Biogas
Power Opportunities
Romania
2014

1.Overview

Biogas is produced by the fermentation of plants, food remnants, biological wastes or animal excrement (manure) and is also found in waste treatment facilities and landfills. Biogas contains a high amount of methane that can be used to recover energy.
Biogas is therefore not a recent invention, but has been known since 1682 when the two scientists Robert Boyle and Denis Papin observed gas formation during the decomposition of plant materials. The Italian researcher Alessandro Volta discovered so-called marsh gas in 1776. At the beginning of the 20th century, theoretical knowledge was put into practice when the first digesters were built.

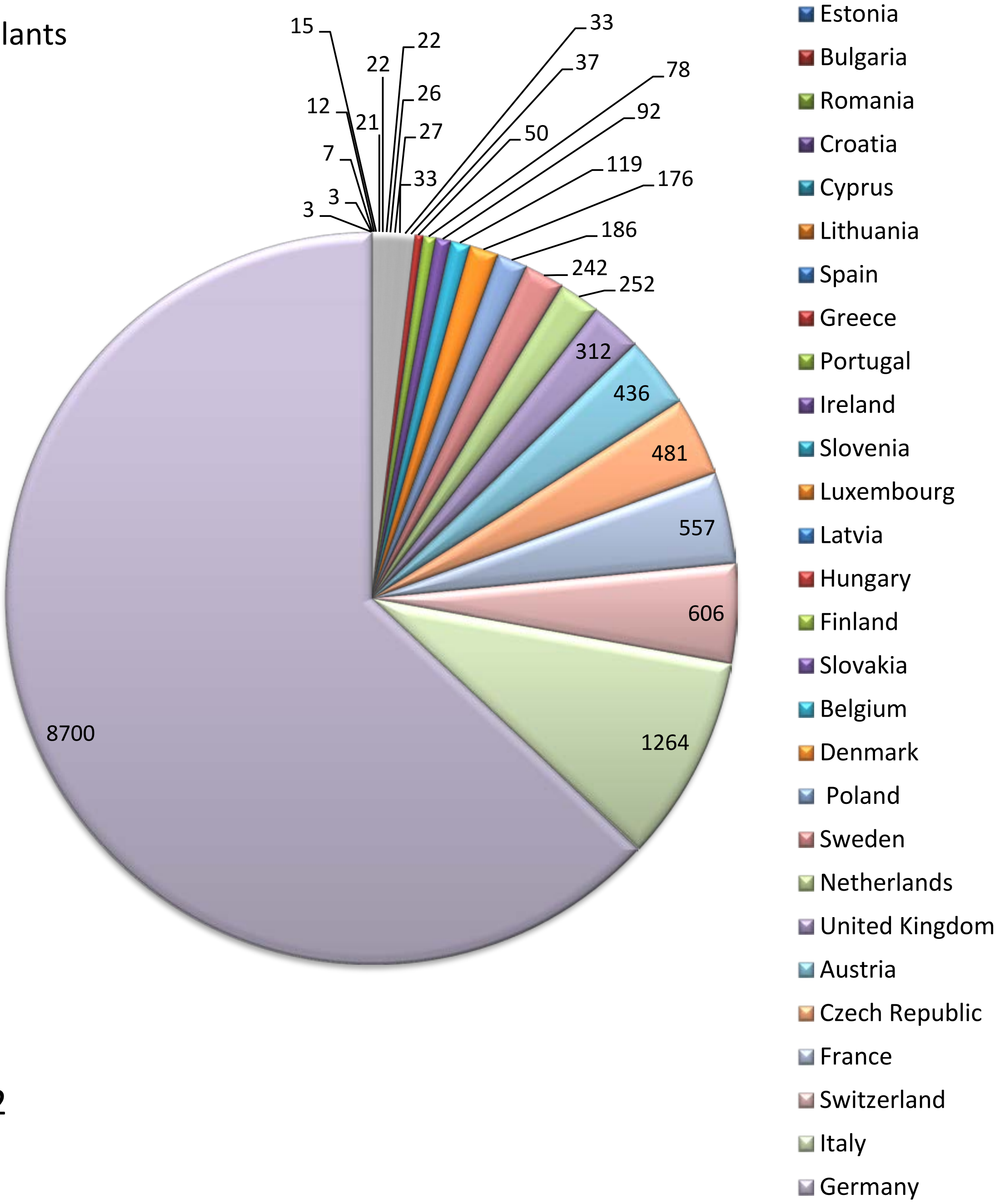
Biogas properties

Biogas consists primarily of methane and carbon dioxide and is completely saturated with water vapour. Depending on the technical design of the fermenter (leakages or internal biological de-sulphurisation), the biogas can contain appreciable quantities of nitrogen and oxygen (air). It can therefore be assumed that the gas conditioning process will have to compensate for fluctuating contamination loads.

Component	Content	Effect
CH_4	50 to 75 Vol. %	Combustible biogas components
CO_2	25 to 50 Vol. %	Reduces the fuel value; raises the methane content and thereby the anti-knock properties of motors; prevents corrosion (weak carbonic acid); if the gas is also damp it damages alkaline fuel cells
H_2S	0,005 to 0,5 mg S/m^3	Corrosive in aggregates and pipelines (stress corrosion); SO_2 emissions after combustion or H_2S emissions if combustion is incomplete; catalytic converter poison
NH_3	0 to 1 Vol. %	NO_x emissions after combustion; harmful for fuel cells; increases the anti-knocking properties of motors
Water vapour	1 to 5 Vol. %	Contributes to corrosion in aggregates and pipelines; condensate damages instruments and aggregate; danger of icing of pipelines and vents at frost temperatures
Dust	>5 um	Clogs vents and damages fuel cells
N_2	0 to 5 Vol. %	Reduces the fuel value; raises the anti-knock properties of motors
Siloxane	0 to 50 mg/m^3	Only forms in sewage and landfill gas from cosmetics, wash powder , printing inks etc.; acts as a quartz grinding medium and damages motors

2. Europe

Country	Number of plants
Estonia	3
Bulgaria	3
Romania	7
Croatia	12
Cyprus	15
Lithuania	21
Spain	22
Greece	22
Portugal	26
Ireland	27
Slovenia	33
Luxembourg	33
Latvia	37
Hungary	50
Finland	78
Slovakia	92
Belgium	119
Denmark	176
Poland	186
Sweden	242
Netherlands	252
United Kingdom	312
Austria	436
Czech Republic	481
France	557
Switzerland	606
Italy	1264
Germany	8700
	13812



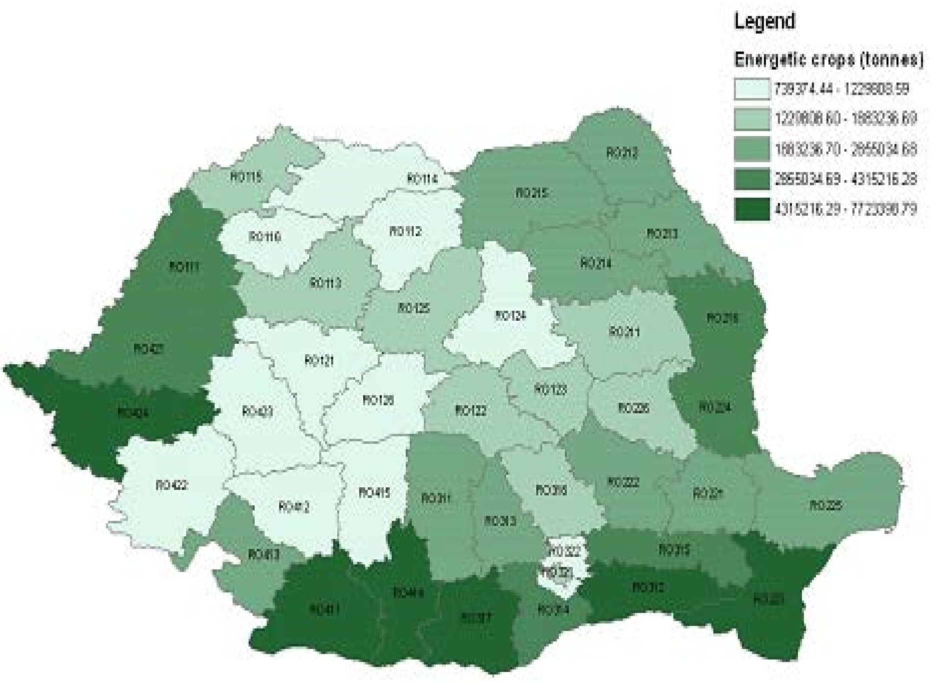
Source: EBA European Biogas Association

For the last decade, the use of biogas coming from sewage collection, farms and industrial treatment has risen constantly. Nowadays biogas plants are easily available in the market, and biogas constructions have been installed all over Europe. Nevertheless a governmental support is needed in order to make the biogas market attractive. The European biogas production potential is so large that it could replace 12 to 20 % of the natural gas consumption. However, because of a high investment cost and a heavy infrastructure, only fifty percent of the biogas production is upgraded, and the natural gas replacement is quasi null. Today about 130000m3 raw biogases are upgraded per hour in Europe, corresponding to about 2000MW per year. The largest potential for biogas is in agriculture, about 80% of the total. In most European countries with a dense natural gas grid, the opportunities for biogas injection are very good. Through the gas grid, biogas could be used for all applications, which are known for natural gas. But an essential precondition to enter into this use and investment is a proper legal situation to promote the use of the renewable energy gas from biomass.

3. Romania

Assessment of biomass potential in Romania (RO)

Energy crops potential

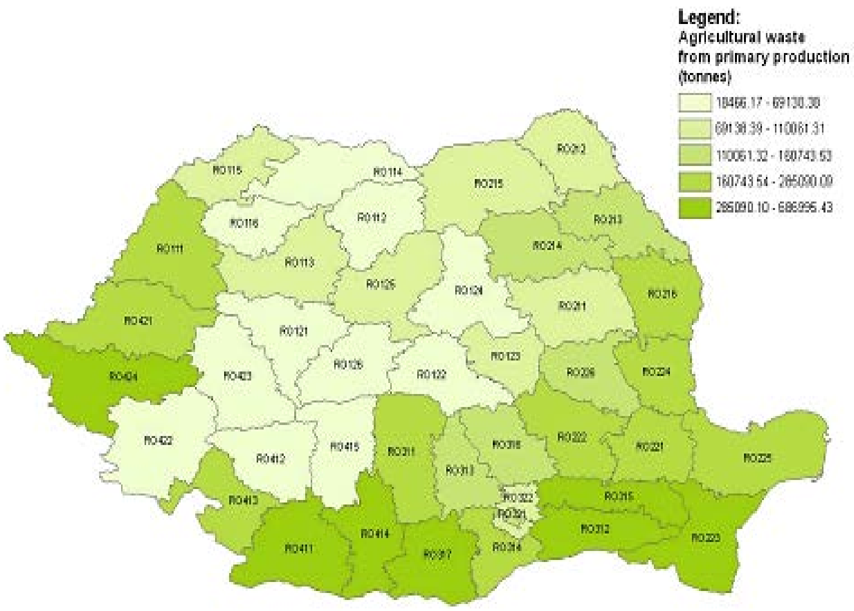


Energy crops in Romania

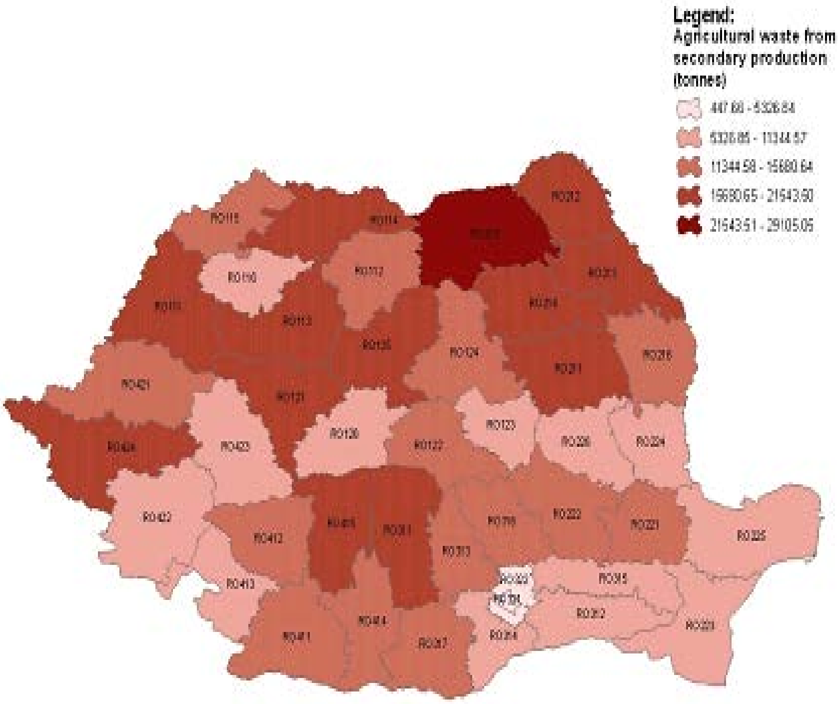
Romania has an important potential for primary production (including energy crops). There are several area well suited for large productions, especially in the South and South-Eastern part of the country, with an average (for the entire region) of the overall production, and for some crops with even a greater potential. The Western plain around Timisoara has a great potential for energetic crops, notably the area is also suitable for oleaginous plants production, hence better places for biodiesel production. Easter plains situated around Buzau to Focsani cities line is a zone suitable for corn production and before and hence a promising area of biogas from energetic crops.

Agricultural waste

It is obviously that the same areas involved in the total energetic primary production are also very important agricultural waste production zones. The maximum capacity for agricultural wastes is around 6 million tones per year, over the last several years.



Agricultural wastes from primary production in Romania



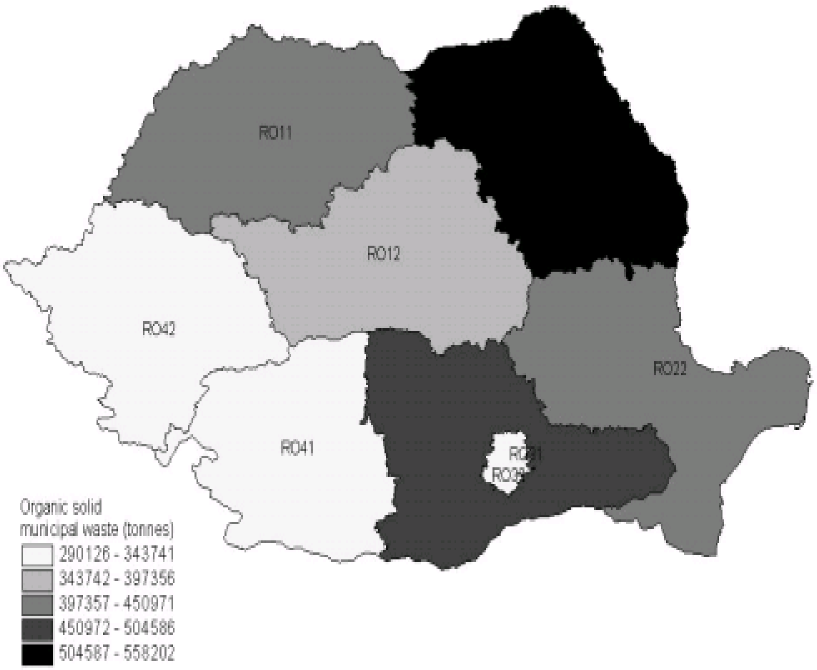
Agricultural waste from secondary production in Romania

The agriculture waste from secondary production is the highest in the Northern part of Romania with a total around 300000 tones per year. There are also other regions with potential for biogas facilities.

Municipal waste

The region RO 21 is also the region with the highest municipal waste production in Romania with an average over the last years of about 550000 tones per year. Very close to these values are the regions RO 31 and RO 32, near Bucharest city. Agricultural waste from secondary production in Romania.

Again two areas are the most important from the production point of view RO 11 and RO 21, with quantities over 1 millions tones per year. Many other regions are almost as important as this already two mentioned ones. Bucharest, Brasov, Constanta, Iasi, Cluj-Napoca and Craiova areas are also promising sites.



Organic solid region waste in Romania

3.1. Biogas Fact Sheets:

In the last years, Romania has become an increasingly important market for renewable energy investors, attracted by the support scheme devised by the state, one of the most advantageous in Europe. Earlier this year, the Ernst& Young report – Renewable Energy Country Attractiveness Indices – placed Romania the 13th place out of 40, among the most attractive countries for investment in green energy projects.

Romania has developed **25.710 MW** biogas plants, including:

- **7.951 MW –** with Technical Connection Approval
- **17.759 MW –** with Connection Contract

3.2. Support system & More Economics

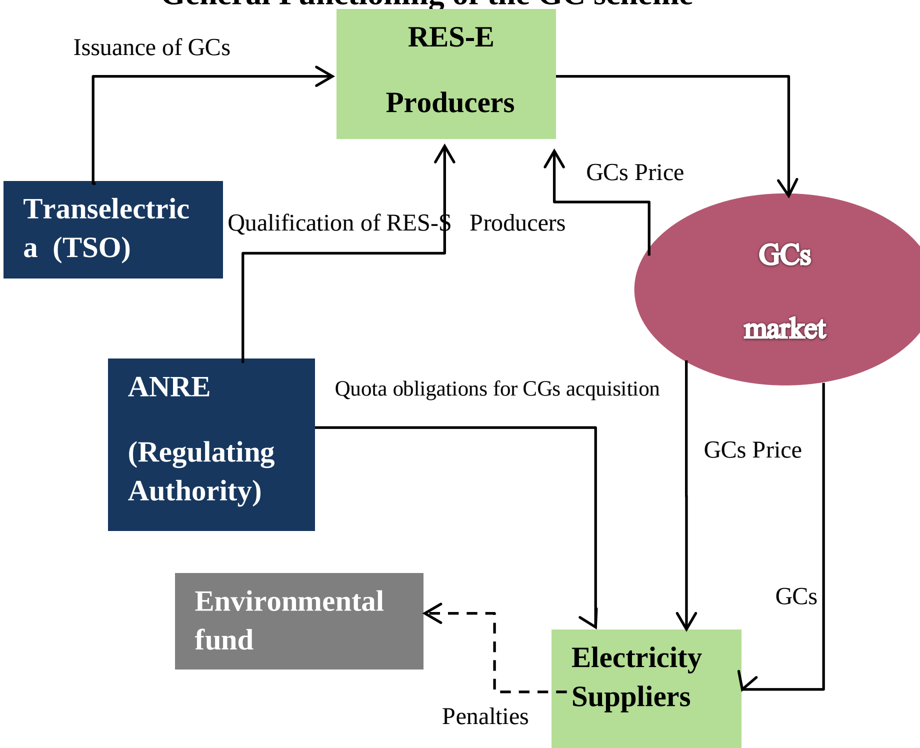
According to Law 220/2008 establishing incentives system for biogas, for every MWh generated and supplied the producer is awarded:

- 3 Green Certificates / MWh

GC Value 29,6 € (minimum price) – 59,2 € (maximum price)

- Green certificate is a certificate proving that certain quantity of electricity is generated from renewable sources.
- Electricity and GC market are separate and operate independently.
- Producer sell their generation on the electricity market for the market price.
- GC system involves greater risk then Fit measure (both electricity price and GC price)
- Consumers have on their bill the costs for GC (energy consumed MWh*GC price)

General Functioning of the GC scheme



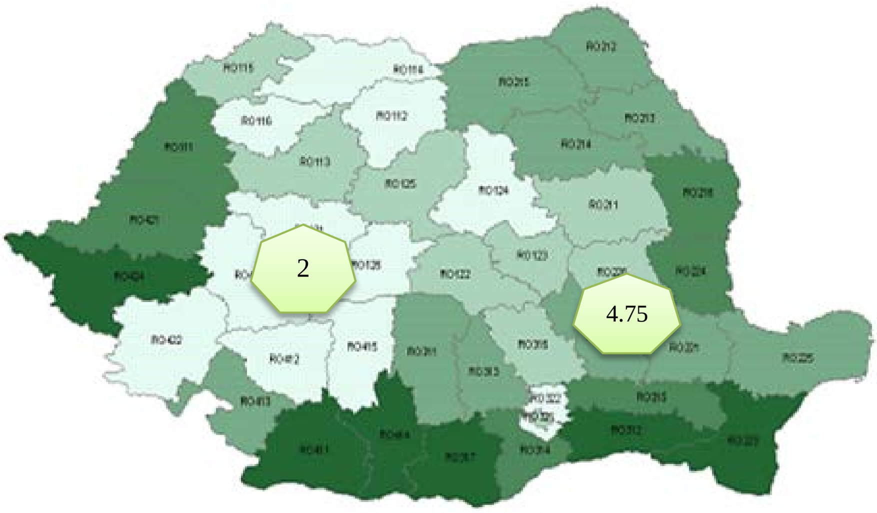
3. Opportunities

Slow Energy Europe is composed by a growing team of professionals with wide experience in RES (Renewable Energy Systems) that can offer strategic consultancy and integrated technical expertise in biogas, in order to develop and finance projects.

We can propose you investment opportunities in Biogas Power Plants, and support your company to develop new projects, to buy and manage the construction of Ready To Build projects.

3.1. Ready To Build Opportunities

Slow Energy Europe can provide **7 MW ready to build** projects to investors or EPC Contractors who are interested in buying and building projects.



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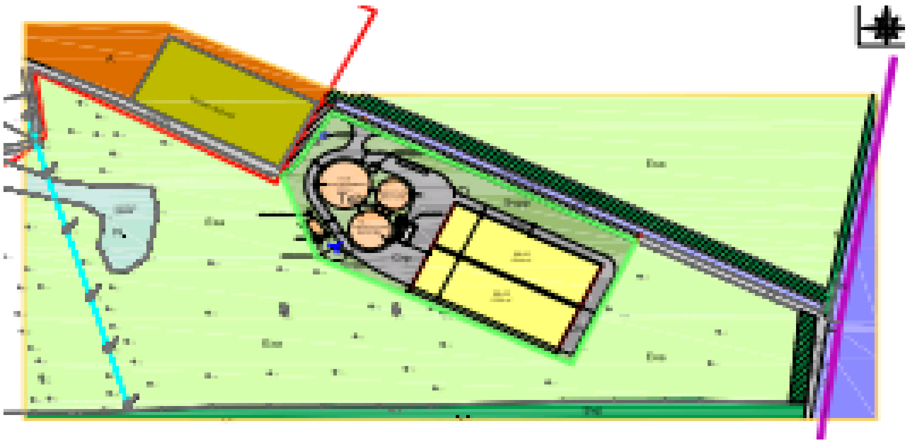
Location	MW
Alba Iulia	1
Alba Iulia	1

4.75

Location	MW
Doaga	1
Tifesti	1
Tufesti	1
Focsani	1
Calieni-Focsani	0.75

3.2. Generalities about projects

Business case: Doaga 1 MW



Feedstock

Contracts with farms for the provision of:

- Cow dung 40%
- Maize silage 60 %

Technology

- MT Energie – Germany
- AB Energy – Italy

SPV structure

- 25% Cattle farm – 1000 cattle and 1000 ha infield
- 75% developer – SC EOSEARTH SRL

Harnessing production

Insurance contract capitalization:

- Electrical energy
- Thermal energy
- Compost

Financial data

Cost	Amount (€)
EPC costs (equipments & mounting)	3,850,000
Other construction works	110,000
Network connection costs	80,000
Land	0
Permits,licenses and technical documents	110,000

Financing Structure	Amount (€)	Percenage
Equity	679,600	15%
Debt	3,170,400	85%

Loan parameters
Value 3,170,400 €
Interest rate 6 %
Reimbursement period 120 months

Output to the network	7.895 MWh
Power production	
Total production	8,326 MWh / year
Own consumption	333 MWh / year

Operational costs	Value
Maize silage consumption	14,000 t/year
Cow slurry consumption	12,000 t/year
Maize silage price	29,2 Euro/t
Cow slurry price	0 Euro/t
Maintenance, insurance, service	102,984 Euro/year

Main financial forecast assumptions	Base case
Output to the network	7,895 MWh/year
Number of green certificates	3 GC/MWh

Main performance indicators	Base case
Project IRR	15,5 %
Project NPV	€ 2,539,116
Available cash at the end of the forecased period	€4,639,752
Average DSCR The DCSR is >1.30 for the entire time horizon	1.45

Raw materials

The project refers to the establishment of a production facility that uses biomass as raw material for the production of biogas, which in turn is used for energy production.

For biogas production there will be used a mixture of animal slurry and vegetal substrate.

As vegetal substrate we take into consideration corn silage for two main reasons: its high production rate per hectare (app. 40 tones/hectare) and the increased biogas production potential (app. 200 m3/tone).

According to the technical characteristics of current technology available in the field of biogas energy production, the plant needs approximately 3.6 mil. m3/year of biogas for the production of 7,993 MWhel./year, biogas quantity obtained from 12,000 t/year of corn silage and 9,000 t/year cow slurry, considering a total operational time of minimum 7,884 h/year.

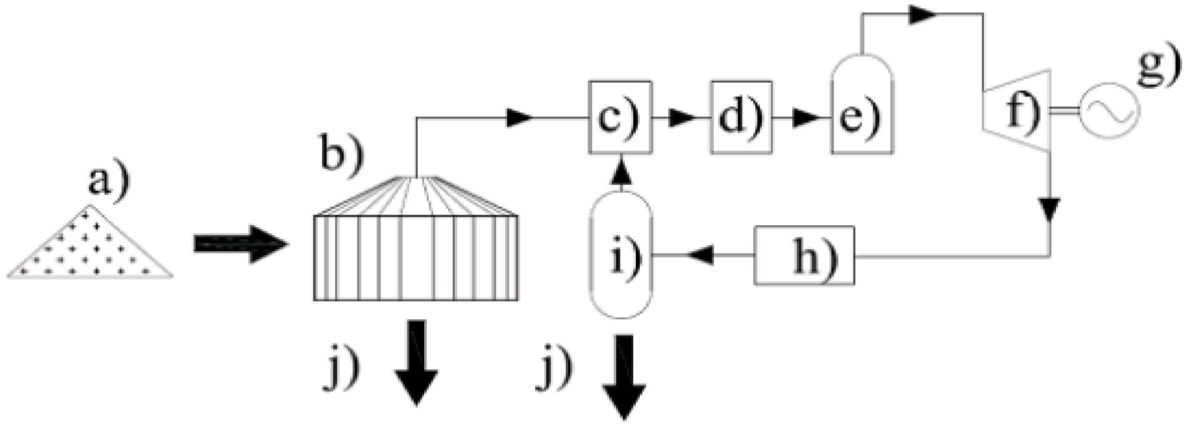
Given the production rate of 40 t/ha, the total agricultural land needed to cultivate corn silage for one year production is 300 hectars. As we stated in the introduction, the agricultural partner has more than 1000 ha of land, of which 600 ha owned as private person. He also owns a cow farm with app. 1000 animals, which is located next to the plant.

The acquisition price of the raw material is a preferential one, based on its production cost, and it is set up by a long term supply contract with our agricultural partner.

Another crop that can be used is triticale, either combined in various proportions of mixture with corn silage, or used individually. Using both crops has some advantages: because corn is a spring crop and triticale are autumn crops, alternating between the two eliminates the need for storing the raw materials for the entire year, helps with crop rotation needed for agricultural land, reduce the risk carried by using a single crop per year, reduces the agricultural land required for the provision of materials. On the other hand, biogas production potential is lower for triticale, only producing between 150 and 170 m3/tone.

The downside is that triticale was not included in the list of energy plants issued by the Romanian Agricultural Ministry and thus there is no possibility, at this moment, to obtain the extra green certificate for using energy plants. There are debates to include triticale in this list and it should be taken in the consideration for the future.

The slurry used will be that of cows, which will be procured from the farm owned by the agricultural partner and which is located next to the plant, having app. 1000 cows.



Exemple scheme of biogas power plant: a) raw biomass, b) fermentation tank (daily load), c) apparatus wich separates carbon dioxide, d) apparatus which separates sulphur, e)biogas tank, f)gas turbine, g) generator, h) heat water tank, i) fermentation tank (agricultural residues), j) wastes