IEE Project BiogasIN

Criteria to assess biogas investments: Guidelines for financing institutes and investors

D.5.4., WP 5

16/11/2011

Erik Ferber

Dominik Rutz

WIP – Renewable Energies

Sylvensteinstr. 2

81369 Munich, Germany

With contribution of

Biljana Kulisic (EIHP, Croatia) and Enrico Rose (European Biogas Association)

Contents

Contents 2
Preface 3
1. Introduction 4
2. The applicant 6
  2.1. Expertise of staff 6
  2.2. Plant monitoring 7
  2.3. Decision on the legal form 8
3. Detail of the projected plant 8
  3.1. Technical details of the plant 8
  3.2. Location 9
  3.3. Storage facilities and fermenters 11
  3.4. Feedstock and digestate 13
  3.5. Insurance 15
4. Cost calculation and financing plan 16
5. Required documentation 17
  5.1. Personal and company documentation 17
  5.2. Project documentation 17
6. Conclusion 18
Literature 19
Annex 20

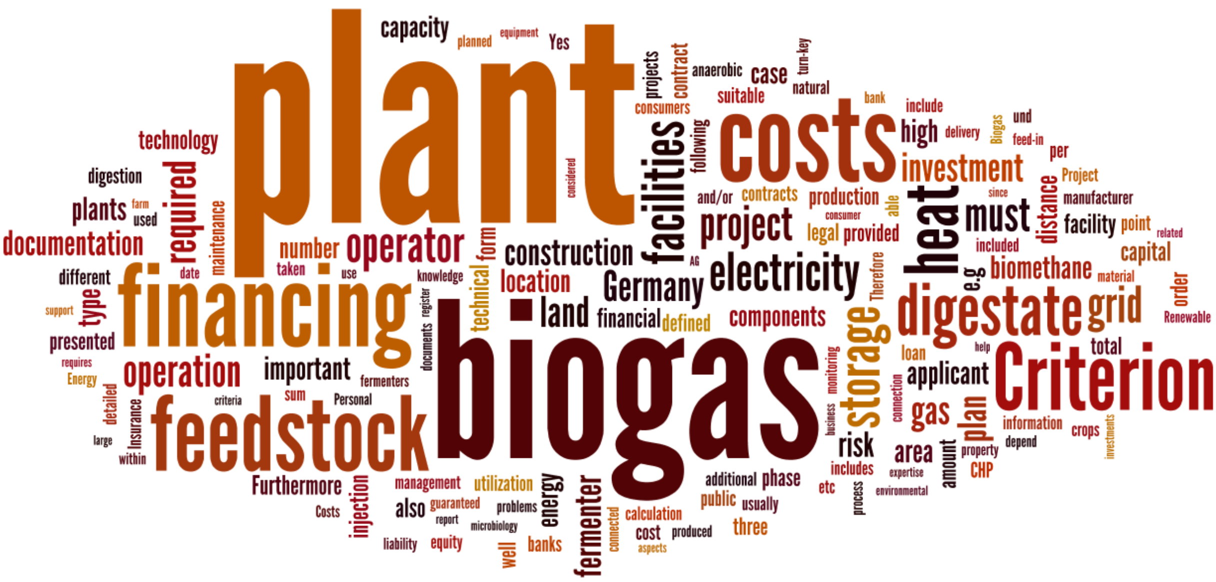
Supported by INTELLIGENT ENERGY EUROPE

The sole responsibility for the content of this publication lies with the authors. It does not necessarily reflect the opinion of the European Union. Neither the EACI nor the European Commission are responsible for any use that may be made of the information contained therein.

Preface

The BiogasIN project "Development of sustainable biogas markets in Central and Eastern Europe" (Contract No. IEE/09/848) is supported by the European Commission in the "Intelligent Energy for Europe" Programme. The objective of BiogasIN is to effectively improve the framework conditions for the installation of new biogas plants in 7 Eastern European countries: Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania and Slovenia.

BiogasIN consists of 10 European partner organisations. The project is coordinated by the Croatian Energy Institute "Hrvoje Pozar". This report was prepared by WIP Renewable Energies, Germany.



Created by Wordle

1. Introduction

For banks, credits (loans) are related to specific financial risks. However, banks earn a significant part of their money by interest rates from credits. Therefore, the aim of banks is to minimize potential risks while offering an interest rate which is competitive to other institutes. There are engagements with traditionally low risks for banks and others with an increased probability of default. The risk of investments in renewable energy projects depends on the technology. For example, revenues from investments in photovoltaic (PV) systems are very predictable if a fixed feed-in tariff is guaranteed, as it is the case for instance in Germany. For these investments, the risk is relatively low.

In contrast to PV, the risk of investment in biogas plants is higher, due to e.g. the complexity of the microbiology in the fermenters and fluctuating feedstock prices. Furthermore, in countries where biogas market is in its developing phase, banks do not have knowledge about biogas technologies and projects which is reflected in difficulties when evaluating loan requests. Such a bank has two options to position itself towards emerging biogas markets:

- passive option: not to finance biogas project
- proactive option: assess the market value and consider it as any other new business activity how to tailor the loans and other financing mechanisms

Without loans from banks, investors have difficulties to implement biogas projects, since considerable high initial investment costs apply. This creates a serious market barrier. Rising trust in biogas technology can contribute to reduce this barrier and facilitate banks to take the proactive option towards the emerging biogas market.

This report describes the most important aspects for the evaluation of biogas projects. This includes a list of criteria which assists to assess the risk and the feasibility of an investment in concrete biogas projects. The target groups of this report are financial institutions and investors of biogas projects.

The criteria include human, technical, financial, and organisational criteria as well as criteria related to legislation and permits. They are briefly described in each chapter and listed in a box. Thus, the investor or financing institution can easily use these criteria as a checklist for the assessment of the overall feasibility of biogas projects. Nevertheless, it has to be considered that the description of the entire proposed project is more important for the evaluation, than the consideration of specific single thresholds, limits or values. Therefore, the presented quantitative criteria shall be regarded as rules of a thumb. Deviations should be ground for additional questions and discussion and not as elimination criteria.

Another aspect is the national circumstances which can differ from one country to the other. This report is based on the vast experiences on biogas in Germany, the leading country in biogas development in Europe with more than 5,000 installed biogas plants. The average biogas plant in Germany is a co-digestion plant running with a mixture of energy crops, manure and wastes as feedstock and with average size between 200-500 kW_{el}.

An example for a loan request form is attached to this report in the Annex. It is based on several forms issued by German banks.

Typical agricultural biogas plant in Germany[1]

Agricultural biogas digester

Combined heat and power plant (CHP)

Municipal Solid Waste (MSW)

Solid feedstock storage facility
(corn silage, agricultural waste)

[1] all pictures by D. Rutz

2. The applicant

2.1. Expertise of staff

The project developer and future plant operator (could be the same person) play a significant role in the success of the biogas project. Thereby, the knowledge and experience with biogas projects is an important criterion and influences the financial risk for the loan provider, which is usually a bank. Biogas production is a complex issue and covers many different sectors. It requires knowledge on agriculture and/or on waste management for feedstock production, on microbiology to keep the anaerobic digestion processes stable, on plant technology, and on legal and economical issues. Furthermore, several management and handcraft skills are required. Ideally a plant operator's expertise includes knowledge and skills on all of these aspects. However, usually no plant operator will be able to provide all skills and competences, especially in countries with emerging biogas market. However, the more knowledge the operator can prove, the better are the chances for a successful implementation and operation of a biogas plant.

Companies from saturated biogas markets that want to enter new biogas markets have realised this lack of trained personnel and provide trainings at their facilities for the buyers of their equipment.

Therefore, a detailed description of expertise in the biogas sector (e.g. by participation in training courses, internships, etc.) should be provided. Furthermore, the motivation of the applicant for his/her involvement in a biogas plant has to be described. A trustworthy and experienced plant operator and a good management system minimize the risk of operation failures due to human incapacity.

Furthermore it has to be taken into account that implementation and operation of a biogas plant requires a considerable amount of person hours. Depending on the type and size of the biogas plant 0.5 – 5 working hours per day are needed for feedstock production, feeding of the biogas plant, maintenance and management (Steiner, 2009). During the construction phase and the first year of operation additional 2 h/day must be calculated (www.landundforst.de, 2009).

Criterion 1:	Expertise in the biogas sector (feedstock production, biology of the anaerobic digestion, plant technology, digestate utilization and economic background) must be proven by the applicant.
Criterion 2:	The concrete motivation for the implementation of the biogas plant has to be explained.
Criterion 3:	Sufficient amount of paid working capacity has to be available.

2.2. Plant monitoring

Due to the complex microbiological processes in a biogas plant, a stable and continuous operation is desired. Small changes in the microbiology can cause longer interruptions and thus high economic losses.

The investor has to decide on the feedstock mix and ensure its long term supply.

In order to guarantee a stable and continuous operation a sound monitoring plan has to be implemented. This includes monitoring of the feedstock-composition and microbiological processes in the fermenter, as well as technical maintenance and economic evaluation.

The designated plant operator has to ensure that he/she is able to monitor the correct **feedstock composition**, e.g. by testing its ingredients and solid matter content.

The stability of the **microbiology** of the anaerobic digestion process is determined by the following parameters and indicators (www.codigestion.com, 2010).

- The pH value should be within a range of 6.8 – 7.5
- The values of Volatile Fatty Acids (VFA) and of Undissociated Volatile Fatty Acids (UFA) must be kept in certain limits, depending on the feedstock and the fermentation bacteria.
- Too high values of Chemical Oxygen Demand (COD) indicate an insufficient rate of anaerobic digestion in the fermenter.
- The content of dry matter must stay within the limits for which the fermentation process is configured.
- A constant temperature with a maximal deviation of 1 K must be kept.
- The ammonium value in the fermenter must stay under certain limits, depending on the used digestion bacteria.

The plant operator should be able to assess the fermentation process with the help of these parameters and to implement suitable measures to avoid process failures. The assistance of professional expertise in continuous monitoring the microbiology by a specialized laboratory, especially during the start-up phase, is also recommended. For turn-key plants, this initial monitoring is often also included in the overall contract with the turn-key plant provider.

Furthermore, the plant operator shall be able to perform **technical maintenance** in case of minor technical problems. Technical support by the plant manufacturer is very expensive and time consuming and might lead to operation stop. However a maintenance contract with the plant manufacturer minimizes the risk of technical problems. Maintenance costs can generally be divided into costs for the CHP plant and costs for all other components of the plant. Costs for maintaining the CHP plant are about 0.3 – 2.5 €c/kWh$_{el}$. Maintenance costs for all other components of a biogas plant are about 1 – 3% of the total investment sum (Steiner, 2009).

Criterion 4:	Supervision of the microbiological processes in the fermenter has to be provided by the plant operator and/or his staff and/or by contracted specialised companies.
Criterion 5:	The plant operator and/or his staff shall prove skills to perform basic technical maintenance work.
Criterion 6:	Maintenance costs for the CHP plant of 0.3 – 2.5 €c/kWh$_{el}$ and 1 – 3% of the total investment sum for all other components have to be included in the business plan.

2.3. Decision on the legal form

The type of the legal form for the operation of a biogas plant has to be carefully chosen. The legal form depends on the number of participating persons, origin of the capital and the extent of personal liability. The following questions help to select a suitable legal form for a biogas project (Hattesohl, 2006).

- Are other persons supposed to participate in the revenues from the biogas plant?
- Is equity capital required to found the legal form?
- Does the investor also operate the biogas plant?
- Do permission procedures for the biogas plant require a special legal form?
- Which is the source of the equity capital?

To what extend does the investor want to be financially liable?

Criterion 7:	The legal form and the ownership of the biogas project must be well defined.

3. Detail of the projected plant

In a detailed risk analysis, plant components, feedstock, capacity of the plant, and utilization of the outputs (heat and electricity) play a crucial role. Furthermore, the location of the plant is important to guarantee the economic success of the plant.

3.1. Technical details of the plant

Part of the application form for loans should be a detailed plan of the plant and a list of all components.

In general, it has to be differentiated between turn-key facilities and facilities composed of equipment from different suppliers. A turn-key facility usually represents a lower financial risk than a facility composed of equipment from different suppliers. This is due to the fact that in case of problems occurring during the construction phase (e.g. delay, defect components, financial problems on the manufacturer's side), a single component provider or constructor is easier to address with claims. On the other hand, a facility composed of items from different suppliers may reduce costs and increase internal labour by the plant operator, but requires also more knowledge on biogas production process.

A well planned biogas plant includes the detailed documentation of the needed infrastructure, fermenters and storage facilities (number, capacity, location, technology), stirring technology and the unit for biogas use (usually a combined heat and power plant). With the help of these specifications, it is possible to calculate the required feedstock and the output of electricity and heat, which represents the basis for a cost and financing plan.

The evaluation of this information requires a high level of expertise on biogas plants. The compatibility of single components and the suitability of the plant capacity in relation to the available feedstock have to be checked. In order to evaluate these issues, it is recommended for the bank to employ a designated biogas expert or to contract a dedicated biogas expert. It is also highly recommended to compare the proposed biogas plant with similar facilities in order to verify the calculation of plant capacity and feedstock supply.

Criterion 8:	A list of plant components and material has to be provided.
Criterion 9:	A construction plan must be presented.

3.2. Location

The location of the plant has a large influence on the costs of its construction and operation, since it affects the management of feedstock and digestate, electricity and heat sale, as well as since it is related to social and environmental aspects. Before starting with loan negotiations, the location has to be defined. Exact information on the property (plot number, owner, etc.) has to be included in the loan application form.

The location affects the costs of the project in several ways. Existing infrastructure is important to ensure access to public streets, and to the electricity and natural gas grids. Building of paved roads, power lines, or gas tubes raises costs and can cause problems if other properties need to be crossed. Usually this infrastructure is guaranteed if the biogas plant is located near existing farms. However, also the vicinity of neighbours has to be considered in order to avoid conflicts regarding noise, odour, dirt, and aesthetic aspects.

A suitable point for electricity feed-in to the grid has to be defined. A (draft) contract with the grid operator and/or utility which guarantees to buy the electricity for the complete duration of the loan period has to be provided previously to the loan negotiations. This contract is very important as it represents the main security for the bank and the investor. Contracts for electricity purchase are often characterized by high complexity. In particular it has to be clarified, which party is responsible for the costs of constructing new current lines and the feed-in point. As an example, the German Renewable Energy Sources Act (Erneuerbare Energien Gesetz, EEG) clearly defines these responsibilities. A plant operator in Germany has to build all infrastructures needed to transport the electricity produced by his plant to the electricity grid feed-in point. The grid operator has to pay for the final connection of the current line to the grid and to assure a suitable capacity of the grid.

For economic and environmental reasons, heat from CHP plants shall not be "wasted", as it happened in Germany some time ago (in Germany often only the electricity was used and the heat was wasted; this changed with the latest amendment of the Renewable Energy Act). For the use of heat, similar considerations as for the electricity utilization have to be made. Contracts with heat consumers and connection to district heating grids or other heat consumers shall be presented. Costs for installing heat pipes mainly depend on the distance between the biogas plant and the heat consumer. Two categories of heat utilization can be distinguished (Messner, 2007).

1. Own consumption / micro-heat-grid: The heat is used by the connected farm, living house or stable. The maximal range of the heat conduction is within 250 meters and needs investment costs of about 100 €/m (in Germany).
2. District heating: The heat consumer is located within a range of 1.5 kilometres. Therefore two tubes are required (feed line and return line). Thus construction costs rise up to about 200 €/m (in Germany).

An alternative for the use of biogas is to upgrade it to natural gas quality (≥ 98% methane content in the gas mixture) and inject the so called "biomethane" into the natural gas grid. This process poses some challenges, especially due to the much higher investment costs. Investment costs of more than 300,000 € for a 1 MW plant must be calculated in addition to the anaerobic digestion components of the facility. This technique is currently only cost-effective among large scale plants (in Germany) producing at least 500 m^3 biogas per hour (1 MW) (Messner, 2007). On the other hand costs for the CHP plant are reduced, although not completely eliminated since usually a CHP plant is operated in parallel to maintain the fermenter temperature. The purified and upgraded biomethane has then to be transported to the natural gas grid injection point. This injection point shall be close to the plant. It has to be considered that not every point of the gas grid is suitable for biomethane injection. The public gas grid in Germany is separated into three pressure stages. Stage three is has the lowest pressure and is connected to the consumers. Therefore it is subject to heavy pressure fluctuation. Due to this fact it is usually inappropriate for injection since the gas compressor only operates with constant pressure. It is therefore advisable to inject the biomethane into the stage two (Theissing, 2006).

Finally, the biomethane has to be transported to the natural gas grid. If the grid is too far away, the costs will increase drastically. Thus, the choice of the location of the biogas plant is also important.

Criterion 10:	The plant site has to be connected to a public street, suitable for heavy machinery (feedstock and digestate logistics).
Criterion 11:	The electricity feed-in point has to be clearly defined.
Criterion 12:	The biomethane injection point (optionally) in the public gas grid has to be clearly defined.
Criterion 13:	Heat consumers have to be identified and draft agreements/contracts provided.
Criterion 14:	Contracts with electricity and/or biomethane and/or heat consumers (ideally for the entire duration of the loan) shall be provided.

3.3. Storage facilities and fermenters

Feedstock supply is usually (in the case of energy crops) very seasonal and therefore has to be stored for a long period. Sufficient storage facilities are required, corresponding to the capacity of the plant. Storage facilities for energy crops have to protect the feedstock from rain and other environmental influences in order to avoid mould and environmental pollution. Storage facilities for manure and waste materials should be stored in airtight facilities in order to reduce odour emissions. There are several different types of feedstock storage facilities, depending on the type of feedstock. These facilities can be concrete or steel tanks or different types of silos.

The centrepiece of each biogas plant is the fermenter, the facility in which the anaerobic digestion process takes place. The fermenter is an air proof reactor tank, where the decomposition of feedstock takes place, in absence of oxygen, and where biogas is produced. Common characteristics of all digesters, apart from being air proof, are that they have a system of feedstock feed-in as well as systems of biogas and digestate output. In European climates anaerobic digesters have to be insulated and heated (Al Seadi et al., 2008).

There are various types of biogas digesters, operating in Europe and around the world. Digesters can be made of concrete, steel, brick or plastic, shaped like silos, troughs, basins or ponds, and they may be placed underground or on the surface. The size of digesters determines the scale of biogas plants and varies from few cubic meters in the case of small household installations to several thousands of cubic meters, like in the case of large commercial plants, often with several digesters (Al Seadi et al., 2008).

The design of a biogas plant and the type of digestion are determined by the dry matter content of the digested substrate. As mentioned before, AD operates with two basic digestion systems: wet digestion, when the average dry matter content (DM) of the substrate is lower than 15% and dry digestion, when the DM content of the substrate is above this value, usually between 20-40%. These definitions and their limit values have some regional variations or they can be differentiated by legislation and support schemes, like e.g. in Germany (Al Seadi et al., 2008).

Wet digestion involves feedstock like manure and sewage sludge, while dry digestion is applied to biogas production from solid animal manure, with high straw content, household waste and solid municipal biowaste, green cuttings and grass from landscape maintenance or energy crops (fresh or ensiled). Both dry and wet digesters are described in the next subchapters, with emphasis on wet digestion systems (Al Seadi et al., 2008).

Depending on the capacity of the facility and the feedstock type, more than one fermenter may be needed. In relation to the feedstock input and output, there are two basic approaches which influence the design of the fermenter: batch or continuous operation. Most biogas plants today are operated by continuous streams. There exist several approaches on how to arrange the fermenters for continuous operation: in parallel, in series, or combined parallel and series.

In general, the digester size depends on the retention time of the feedstock and ranges between 10 to 80 days. The longer the retention time, the larger the digesters have to be. A longer retention time increases biogas yields, but increases also costs for construction.

Typical sizes of biogas plants in Europe are in the range of 300 kW_{el}. A biogas plant exceeding 1 MW_{el} requires a considerably high amount of feedstock and should only be considered if feedstock and digestate logistics can be handled.

After the anaerobic digestion, the digestate has to be stored. The immediate use or further processing of the digestate is not always possible. For example digestate may not be spread as fertilizer during winter and depends on the fertilizer needs of the crops. Ideally, storage facilities for digestate are covered with a gas-proof foil to collect the biogas from the lower, but still ongoing anaerobic digestion in the digestate tank. The additional biogas yield during storage can increase the total biogas yield of the plant up to 20%. Furthermore, unpleasant odour emissions and harmful greenhouse gas emissions (methane) are reduced. Digestate storage facilities should be designed for storing the accumulated digestate produced by the biogas plant for half a year (Fachagentur Nachwachsende Rohstoffe e.V., 2006).

The area required for the construction of the fermenters and storage facilities depends on the feedstock and the capacity of the plant. It is important to evaluate the required area in an early planning phase as the fermenters and the storage facilities require the largest area of a biogas plant. A minimum of 2,500 m^2 building area is needed for a medium sized biogas plant (250 m^3/h) (www.biogas-netzeinspeisung.at, 2006).

Generally, biogas plants have to be built on suitable and embattled ground. Ground water protection has to be ensured.

Criterion 15:	Design of feedstock storage facilities (number, type) suitable for the used feedstock has to be presented.
Criterion 16:	Fermenters have to be suitable for the type and amount of feedstock and technically well planned (insulation, stirring, input/output, material, etc.).
Criterion 17:	Digestate storage facilities should be covered in order to catch the remaining biogas emitted from the digestate.
Criterion 18:	All storage facilities must prevent environmental pollution (odours, leakage).
Criterion 19:	Digestate storage facilities should be designed for storing the accumulated digestate for at least half a year.
Criterion 20:	The exact location of the fermenters and storage facilities on the plot has to be presented. The building area required for the whole biogas plant site must be sufficient.

3.4. Feedstock and digestate

The location of the projected biogas plant largely depends on the feedstock availability. Suitable feedstock quality and amount is of major importance for efficient operation of the biogas plant. An overview on feedstock sources needs to be presented, and may include available arable land for energy crop production, number of livestock and breeding practices, availability of wastes, etc.

It is very important to be aware of the particular biogas yields, dry matter and volume consumed by the projected feedstock in order to calculated digester volume and storage facilities. Table 1 illustrates some of the most typical sources of feedstock and the corresponding key values.

Surveys from the Bavarian Regional Office for Agriculture (Röhling & Wild, 2008) among Bavarian (Germany) biogas plant operators showed that a minimum of 0.4 ha land is required to provide feedstock for 1 kW_{el} output by a biogas plant running mainly on energy crops. This value can only be achieved with a high proportion of corn silage. It has to be considered that only 40% of the overall energy content of the raw material can be converted into electric energy. A major part is converted into heat.

In case of using energy crops, at least half of the required feedstock should be produced by the biogas operator himself in order to avoid high additional costs caused by feedstock bought from other farmers. Additional supply shall be guaranteed by long term feedstock delivery contracts (of more than 5 years). Furthermore, the distance between the fields for energy crop cultivation and the biogas plant has a large impact on the plant economy. In Germany, the transport of each m^3 of biomass costs about 2 – 2.9 € per kilometer (Theissing, 2006). The average distance of feedstock transport needs to be assessed. It is recommended to cultivate the required energy crops within a radius of 10 km around the plant (Epp et al., 2008), while the liquid manure source should be within a 3 km radius from the biogas plant. Waste materials may be transported longer distances.

Table 1: Most typical feedstock and corresponding biogas yields (Source: www.lfl.bayern.de)[2]

Feedstock	DM (%)	oDM (%)	Nm^3/t FM	CH_4 (%)
Feeder Cattle slurry	10	85	34	55
Pig slurry	6	85	20	60
Cattle manure	25	80	90	55
Pig manure	23	83	74	60
Poultry manure	15	75	56	65
Sweet sorghum	21	92	107	52
Sudan grass silage	22	90	98	53
Rye silage	25	88	130	54
Grass silage	40	89	200	55
Maize silage	33	96	185	52

The best way of utilizing the digestate is the use as fertilizer on agricultural land, however, only a limited amount of digestate can be applied per hectare. Experience shows that often 140% of the agricultural area used for energy crop production is needed for digestate spreading. Ideally, all digestate shall be spread on own fields, if this is not possible, other consumers have to be found. The farmer has to consider the high amount of nitrate in the digestate. Critical values defined by the EU Nitrate Directive must not exceed. An option would be also to include a liquid-solid separation and to sell the solids as high quality compost. However, this adds costs for the liquid-solid separator.

[2] DM: Dry Matter – Dried organic material and thus not containing any water
oDM: organic Dry Matter – Organic fraction of the Dry Matter
Nm3/t FM: Normal m3/t Fresh Matter – Volume consumed by 1 t of fresh feedstock
CH4: Methane

Criterion 21:	For plants running with energy crops, at least 50% of energy crops should be produced on own land. Other feedstock supply must be guaranteed by long term contracts with suppliers.
Criterion 22:	If Energy crops are used, they should be produced within a radius of 10 km around the plant. Liquid manure should be provided within a radius of 3 km from the plant. Also waste material shall not be transported for long distances.
Criterion 23:	Enough land for spreading digestate has to be available; otherwise digestate has to be sold. Costs for digestate sale/disposal have to be included in the cost calculation.
Criterion 24:	The use/sale of digestate spread must be presented in conformity with the EU Nitrate Directive.

3.5. Insurance

Even if all technical and non-technical issues are optimised, there is always a risk of unforeseeable problems and accidents. Therefore, insurances are needed to reduce the financial risks. The most important insurances are related to physical damage of the equipment, machinery failure, construction phase, fire, interruption of plant operation, and liability.

Criterion 25:	Insurance for physical damage and machinery failure shall be taken out.
Criterion 26:	Insurance for fire damages and accidents shall be taken out.
Criterion 27:	Insurance for the interruption of the plant operation shall be taken out.
Criterion 28:	A general liability insurance shall be taken out.
Criterion 29:	A construction work insurance covering damage to the plant during the construction phase shall be taken out.

4. Cost calculation and financing plan

All above mentioned issues need to be considered in a detailed and reliable cost calculation and financing plan. The cost calculation must include all investment costs, costs for operation and maintenance as well as costs for financing.

Large parts of the investment costs include costs for the fermenter and for the CHP plant. Additional costs have to be allocated to storage silos for feedstock, electricity- and/or gas grid connection, property, earth works, other technical equipment and infrastructure. With a ratio of 25 – 35% of the total costs of the project, these additional costs represent a considerable amount of the entire investment sum (www.landundforst.de, 2009). The initial investment for a 250 to 500 kW_{el} biogas plant ranges from 3,000 to 4,000 €/kW.

In summary, the following issues shall be considered:

- Planning: Costs for planning the biogas plant can generally be estimated 10% of the total investment.
- CHP plant: Costs for the combined heat and power plant can be usually exactly included as it is sold as a turn key complex. 20% of the total investment sum can be assumed (Steiner, 2009).
- Fermenter: Costs for the fermenter can be also a turn key component, but can be constructed individually as well (e.g. if the fermenter was a former manure storage facility). It can reach 40 – 50% of the total investment sum (Steiner, 2009)
- Stirring technology: Stirrers highly depend on the used feedstock. Thus, costs depend on the feedstock and fermenter design.
- Electronic components.
- Feedstock and digestate storage facilities: Costs depend on the type of feedstock and on the fermenter capacity. The digestate storage capacity depends on the digestate output and on the storage time, which is often predetermined by legislation.
- Liquidity reserve: To include a liquidity reserve of 5% of the initial investment costs is recommended in order to pay costs which were not foreseen e.g. during the construction phase (www.landundforst.de, 2009).
- Financing costs: These costs depend on the type of capital (equity or debt capital) and on the interest rates.
- Operation costs: This includes costs for feedstock (long-term contracts with fixed prices shall be made with feedstock providers), costs of utilising the digestate and costs for operation and maintenance.
- Other costs: Any other costs related to the construction, operation, and maintenance must be included.

All costs of the project and the foreseen income shall be included in a financing plan, which shall be based on realistic and conservative assumptions. Most plants will be financed with a large amount of debt capital. The ratio between equity and borrowed capital should be at least 0.25 (Krauth & Sametinger, 2007). In order to get debt capital, the amount of equity shall be proven. Furthermore, any private or public investment support shall be included.

Criterion 30:	A detailed cost calculation and financing plan which is based on realistic and conservative assumptions must be presented.

5. Required documentation

Summarizing, this chapter gives an overview of documents, the bank should ask from the applicant in order to be able to better evaluate the reliability of the project and to minimize the financial risk. This list includes the most important documents the applicant should prepare before starting credit negotiations.

5.1. Personal and company documentation

As mentioned earlier, the designated operator of the biogas plant has high influence on the economy of the project. The following documents help assessing the reliability of the applicant (Umweltbank AG).

- Personal information of the applicant or operator (including proof for biogas expertise)
- Tabular CV
- Last three income tax returns
- Last three payslips or last three annual balance sheets
- Legal documents for the biogas company (if applicable)

Criterion 31:	Personal documentation shall be provided. If applicable, also legal documents of the biogas company shall be provided.

5.2. Project documentation

Documentation on the planned biogas project (plant site, technical details, insurances, contracts) is an important prerequisite to create planning security for both, the plant operator and the financial institutes. The following documents contribute to a good assessment of the project (Umweltbank AG).

- Land register map (including plot identification and subscription of the plant)
- Recent certificate of title of plant location
- Leasing contract (in case the applicant is not the land owner)
- Insurance offers (machinery breakage, business interruption, public liability)
- Details of the cost – and financing plan
- Offers for all relevant parts of the plant
- Contract of heat delivery and heat quantity (in case of heat utilization)
- Economic efficiency calculation
- Commitment of grid access by electricity distributor
- Building permission and any other permission required to operate the plant
- Feedstock supply contracts
- Contracts for the sale of digestate

Criterion 32: Project documentation shall be provided.

6. Conclusion

When planned properly an engagement in a biogas plant is a secure investment. Biogas production and utilization is a mature technology and the market includes a high number of reliable and experienced component manufacturers and companies for turn-key plants, especially in countries with large biogas markets, such as in Germany or Austria. Either guaranteed feed-in tariffs or long term contracts with large energy utilities or private energy consumers for the sale of electricity creates a high level of planning reliability and security for the operator's income.

Nevertheless detailed analysis of the whole project is essential to minimize financial risk. Depending on the type of financing, the investor has to provide sufficient securities, such as real estate, in case the project fails. For project financing, additional securities are not so important, since the biogas plant itself is regarded as suitable security.

Literature

Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R. (2008) Biogas Handbook. – University of Southern Denmark Esbjerg; ISBN 978-87-992962-0-0

Epp, C., Rutz, D., Köttner, M., Finsterwalder, T., WIP Renewable Energies, Project BIG>East, Guidelines for Selecting Suitable Sites for Biogas Plants, April 2008

Fachagentur Nachwachsende Rohstoffe e.V., Handreichung Biogasgewinnung und –nutzung, Gülzow, 2006

Hattesohl, C., Blanke Meier Evers Rechtanwälte, Errichtung und Betrieb von Biogasanlagen im landwirtschaftlichen Bereich, 2006

Krauth, V. and Sametinger, K.: VORSEO, Energy 4 Cohesion – Internal Strategy Paper for Innovative Financial Schemes in the Framework of EC Cohesion, May 2007

Messner, J., Staatliche Biogasberatung, Wärmenutzung in landwirtschaftlichen Biogasanlagen, 2007

Röhling, I. and Wild, G., Bayerische Landesanstalt für Landwirtschaft, Biogasproduktion in Bayern 2007, October 2008

Steiner, B., BBV-Unternehmerberatung, Biogas Chancen, Risiken und Probleme, February 2009

Theissing, M., Bundesministerium für Verkehr, Innovation und Technologie, Biogas Einspeisung und Systemintegration in bestehende Gasnetze, Wien, January 2006

Umweltbank AG, Biogas – Finanzierung Kreditanfrage

www.biogas-netzeinspeisung.at/planungstipps-checklisten/beurteilung-ausschlusskriterien.html, October 2006

www.codigestion.com/index.php?id=411&L=1, February 2010

www.landundforst.de/?redid=322189, November 2009

www.lfl.bayern.de/ilb/technik/10225/?strsearch=destillierer&pos=middle&button=Suchen

Annex

Example for a Credit Request Form

This form is based on the request forms and guidelines of the following German institutions: Umweltbank AG, C.A.R.M.E.N., Finanzierungs- und Mobilien Leasing AG (FML) and enbion GmbH

Prepared by

Erik Ferber and Dominik Rutz

WIP – Renewable Energies

Sylvensteinstr. 2

81369 Munich, Germany

With the support of the BiogasIN Project (Contract No. IEE/09/848/SI2.558364)

1. Applicant

Full name	
Street, postal code, city	
Telephone	Fax
Cell phone	eMail - Address

Profession: o Farmer o Employee o Self-employee o Other: ____________________

The operation and technical controlling of the plant is supervised by the following person:

Name	Relation to plant operator (e. g. son, long-time employee, etc.)	Expertise in the field of biogas (e. g. by training, internship, etc.)

Please name your motivation for constructing of a biogas plant: Which changes in your business do you expect?

2. Projected biogas plant

Type of installation:

Utilisation of heat: o no
o yes

consumer of heat	kWh/a

Operation of the biogas plant:

o The biogas plant is legally connected to the farm
o The biogas plant is not legally connected to the farm and without liability of the farm

Is the location of the biomethane injection into the natural gas grid already defined? o No o Yes

Is the location of the electricity connection already defined? o No o Yes

Do the contracts for electricity connection and biomethane injection include grid safety management? o No o Yes

Did a grid compatibility check for electricity and biomethane find place? o No o Yes

Does electricity connection or biomethane injection require crossing a third parties property? o No o Yes

Does the biogas plant operate on own property? o No o Yes

Technical details:

o Purchase of a turn-key facility provided by the manufacturer: ______________________________________

o Purchase of a facility composed of equipment from different suppliers. Name of planner of the overall concept:

Construction management is done by: o applicant o planner o ___________________________

Fermenters and storage facilities:

	number	manufacturer	design (e.g. concrete, steel etc.)	capacity per unit [m^3]	already existing
manure/waste storage					o
silo for feedstock					o
main fermenter					o
secondary fermenter					o
digestate storage					o

Stirring technology:

number of stirrers	type of stirrers	manufacturer

Combined heat and power plants:

number	manufacturer	kW_{el} per unit	guaranteed efficiency	design
				o gas engine o pilot injection engine
				o gas engine o pilot injection engine

Microbiology:

Biological control o by plant operator o with support of manufacturer

o laboratory contract with ____

Location:

exact address (street, postal code, city) as well as plot number

land owner (Name, Address)

entries in the land register of the plant location (e.g. land charge, right of way, ect.)

Existing buildings:
o No o Yes: ____

Access to public streets:
o No o yes

Is the biogas plant to be built o in a settlement area or o in a rural area (no settlement area)?

distance to mean voltage cable	distance to heat consumer I (e.g. own stable, living house)	distance to heat consumer II (e.g. neighbourhood)
m	m	m

distance to connected farm	distance to closest living area	distance to closest hydrant or the like
m	m	m

distance to closest landscape conservation area	distance to closest water conservation area
m	m

<u>Available agricultural land and number of animals of the applicant:</u>

	total area (ha)	percentage of own property	percentage of leased property
arable land			
grassland			
land available for energy crops			

	species	number	type of animal breeding
animals			

Do you plan to skip animal breeding in the near future? o No o Yes, when? ____________________

<u>Feedstock:</u>

type	supplier	available amount/year (t)	price/t in Euro	cost per year

3. Cost and financing plan

Cost for

planning	€
CHP plant	€
fermenter	€
stirring technology	€
electronic components	€
liquidity reserve	€
other	€
=sum of costs	**€**

Financed by

equity capital	€
incentives, support	€
own resources	€
other loans	€
=sum of financing	**€**

<u>Explanation of cost and financing plan:</u>

1) Other costs

other costs caused by	costs in Euro
- interst rate during construction phase	
- charges, additional costs	
- costs of first substrate charge	
-	
-	
-	
-	
-	

2) Origin of equity capital

3) Incentives

incentive donors	submission date	date of approval
-	-	-
-	-	-

4) Own labour contribution

type of labour	value in Euro
-	
-	
-	

5) Other loans

loan provider	interest rate	planned payback date

Construction timetable:

starting date of the construction	finalisation date of the construction

4. Required documentation

For the credit application copies of the following documents are required. Please provide additional information if necessary.

Type of documents:

Personal documentation in case of natural person / companies constituted under civil law	**is attached**	**submission date**
Confidential personal information according to the forms (each shareholder)	o	____________
Last three income tax returns (each shareholder)	o	____________
Last three payslips (each shareholder) or last three annual balance sheets	o	____________
Tabular CV (in case of civil law association: only executive director)	o	____________
Company contract	o	____________

Personal documentation in case of legal person (private limited partnership, limited company, corporation, ect.)		
Last three balance sheets as well as recent business analysis	o	____________
Tabular CV of the executive director	o	____________
Confidential personal information of the executive director	o	____________
Abstract of the commercial register	o	____________

Project documentation		
Land register map (including plot identification and subscription of the plant)	o	____________
Recent abstract of register of real estate of plant location	o	____________
Leasing contract (in case the applicant is not the land owner)	o	____________
Insurance offer (e.g. machinery breakage, business interruption, public liability)	o	____________
Details of the cost – and financing plan	o	____________
Offers for all relevant parts of the plant	o	____________
Contract of heat delivery and heat quantity (in case of heat utilization)	o	____________
Economic efficiency calculation	o	____________
Commitment of grid access by electricity distributor	o	____________
Building permission and other permissions required to build and operate the plant	o	____________
Substrate delivery – and contracts for sale of digestate	o	____________