compensate the investment costs and other to compensate the operating costs, in both cases assuming that these costs are not recovered when the biogas plant is selling the electricity at the market price. The calculations assume that the adequate internal return rate is around 7.5%. The amount of working hours of the biogas plant that can be claimed for feed-in-tariff is much lower than the actual working hours of the biogas plant, that are usually more than 8000 hours/year. The feed-in-tariff can be changed every 3 years.

These measures, together with the tax on hydrocarbons applied to biogas (0.65 €/GJ) have caused a significant reduction of the biogas sector activity in Spain.

Order IET/1045/2014:

This order fixes the retributive parameters for the calculation of the FIT regulated by the above mentioned Royal Decree.

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Draft of Royal Decree for self-consumption:

This Royal Decree will regulate the energy self-consumption. In the current draft, a tax named "backup toll" is established for these facilities that are connected to the public electricity grid just in case the biogas plant is not operating. This backup toll applies even to the energy generated in the biogas plant and self-consumed by the industry. This measure has risen controversy in the sector. However, the definitive text of the regulation is still not available at the moment of writing this report.

Agricultural use of digestate:

Royal Decree 261/1996 on the protection of water from the pollution caused by nitrates from agricultural origin

It limits the amount of nitrogen from agricultural sources to be applied to the land to 170 kg-N/Ha/year in the so-called "vulnerable areas". This could be a limitation for the implementation of biogas plants in the areas where intensive farming is the predominant economic activity.

Royal Decree 506/2013 on fertilizers

This is the basic regulation of fertilizers in Spain. It includes the "organic biodegradable waste" as possible raw material to produce certain types of regulated fertilizers. It classifies the fertilizers according to their origin and establishes the minimum amounts of nutrients and organic matter that should be present in order to consider the materials as fertilizer or soil amendment. In most of the cases, the minimum amount of nutrients is much higher that the usual content in the digestate, and therefore a further treatment (usually composting) is necessary if the digestate is to be sold under this framework. However, it is possible to use the digestate in bulk without being considered as fertilizer or soil amendment in the sense of this regulation.

2.1.7. Sweden

Sanitary regulations:

The requirements for hygienization in Sweden follows European Union legislation on animal by-products (ABPs) Nº 142/2011 including the never ending additions and changes to this regulation. This legislation also dictates limitations on how and under what conditions animal related agro-food industry by-products can be used for biogas production.

Landfilling of organic waste is prohibited in Sweden since 2005. In 2002, a national environmental objective was instated aiming for at least 35 percent of food waste from households, restaurants and shops to be recycled through biological treatment, including home composting by 2010. This goal was not achieved, but nearly 25 percent of food waste is currently recycled by biological treatment.

The government has now decided to introduce a number of new milestones in areas such as waste management to be achieved by the year 2018. For example resource recovery in the food chain should increase by ensuring that at least 50 percent of food waste from households, shops and restaurants is separated and treated biologically so that energy and plant nutrients can be recovered.

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Environmental regulations:

The Swedish Environmental Code (Miljöbalken MB, 1998:808) is a comprehensive legislation related to all environmental impacts. The Act came into force on 1 January 1999 and is based on the principle that *we who are alive now should act in a way that does not harm the environment and depletes natural resources for the future*. The use of land, buildings and equipment, which through emission or otherwise could harm health or the environment is termed environmentally hazardous activities.

According to the definition in the Environmental Code, biogas production is an environmentally hazardous activity (Chapter 9, Section 1). A so-called environmentally hazardous activity does not need to be particularly dangerous. The definition is more relevant to determining whether an operator needs to seek permission for an activity or just notify the authorities about the activity.

For this purpose activities are divided into A, B and C operations with different limits and different requirements. The activities are also linked to activity codes. Biogas plants are classified based on the activity codes for gaseous fuels and biological treatment that can be found in the Environmental Inspection Ordinance (Miljöprövningsförordningen 2013:251).

- Small scale agro-food biogas production at < 100 kW might be a C-activity covered by code 40.20 or 90.170 (substrate volume 10 < 500 tonnes/year), which means that notification of authorities would suffice.
- Larger projects may be deemed a B-activity under codes 40.10 or 90.160 (methane production >150000 Nm3/year and/or substrate volume >500 tonnes/year), which means that a permit would be required.

Operators of both types of activities would have to convince the regulator that measures have been taken to minimize any potential negative environmental impact of the activity in accordance with the Environmental Code. Proving this can be complicated and sometimes expensive as it may require consultant help to write the application and complete an environmental assessment of sufficient quality that will pass the regulator.

Use of biogas:

With regards electricity production from biogas: Excess of electricity produced can be distributed on the grid following the conditions for contracts according specific negotiations with the utility company in question. To distribute the electricity to the grid and get paid for it, producer must install a meter that provides hourly data on electricity delivered. For small customers, that use more electricity than they produce, the utility company will pay for the required meter if the fuse is at or below 63 amps.

There is an ongoing review of laws and regulations to make it easier for those who want to generate their own electricity. In November 2010, the Swedish Energy Agency submitted a report to the Government which, among other things, proposed that electricity suppliers should be obliged to accept the generated electricity. The report also suggests that network operators should use net metering, meaning that your network charge should be based on the difference between the electricity you buy and you deliver.

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No political decisions regarding the submitted proposal have been made yet as they are contrary to current tax laws. The government is currently investigating the issue and is expected to propose legislation that includes some version of net metering.

With Regards heat production from biogas: Heat can be produced and used locally without much hindrance. In addition, many Swedish population and/or industrial centres will have local district heating systems. In cases where the location of a biogas plant is favorable it may be possible to integrate the plant with the local district heating system. No general rules exist that governs such integration which means that all deals must be negotiated on a project basis with the utility in question.

Agricultural use of digestate:

If the digestate is to be sold as fertilizer, i.e. not just used on own property, the digestate producing plant has to be approved by the Swedish Board of Agriculture. As stated before, the European Union Animal By-Product regulations apply. The rules apply for storage and land application of digestate as for animal manure.

Rules exist for Nitrogen and Phosphorus application rates and timing of application SJVFS 2004:62, as well as maximum application rates of heavy metals SNFS 1994:2 and 1998:944. In addition, certain areas in Sweden are considered extra sensitive from a nitrogen leaching or eutrophication perspective. These areas have stricter limits with respect to land application and additional rules about preventing ammonia emissions from storage of organic fertilizer (including digestate) through some type of storage cover (minimum natural crust) (SFS 1998:915).

In Sweden the term "biofertilizer" (biogödsel) is used exclusively for digestate certified according to the certification system SPCR120. SPCR120 was created in 1999 as a voluntary certification system for digestate from biogas plants. The system is owned and so far financed by the association Avfall Sverige – Swedish Waste Management. In February 2013 there are in total 14 biogas plants and 3 compost plants with certificates. The background to the system was to build market confidence for high quality products with the origin in source separated organic waste. It was also important that the market actors regarded digested as different products compared with sewage sludge. During the 90's it was common that digestate and sewage sludge was regarded as the same product. Thus, the certification system for digestate does not accept any products from the sewage sector as substrate, i.e. sewage or septic sludges.

The system has a positive list for which types of substrates that are accepted. The substrates have to be clean and source separated organic wastes (e.g. organic household waste, organic waste from restaurants), manure and agricultural crops like silage. Organic waste with animal origin has of course to follow the EU animal byproduct directive (e.g. manure, slaughterhouse waste, meat from retail shops). In principle only substrates with food or feed origin are accepted.

A one-year qualification time is observed before a plant will get a certificate. During this qualification year all analysis has to meet the requirements in the system like maximum heavy metal content (Cd, Cr, Cu, Hg, Ni, Pb and Zn), disease control and visible impurities. A plant with a certificate needs to have a documented and structured working procedure. Supervisory inspection is carried out by the certifying body through producer visits and inspection of the producer's self-monitoring system.

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Certified digestate is widely accepted as fertilizer among farmers, food industry and authorities. Today all Swedish food industries or associations accept certified digestate as a fertilizer. Even the Swedish organic food certification system KRAV accepts certified digestate to be used as fertilizer, as long as the substrates follow what is accepted according to the EU directive for ecological production.

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3. European Union (UE) financial frameworks

According to Renewable Energy Directive, by 2020, 20% of all energy used in the EU has to come from *renewable sources*, including biomass, bioliquids and biogas.

"The UE countries are to establish national action plans which set the share of energy from renewable sources, as well as in the production of electricity and heating, for 2020".

These plans will also establish procedures for the reform of planning and pricing schemes and access to electricity networks, promoting energy from renewable sources.

The incentives provided for in this Directive will encourage increased production of biofuels and bioliquids worldwide. Where biofuels and bioliquids are made from raw material produced within the Community, they should also comply with Community environmental requirements for agriculture, including those concerning the protection of groundwater and surface water quality, and with social requirements.

3.1. Financial frameworks in countries involved in BIOGAS3

3.1.1. France

Anaerobic Digestion (AD) plants are characterized by a very large range of investment and operating costs depending on the size of the installation, waste used, local constraints, energy recovery system chosen, local uses of energy produced. Investment costs are between 10000 and 15000 €/kWel for a 30kWel biogas unit and around 8600€/kWel for a 100 kWel (source ADEME). Over than 10000€/kWel, it is often considered than the project is not economically suitable (but depending of the feed-in tariff of electricity and amount of subsidies given). An investment is considered profitable if the Internal Rate of Return is over than 6%.

The French government will support an investment if the payback is in general less than 15 years without subsidies (depending on the region). Nevertheless, attribute subsidies is desired by the government to keep some control of the development of the sector, avoid potential risks of abuse, correct local disparities and organic waste availabilities.

1. Public financing institutions and programs:

French Energy and Environmental Agency (ADEME) provide subsidies with its "HEAT funds" (heat recovery equipments or heating networks) and "WASTE funds" (waste and biomass recovery).

Government subsidies can be completed by European funds (FEDER) or regional organizations subsidies. In France, for a biogas unit, the average level of public subsidy is currently 35% of total investment costs (31% for big centralized units, 38% for farm units and 40% for small scale AD units, source ADEME).

Different kinds and amounts of subsidies for biogas units exist in France, depending on the region where the AD unit is located, innovating process, economic profitability, local and secured waste supply, etc.

Example: in Brittany, the conditions of subsidies given in 2013 are (for farm units or centralized units):

Biogas Units subsidies:
The economic support depends of the electrical power (P) of the CHP engine, and it will not exceed:
- 10.000€/kWel if P<80kWel.
- 9.000€/kWel between 80 and 100 kWel included.
- 7.000€/kWel between 100 and 250 kWel included.
- 6.000€/kWe if P>250kWel.

If P<250 kW, subsidies are between 20 to 40% of eligible investment costs
If 250<P<500 kW, subsidies correspond to 15% of eligible investment costs
If P>500 kW, the rate will be determinate through an economical analysis.

Heating Network subsidies:

Example of eligibility: Pumps and connections for heating network, trench, civil engineering, hydraulic distribution. The economical support will not exceed 55% of eligible costs, capped according to the diameter of the heating network.

Even after public subsidies, the investment cost remains high for holders of biogas projects, especially for small-scale biogas units which do not benefit economy of scale. In France, it exists some financial arrangements developed by the region (ex: OSEO, public investment bank) which provide a minimal guarantee asked by credit institutions (banks) to private holders of biogas projects. This system provides flexibility and comfort bankers on the possibility of a bank loan (bankers are often reluctant by their ignorance of AD units, especially in time of economical crisis).

2. Private financing institutions and programs:

After public economical support on the investment, around 65-70% have to be funded by the holder of the project (AFI or farmer) with bank loans or own capital. For small scale AD, a big part of self-construction (civil engineering) or a reuse of existing structures can decrease the investment costs and make easier the investment.

Other way of financial contributions is a private investment by investments societies which bring funds to accelerate and optimize the financial project development. In Brittany (for example), SAS Eilan invests in renewable energy projects, like AD units. Private societies will invest if the project is solid and profitable and bring security for bank loans.

3.1.2. Germany

It is estimated that the German Food and Beverage Industry produced around 1.9 Million tons of residues per year, this covers around 17 % of all wastes accumulated in Germany.

On average, to dispose one square meter of waste in Germany costs around 49 € (average price from several chosen cities). However this price varies from state to state and is also depended on the type of waste and the waste producer.

Though there already exist several options to dispose organic waste, those options mostly are offered from regional waste management companies, such as reutilizing organic waste within biogas plants.

One well-known example is the concept of "ReFood". This company distributes without charge own rubbish bins for the disposal of organic residues, picks them up and charges the input into own large-scale biogas plants.

The most influential law for the promotion of biogas plants has been the Renewable Energy Sources Act (EEG) in Germany. This law implies that newly built biogas plants are guaranteed to receive a fixed price for feeding-in their electricity into the grid for 20 years starting from the year of implementation of the plant. This leads to a reliable and calculable financial framework, reduces risks and encourages investments in this particular business unit. The EEG in Germany was reformed in 2014. It was agreed upon the legal framework for the EEG on the 11th of July 2014 within the Federal Council. The below mentioned feed-in tariffs already consider this reform:

The feed-in tariff is depended on the type of substrate that is digested to biogas. In terms of the digestion of organic wastes the feed-in tariffs foresee prices of:

For the digestion of organic wastes:
- 15,26 c€/kWh$_{el}$ up to an installed capacity of 500kW
- 13,38 c€/kWh$_{el}$ up to an installed capacity of 20MW

For the digestion of manure:
- 23,73 c€/kWh$_{el}$, if
  - electricity is produced at the location of biogas plant.
  - installed capacity does not exceed 75kW.
  - the share of manure has a minimum of 80% liquid manure.

However, other financial frameworks are available but not yet widely realized:

- Direct commercialization of biogas through electricity grid.
- Independently of political regulations, biogas plant operators have the possibility to feed-in their electricity into the grid or sell the electricity to other parties by receiving the usual market price from the electricity market.
- Additionally, operators receive a monthly market bonus from the grid operator (for electricity from biomass as a compensation for the lower price of the official

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electricity price. The basis of assessment for this bonus is the above mentioned feed-in tariffs minus the monthly market price from the electricity stock market.

The market bonus model came into force recently and is not widely implemented yet. Due to the lower tariffs of the EEG 2014 however, more changes and implementations supporting different commercialization models are expected.

1. Public financing institutions and programs:

In order to accelerate the objective goals for the EU due to the expansion of renewable energies, the federal government promotes small scale biogas plants not only by fixed prices of the EEG apportionment. Another inherent support, subject to the administrative provisions of §§ 23 and 44 of the Bundeshaushaltsordnung (BHO), describes funding programs by a) the Kreditanstalt für Wiederaufbau (KfW) and b) the Landwirtschaftliche Rentenbank that meet the EC Regulation # 800/2008, Chapter II, Article 15.

These grants are now to be presented in the course:

a) KfW-Programm Erneuerbare Energien "Standard" (270, 274). The object of the KfW is the realisation of public contracts such as the promotion of SMEs and start-ups, the granting of investment loans to small and medium-sized enterprises as well as the financing of infrastructure and housing, the financing of energy-saving technologies and municipal infrastructure. Across all fields of activity, the KfW promotes environmental and climate protection projects.

One of these programs is the Erneuerbare Energien "Standard". It is devoted to construction, expansion and acquisition of equipment and grids in terms of renewable energies listed in § 5 No. 14 EEG 2014, e.g. small scale biogas plants. Accordingly, it aims to allow low-interest project finance for the use of renewable energy sources for electricity and heat generation. It covers up to 100 % of the eligible net investment costs. The subsidised credit will be issued according to the benefits for up to 20 years. The interest rate lies between 1.46 % to 8.08 % effective interest rate (APR), depending on the credit quality of the proposer and the impairment of the collateral. Additional to the low-interest loans, proposers with an installed electrical capacity up to 70 kW can apply for a part debt relief from federal funds in the amount up to € 15,000.

b) Bank loan of the Landwirtschaftliche Rentenbank. The funding of the Rentenbank aimed both at production plants in agriculture and forestry, viticulture and horticulture as well as at producers of agricultural means of production, trade and service companies, which are closely connected with agriculture. The development mandate explicitly includes the agricultural-related environmental protection, renewable energy and renewable raw materials from agriculture, the spread of organic farming, the agro-related consumer protection and animal welfare in agriculture.

The program "Energie vom Land" for example financed investments in renewable resources and other organic compounds (e.g. biogas plants, biomass cogeneration plants, plants for the production of biogenic fuels). Therefore up to 100 % of the eligible costs can be financed. It is intended to flexibilise the instalments of the outstanding investment project. Therefore maturities from 4 to 30 years are available with a fixed interest period of 10 years.

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In both cases the house bank occurs as the executive body, who secures the customary collateral. Nevertheless, risk adjusted pricing for the margin of the house bank is already included.

Example: The following example illustrates a project credit lending for a 250 kW_{el} biogas plant in 2010.[1] In order to make rearing of pig fattening independent from rising energy and heating costs, it is planned to invest in a new biogas plant. This can cost more than 5,000 €/kW in addition it is mainly financed from debt capital.

The graph below shows exemplary the scheduled financial demand:

Capital requirements and maintenance costs for a biogas plant with 250 kW						
Capital requirements for…	**Share on total costs**	**Creditor**	**Term/fixed interest rate /grace periods**	**interest rate nominal interest rate**	**effective interest rate**	**Useful live**
- Constructions - Fermenter - Silage & Slurry storage - Attachment - Utilities	40%	KfW installment loan	20/10/01	3,15%	3,75%	20 years
- Technical equipment - Solid matter - Agitator & Pumps	33%	Rentenbank installment loan	10/10/0	3,40%	3,43%	10 - 20 years permanent replacement by repairs
- CHP plant	16%	Rentenbank installment loan	8/8/0	3,10%	3,12%	8 years replacement investment
-Current assets (Substrates)	10%	Equity	10/10/10	2,50%		

Budgeting & loan example, own table cf. Mattias, J & Gründken, B. (2010)

The financing of the biogas plant elaborates the economic lifetime of the plant components. Because of that three loans with different maturities are required. For the construction work a loan from KfW with a scheduled term of 20 years and 10 years rate fixation is used. To finance the technical plants as well as the CHP plant, loans from the Landwirtschaftliche Rentenbank with maturities of 10 years and 8 years respectively were disbursed. Merely the substrates as working capital needed to be inserted by the borrower himself.

2. Private financing institutions and programs:

Since the market for biogas plants has been well developed and established over the last couple of years, several banks started to offer suitable bank loans for biogas projects. Today, due to the changed circumstances with decreased feed-in tariffs, banks might demand more pre-conditions in order to grant loans.

Normally, a biogas plant is treated as an own economical unit/ company and liabilities and credit-worthiness have to be proven individually will be estimated according to future expected project results (project finance). If a biogas plant however belongs legally to a company (e.g.

[1] *Mattias, J. & Gründken, B. 2010. „Günstig finanzieren mit Rentenbank Krediten" extracted from top Agrar 6/2010, 1-4.*

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SMEs), the securities and reliabilities can be rated higher due to the credit-worthiness of the whole company (corporate finance).

Depending on the loan between the loaner (bank) and the borrower (company and/or biogas plant) there can be individual agreements. The transfer of feed-in tariffs to the bank is one of the most common arrangements.If the pre-conditions are met and proven (through pre-feasibility and feasibility studies), some German banks granting loans for the investment in biogas projects (e.G. Umweltbank, GLS). In the case of corporate financing it might be recommendable to consult the company's own bank, due to their relationship to and knowledge of the company.Further private financing opportunities are so called Operators Models ("Betreibermodelle). These models are usually realised by local biogas equipment manufacturers. The delivered and operating turnkey plant proceeds to a special purpose vehicle or project company. Operators of the biogas plant (often the farmer) provide the ground, the substrates and operate the plant. The operator then only receives remunerations for operating and maintenance while the external investor (e.g. the plant manufacturer) pays the investment and keeps all revenues.

3.1.3. Ireland

1. Public financing institutions and programs:

The Draft Bioenergy Plan published by the Department of Communications Energy and Natural Resources (DCENR) include a renewable heat incentive (RHI). The level of support under this RHI is yet to be determined however it is expected to offer a significant support mechanism to offset potential fines the state will face post 2020 should the NREAP targets be missed.

DCENR also offer a Renewable Energy Feed in Tariff (REFIT) for small scale anaerobic digestion that supplies electricity onto the grid. The rate was set at 0.15 € per kWh index linked. The Index Link currently raises this to just over 16 c€/kWh. The REFIT is dependent on meeting significant Primary Energy Savings targets of 75%, this has the effect that to be successful an AD project must have a significant use of heat.

Mentioned Draft Bioenergy Plan published October 2014 provides an outline of current and planned Irish Government financial support for biogas and other renewable energy forms, while details (including genesis) of current supports are on the Department of Energy website http://www.dcenr.gov.ie/Energy/Sustainable+and+Renewable+Energy+Division/REFIT.htm

Summary details and tariff rates are elaborated below.

Renewable feed-in tariff

A renewable feed-in tariff (REFIT) for electricity will remain a central goal of Bioenergy policy. The REFIT 3 scheme (for biomass technologies) was introduced in 2012 to stimulate the installation of 310MW biomass electricity technologies including AD, CHP, and co-firing of biomass with peat. The scheme is for projects built and operational between 1/1/10 and 31/12/15. The tariff levels and structures were designed to encourage the efficient use of biomass, and have higher tariffs rewarding high efficiency cogeneration. See table below, including AD and non-AD for comparisons. The market certainty of the scheme allows

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generators to enter into long-term supply contracts for biomass. Next table includes a summary about tariff in Ireland (REFIT 3)

REFIT 3 Tariffs per MWh (€)	2014	2015
Biomass Combustion	89.136	89.314
Biomass Combustion - Energy Crops	99.623	99.822
Large Biomass CHP (above 1500kW)	125.839	126.091
Small Biomass CHP (equal to or less than 1500kW)	146.812	147.106
Large AD Non CHP (above 500kW)	104.866	105.076
Small AD Non CHP (equal to or less than 500kW)	115.353	115.583
Large AD CHP (above 500kW)	136.326	136.598
Small AD CHP (equal to or less than 500kW)	157.299	157.613
The balancing payment in REFIT 3 is set at €9.90 per MWh		

Tariff payments are also made for biomass landfill gas and other renewable energy sources through REFIT 1 and REFIT 2 schemes, as in the table below. REFIT 1 (Onshore wind, hydro and biomass landfill gas), was open for applications until 31/12/09 and since that date no new applications have been accepted, although projects accepted into the scheme before that date, which under the relevant legislation were granted an extension of time to become operational, continue to be developed. The REFIT 2 scheme (onshore wind, small hydro and landfill gas) was opened in March 2012 and is for projects built and operational between 1/1/10 and 31/12/15. Next table includes a summary about tariff in Ireland (REFIT 1 and 2)

REFIT 1 Tariffs per MWh (€)	2014	2015
Large Wind (above 5MW)	69.581	69.72
Small Wind (equal to or less than 5MW)	72.023	72.167
Hydro	87.892	88.068
Biomass Landfill Gas	85.451	85.622
Other Biomass	87.892	88.068
The balancing payment per megawatt hour in REFIT 1 in 2015 is €10.458		
REFIT 2 Tariffs per MWh (€)	**2014**	**2015**
Large Wind (above 5MW)	69.581	69.72
Small Wind (equal to or less than 5MW)	72.023	72.167
Hydro	87.892	88.068
Biomass Landfill Gas	85.451	85.622
The balancing payment in REFIT 2 is set at €9.90 per MWh		

Renewable heat incentive

Government analysis has concluded a renewable heat incentive (RHI) would provide stability and long term security for investors, ensure better value for money for consumers, and have a significant positive impact on non-ETS sector emissions. It is proposed, subject to State Aid clearance from the European Commission, that from 2016 a Government-funded incentive scheme would be introduced for larger non-ETS industrial and commercial renewable heating installations. The scheme will be designed to reward users for each unit of renewable heat used from sustainable biomass, and to deliver the additional heat required in the context of meeting Ireland's target of 12% of heat demand from renewable sources by 2020. Details of qualifying criteria and payment rates are due to be finalised in 2015. The scheme will be kept under review to assess its effectiveness.

On the other hand, biogas used for vehicle fuel is supported under the Biofuel Obligation Scheme. Traders placing biogas on the market for vehicle fuel receive 1.5 certificates per m3 of biomethane. In addition they receive double certification if the biogas is produced from waste material. Certificates are traded in the open market, the price range has tended to be in the order of 20-25c per certificate. We have calculated that in the event of over supply of certificates biodiesel will be displaced at a certificate price of approximately 14c.

The Rural Development Programme 2015-2020 is expected to include measures to lower the carbon footprint of agriculture – this is expected to offer some support for biogas as a carbon mitigation measure.

2. Private financing institutions and programs:

Private banks in Ireland are lending under strict terms to renewable energy project developers. Finance is subject to copper fastened feedstock supply agreements, energy sales and other critical project criteria. There is currently no dedicated programme for financing of biogas projects, banking expertise in the area is significantly low. Funding levels are of the order of 60% where sufficient asset security can be provided.

3.1.4. Italy

1. Public financing institutions and programs:

Two most important laws must be taken into account regards with financial framework: Ministry Decree DM 06/07/2012 Incentives for renewable electrical energy (not photovoltaic), and Law Decree DL Nº 28 5/12/2013 Incentive of biomethane got into natural gas system.

- **DM 06/07/2012 - Incentives for renewable electrical energy (not photovoltaic):**

It is a national legislative system for promoting biogas production plants and it gives great advantages, in particular, for small plants (<100kWh).

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The incentive has a different calculating formula, depending on the plant power value and product used for plant feeding (see following table).

Feeding product	Power value (kW)	Incentive rate (€/kWh)
Products of biological origin	1 < P ≤ 300	0,180
	300 < P ≤ 600	0,160
	600 < P ≤ 1.000	0,140
	1.000 < P ≤ 5.000	0,104
	P > 5.000	0,091
By products of biological origin	1 < P ≤ 300	0,236
	300 < P ≤ 600	0,206
	600 < P ≤ 1.000	0,178
	1.000 < P ≤ 5.000	0,125
	P > 5.000	0,101
Waste with a "flat rate" biodegradable fraction	1 < P ≤ 1.000	0,216
	1.000 < P ≤ 5.000	0,109
	P > 5.000	0,085

In particular, for small plants (power < 1 MW), are possible additional bonuses.

For plants with **high-efficiency cogeneration** additional bonuses are:

- 40 €/MWh for plants fed with products of biological origin
- 40 €/MWh for plants fed with by products of biological origin
- 10 €/MWh for other types of plants

For plants with high-efficiency cogeneration and **nitrogen recovery systems,** other additional bonuses are possible (see following table):

Feed type	Power value (kW)	Nitrogen bonus		
		Removal (40%)	Recovery (30%)	Recovery (60%)
Products of biological origin	1 < P ≤ 300	0,015	0,020	0,030
	300 < P ≤ 600	0,015	0,020	0,030
	P > 600	0,000	0,000	0,030
By products of biological origin	1 < P ≤ 300	0,015	0,020	0,030
	300 < P ≤ 600	0,015	0,020	0,030
	P > 600	0,000	0,000	0,030
Waste with a "flat rate" biodegradable fraction	1 < P ≤ 300	0,015	0,020	0,030
	300 < P ≤ 600	0,015	0,020	0,030
	P > 600	0,000	0,000	0,030

Incentives are granted for 20 years and the maximum cumulative cost of all types of incentive is set at € 5.8 billion per year.

Plants with capacity >5MW access to the incentive system as a result of participation in competitive auctions downward, but for small plants it is not necessary.

- **DM 5/12/2013 - Incentive of biomethane got into natural gas system:**

This law describes specific incentives for biomethane (gas produced by the breakdown of organic matter in the absence of oxygen) and includes 4 different cases:

1. Entering the biomethane in transport and distribution networks of natural gas.

Incentives are granted for 20 years and are calculated as follows:

2*AAP – AMP where, AAP = Biogas Average Annual Price AMP = Biogas Monthly Annual Price

When biomethane is produced using only by-products and waste, the incentive is increased by 50%.

Alternatively, only for systems with the potential to produce up to 500 Sm^3/h, is bought with a price

$$P=2* AAP$$

Incentives are granted for 20 years.

2. Use of biomethane in transport after getting into natural gas system.

Incentives are granted for 20 years and there is a 50% increase when the the biogas is produced from biodegradable fraction of waste, by-products or from algae

3. Use of biomethane in plants with high-efficiency cogeneration.

Incentives described in "*DM July, 6 2012*" are applied; in addition it is possible to use biomethane within a different site than the production site (transport through the network of natural gas).

4. Existing biogas plants converted to biomethane production (also partially, even after increasing the capacity).

Depending on the case as described in the previous situations, it is possible to get incentives in different percentage but always lower than in the case of new plants:

Situation	% of incentives described for new plants
1 and 3	40%
2	70%

- **Other incentives:**

In addition to the national legislation, local governments provide, periodically, incentives for the production of biogas. Currently, incentives in Emilia Romagna Region and in Trentino Alto-Adige Region are available.

Emilia Romagna Region: 2007-2013 Program – Priority 3 - Improving energy and environmental and sustainable development - Incentives for small and medium enterprises

Emilia Romagna Region offers 23.7 million to improve energy efficiency and encourage the development of renewable energy sources (such as biogas).

Incentives have a maximum term of 7 years and an amount of between 20.000€ and 1.000.000€.

40% of the total funding will be through public funds, the remaining 60% through private funding resources made available by lenders.

The effective interest rate charged on the undertaking beneficiary will pay Euribor plus 4.75 percentage points

For more details see:
http://imprese.regione.emilia-romagna.it/Finanziamenti/energia/fondo-rotativo-di-finanza-agevolata-per-la-green-economy

Trentino Alto-Adige Region: contributions for the construction and expansion of biogas plants

Trentino Alto-Adige Region (Bolzano district) grants incentives for the construction and expansion of biogas plants from wastewater breeding: the obtained gas must be used for electrical and /or thermal purpose (at least 70%).

Incentives may cover costs for:

- feed and extraction plant
- agitator
- gas deposit
- facility for gas treatment and distribution
- plant for the combined production of electricity and heat
- thermo-hydraulic systems
- control systems.

Contributions may be granted only for equipment and installation and not for the replacement of parts of existing system.

For more details see:
http://www.regione.taa.it/bur/pdf/I-II/2014/9/BO/BO09140189428.pdf

2. Private financing institutions and programs:

Also, a company wanting produce biogas can take advantage of ***specific loans by some banks.*** Below two examples:

Monte dei Paschi di Siena

The bank "Monte dei Paschi di Siena" offers medium/long-term founding for wanting produce energy from renewable sources (plants with power < 1MW).

The maximum amount financed is € 1,500,000.00 (depending on the type of plant) and the maximum duration is 15 years.

Nominal annual interest rate is variable and depends on a parameter indexing and spreads.

For more details see:
http://www.gruppo.mps.it/ap_trasparenzaweb/Documenti%5C103036988.pdf

Cassa di Risparmio di Bolzano

The bank "Cassa di Risparmio di Bolzano" supports projects for biogas plants with a capacity of about 1 MW (fixed investments of 4.2 to 4.5 M€ or "senior" funding of ~ 3.5 M€).

The maximum duration of the founding is 12 years.

For more details see:
http://www.isesitalia.org/images/ises/eventi/2010/pdf/Guida_Cassa%20Risparmio%20BZ.pdf

3.1.5. Poland

Public and private financing institutions and programs:

The system of state support for renewable energy sources established in the Energy Law: It includes certificates of origin for electricity generated from a renewable energy source "green certificates", as well as certificates of origin from cogeneration "yellow certificates" for gas fired energy sources or with power capacity of the source up to 1 MW (for more details see chapter 2.2.5)

Several funding programmes are listed below:

System Of Green Investments. Priority programme part 2. Agricultural biogas plants

Institution: NFEP&WM (National Fund for Environmental Protection and Water Management)

Characteristics: Forms of financing:

- **Grant**: up to **30 %** of eligible costs.

- **Loan** up to **45%** of eligible costs - max. 15 years, floating interest rate WIBOR 3M + 50 basis points (per annum).
- funding in the part dedicated to preparatory work (including technical concepts, feasibility study, environmental impact report), will be granted as *de minims* aid,
- for the remaining eligible costs regional aid is granted, in accordance with conditions laid down in the regulation on regional aid.

Beneficiaries: Entities (individuals, legal persons or entities without legal personality, granted legal capacity under the regulation) which undertake projects for the generation of electricity or heat with the use of biogas produced in the processes of decomposition of biomass of agricultural origin and the production of agricultural biogas in order to introduce it into the distribution network and direct gas network.

Calls for proposals take place under competition procedure.

Advantages / disadvantages / barriers:
Advantages: A product that combines a grant with a loan. Financing institution does not use as security property which isn't the subject of financing.
Disadvantages: Small allocation of funds. Insufficient number of calls for proposals.
Obstacles: For advanced projects only. Heat energy must be used. Selection of contractors through public procurement or queries according to the Civil Code.

Support for distributed renewable energy sources - Part 4. Prosumer - line of funding for the purchase and installation of renewable energy micro-installations.

Institution: NFEP&WM, also via VFEP&WMs (Voivodeship Funds for Environmental Protection and Water Management) and banks.

Characteristics. Types of funded projects (among others):

Micro-renewable energy system with installed capacity up to 40 kW, for the production of electricity or for the production of heat and electricity, for single-family or multi-family dwellings - existing or under construction.

Forms of financing:

- **Loan** (interest rate of 1% per year, max. 15 years) along with a **grant** - together up to 100% of the eligible costs of systems covered by the project, including in the form of a grant up to **30%**, and in 2014-2015 - up to 40%.

  The maximum amount of the eligible costs of purchase and installation is 300,000 PLN (in each case for the installation of a biogas-fuelled micro-generation system)

Beneficiaries: individuals, housing cooperatives and local government units and their associations

Advantages / disadvantages / barriers:
Advantages: a combination of low-interest loans and non-repayable grants.
Disadvantages: Lack of farms among the beneficiaries. The programme will probably be oriented towards PV energy sources.
Obstacles: No differentiation of the programme in terms of technology, too low eligible costs.

Several programs from the VFEP&WMs institution

Characteristics: Low-interest loans (including via banks), the possibility of remission up to 15%-30%, interest subsidies on loans.
Advantages / disadvantages / barriers:
Advantages: Available for smaller projects.
Disadvantages: In most cases small allocation of funds.

Regional Operational Programmes (ROP)

Institution: marshals' offices

Characteristics: Programmes for the 2014-2020 financial perspective are under approval, the first calls for proposals are foreseen for 2015.

Draft ROPs cover renewable energy sources (including biogas plants), but at this stage the exact form and level of funding is unknown.

Advantages / disadvantages / barriers:
Obstacles: Only advanced projects.

Programme for the Development of Rural Areas 2014-2020

Institution: Agency for Restructuring and Modernisation of Agriculture (ARMA)

Characteristics: No competitions for the financing of biogas plants at present.

Programme for 2014-2020 is under approval, the first calls for proposals are foreseen for 2015.

Bank loans

Institution: BOŚ S.A., BGŻ S.A., co-operative banks.

Characteristics: Working-capital and investment loans (substrate, VAT). Interest rates from 6 to 10%, financing period up to 25 years. Required own contribution - about 10%.

Advantages / disadvantages / barriers:
Advantages: Not related to the selection of contractors in a competition or under public procurement rules.
Disadvantages: Origination fees and commissions. Property which isn't the subject of financing used as security. Required own contribution, usually in the form of cash.
Obstacles: Less available for projects implemented by SPVs

Not all banks support investments in renewable energy.

3.1.6. Spain

1. Public financing institutions and programs:

The financial framework in Spain is mainly composed by:

- Feed-in-tariffs (FIT) regulated by the Royal Decree 413/2014 and the Order IET/1045/2014. This FIT is calculated specifically for each plant and a general number cannot be provided.
- Plan for biodigestion of animal slurries: this plan offers grants up to 40% of investment for rural digesters using mainly slurry or manure. Co-digestion is limited. The management of these funds is done by the regional governments.
- Financing by Third Parties: this is a financing scheme of the IDAE (Institute of Energy Diversification and Saving, dependent on the Spanish Ministry of Industry, Energy and Tourism). With this scheme, the investment is made by IDAE, which recovers the investment with the generated energy. After this point, the IDAE withdraws from the project and the facility (the biogas plant in this case) becomes property of the company, and the benefits obtained from the generated energy will be kept by the company as well. This financing scheme is dependant on the availability of funds, and at the present time no new projects are being financed, to the best of our knowledge.
- JESSICA F.I.D.A.E. Funding for Renewable Energies and others. This funding was launched by IDAE as intermediary body delegated by Managing Authority of the European Regional Development Fund (ERDF). Funding co-financed by the ERDF and IDAE and operated by the European Investment Bank. This funding is compatible with other public and private financing possibilities, as well as with co-financed subsidies or not by European Funding (except European Social Bank, Cohesion Fund, European Fisheries Fund, The European Agricultural Fund for Rural Development, or under other different operational ERDF programmes). The European Investment Bank has selected three managers (Banco Bilbao Vizcaya Argentaria, Banco de Santander and GED Infrastructure) to channel the funding to the final party benefited.
- Regional support: the regional governments are giving support to renewable energies in different ways. The casuistry is too wide to be addressed in this document, but a summary of all the regional grants or financial support can be downloaded from this website: http://www.idae.es/index.php/idpag.35/relmenu.389/mod.pags/mem.detalle

2. Private financing institutions and programs:

Nowadays, there are no private initiatives focused on financing biogas plants. In most cases, small-scale biogas plants have been financed by owner through own resources or bank loan. In particular, for small-scale biogas plants projects is easier to obtain funding from rural banks than from other kind of banks.

In addition to that, Official Credit Institute financing (loans) is possible to be used for small-scale biogas plants if the project is solid and well-designed according to several Spanish biogas plant providers' consultations.

3.1.7. Sweden

1. Public financing institutions and programs:

The support system in Sweden is mainly focused on increasing the usage of biomethane as vehicle fuel. The exiting support systems are:

- No carbon dioxide or energy tax on biogas. Today this corresponds to a value of 68 €/MWh compared to petrol and 52 €/MWh compared to diesel of which 26 €/MWh is from the carbon dioxide relief and the remaining part is from the energy tax relief.
- 40% reduction of income tax for use of company NGVs until 2017
- Investment grants for marketing of new technologies and new solutions for biogas during 2013-2016. Maximum 45% or 25 MSEK (~3 M€) of investment cost
- A joint electricity certificate market between Norway and Sweden. The producers get one certificate for every MWh electricity produced from renewable resources and electricity consumers must buy certificates in relation to their total use. Average price 2012 around 17-2 2€/MWh
- 0,2 SEK/kWh raw biogas (~€ 0,02 / kWh) for manure based biogas production to reduce methane emissions from manure. Total budget 240 MSEK (10 years). Eligible plants will receive the compensation up to a production ceiling, which due to limited funds, will be limiting. The ceiling will be double for plants that produce vehicle fuel grade biomethane, The eligible production ceiling is still under review in terms of the details around how high it will be.

The main barrier for small scale biogas projects to access financial programs is that all but the methane emission reduction compensation (last bullet above) is catered towards producing biogas for use as vehicle fuel. The methane emission reduction compensation program only applies to biogas that originates from manure and is not active yet. It is expected that it will be enacted in the autumn of 2014.

2. Private financing institutions and programs:

There have not been found any general private incentive from banks for investment in biogas production. Small-scale plants are usually financed by own resources and ordinary bank loans on commercial basis. Usually the plant owner has to guarantee the loan with another security than the biogas plant, such as agriculture or food industry. That is because the economy in an investment in a small-scale biogas plant for heat and electricity production in Sweden is dependent on that a local business is willing to buy the energy (most likely the farm or the food industry). For larger biogas plants producing bio-methane for the market it is however usually possible to use the biogas plant as security for a part of the loan.

There is however some examples of business models in which innovative private founding are included. One is arranged by the company Wapnö (n.d.). They give individuals and businesses the opportunity to privately lend funds for the biogas investment. These loans are then paid back in the form of vouchers that can be redeemed for goods and products that Wapnö produce.

Another example is a private initiative that probably don't qualify as an financing model, but improve the investment calculation and by that also probably makes it easier to get better terms

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from the bank. In the region of Jämtland a group of farmers with small-scale biogas plants have entered a business agreement with the housing enterprise Östersundshem (Brink 2015). Östersundshem buy certificates of origin for the electricity the farmers produces. By that the farmers get 350 SEK/MWh for the certificates when selling electricity to Östersundshem. This gives the farmers incitement to increase the biogas production in their biogas plants by digesting byproducts from the slaughterhouses and dairies in the region.

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