Economic Viability of Biogas Plant in Livno, Bosnia and Herzegovina

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
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11 November 2010, Livno

Affidavit

I, **ZDRAVKO MARKOV**, hereby declare

1. that I am the sole author of the present Master Thesis, "ECONOMIC VIABILITY OF BIOGAS PLANT IN LIVNO, BOSNIA AND HERZEGOVINA", 72 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
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Vienna, _____ _____

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Abstract

The aim of this project was to examine feasibility of the biogas production in Bosnia and Herzegovina. Big>East Economic Model was used to asses the potential gas, heat, and electricity production. The project's economic viability was checked over 15 year period. The underlying assumptions, licensing procedure, and legal framework are explained. The production and use of biogas from anaerobic co-digestion of 20.000 t/year of manure, maize, and grass and cogeneration of heat and electricity from the produced biogas would provide Net Present Value (NPV) of 871.236 €. The results show that exploiting the internal value chain of biogas can provide the environmental and socio-economic benefits not only for the investor and involved farmers, but also for the society as a whole.

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AD	Anaerobic Digestion
CHP	Combined Heat and Power
REN	renewable energy
kg	kilogram
kW	kilowatt (power unit; electric, thermal)
kWh	kilowatt-hour (energy unit)
m^3	cubic meter
h	hour
y	year
CO_2	carbon dioxide
t	ton
TS	Total Solids
NPV	Net Present Value
IRR	Internal Rate of Return
EBT	Earnings Before Tax
BiH	Bosnia and Herzegovina

1. Introduction

Animal waste products and „energy crops" can be used to obtain biogas. The biogas production can be one of possible alternatives how to diversify agricultural production and how to improve economy of an agricultural company. The energy obtained from biogas, either as heat or as electric power, can be used by the company to improve its own energy balance, and the excess can be sold to further buyers. Growing plants for biogas production and processing animal waste combined with operating a biogas plant makes biogas economically attractive for farmers not only as additional income, but also as new important social role—energy producers and waste processors.

Biogas is a flexible energy source suitable for different needs. In many European countries, biogas is used as fuel for cogeneration of heat and electricity. When purified, biogas may be injected in the network of natural gas, or it can be compressed and used as a vehicle fuel since it can be pumped and stored. Typical composition of biogas is shown in Table 1.

Table 1. Typical composition of biogas[1]

Matter	**%**
Methane, CH_4	50–75
Carbon dioxide, CO_2	25–50
Nitrogen, N_2	0–10
Hydrogen, H_2	0–1
Hydrogen sulfide, H_2S	0–3
Oxygen, O_2	0–2

[1] Retrieved 15.03.10. http://en.wikipedia.org/wiki/Anaerobic_digestion

Besides energy, plant for biogas production also produces so called digestate. The digestate is biomass remaining after anaerobic decomposition of organic matter, and it is a valuable fertilizer rich in nitrogen, phosphorus, potassium, and micro-nutrients. Compared with fresh manure, biogas digestate has better fertilizing properties due to the homogeneity and higher nutritive value, better ratio of carbon and nitrogen, and almost complete absence of smell[2]. Figure 1 shows vehicle for direct application of digestate as fertilizer.

Figure 1. Vehicle for direct application of digestate as fertilizer

According to Directive 2003/30/EC, Article 2, biogas is defined as a fuel gas produced from biomass and/or from the biodegradable fraction of waste, that can be purified to natural gas quality, to be used as biofuel, or woodgas[3]. Buy burning 1 m^3 of biogas in co-generation unit, it is possible to produce 2,3 kWh of electric and 2,8 kWh of heat power[4].

Production and use of biogas from anaerobic digestion (AD) has a positive effect on environmental and socio-economic benefits not only for the involved farmers, but also for society as a whole. Exploiting the internal value chain of biogas can improve local economic conditions, provide jobs in rural areas, and increase purchasing power in the region and therefore help in improving living standards and contribute to economic and social development.

[2] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)
[3] Official Journal of the European Union, DIRECTIVE 2003/30/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 8 May 2003 on the promotion of the use of biofuels or other renewable fuels for transport, Retrieved 20.03.10, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2003:123:0042:0046:EN:PDF
[4] Retrieved 15.03.10, http://zorg-biogas.com/biogas-plants

2. Anaerobic digestion

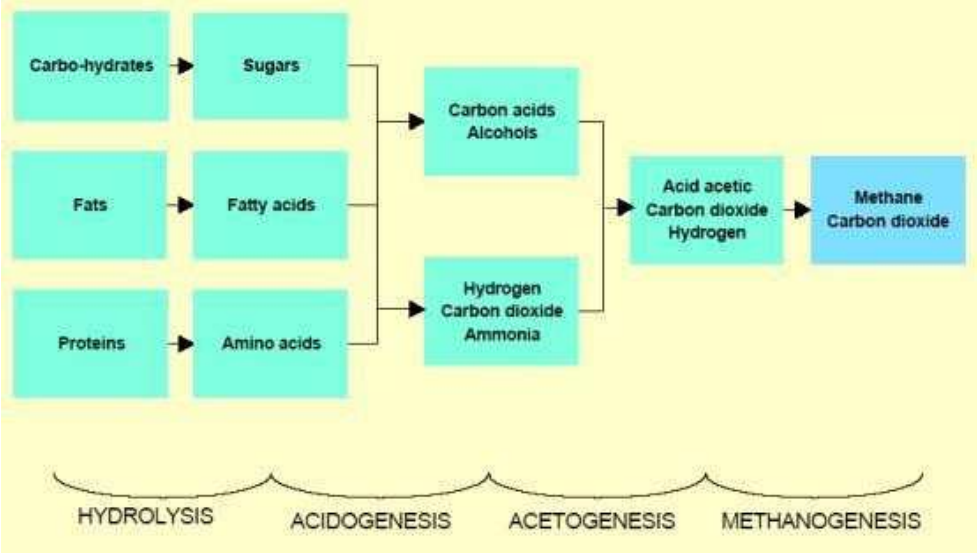
Anaerobic digestion (AD) is a biochemical process in which complex organic compounds are decomposed by the activity of different bacteria without the presence of oxygen. It is a natural process that happens every day—for example in marine sediments, in the digestion of ruminants, or in peat creation. In case of biogas plants, the main results of AD process are gaseous product and digestate. The gaseous product is called biogas and is composed of approximately 60% of methane and 35% of carbon dioxide, and also hydrogen sulfide, ammonia, water vapor and nitrogen at low concentration[5]. Digestate is the rest of the processed substrates formed during biogas production.

If the AD process uses a homogeneous mixture of two or more different substrates, such as slurry and organic waste from food industries, the procedure is called co-digestion, and co-digestion is the most common way of producing biogas[6].

During the AD biogas production, very little heat is created as compared to aerobic decomposition or composting. The energy stored in the substrate's chemical ties is released as methane. Process of the formation of biogas is the result of a series of related processing steps during which the initial substrate is decomposed into simpler compounds until occurrence of biogas. As shown in Figure 2, there are four main phases in process of biogas: hydrolysis, acidogenesis, acetogenesis and methanogenesis.[7]

[5] Grelaud T.,(2007). Economic viability and environmental benefits of anaerobic digestion of farm-animal waste in France
[6] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)
[7] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)

Figure 2. Main phases in biogas process[8]



The digestion process begins with bacterial hydrolysis of the input materials in order to break down insoluble organic polymers such as carbohydrates and make them available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. Acetogenic bacteria then convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide[9].

Different types of biomass can be used as substrate for the AD production of biogas. Most commonly used substrates are following categories:

- manure and slurry,
- residues and by-products from agricultural production,
- degradable organic waste form agricultural and food products (residues plant and animal origin),
- organic part of municipal waste and waste from catering (the remains of plant and animal origin),
- waste sludge, and
- energy crops (maize, sorghum, various types of grass, clover)[10].

[8] Teodorita Al Seadi 2003 - University of Southern Denmark
[9] Anaerobic digestion reference sheet, waste.nl. Retrieved 25.03.10, http://en.wikipedia.org/wiki/Anaerobic_digestion
[10] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)

There are several benefits resulting from the use of AD technology:

- Provides natural waste treatment process,
- Requires less land than aerobic composting,
- Reduces waste volume and weight to be disposed on landfill,
- Reduces greenhouse gas emissions,
- Eliminates odors,
- Produces nutrient reach fertilizer,
- Provides energy,
- Generates high quality renewable fuels,
- Produces biogas that can be used in many applications, and
- Considering the whole life cycle, it is more cost-effective than other treatment options[11] .

2.1. Anaerobic digestion of animal waste

The treatment of animal waste through anaerobic digestion offers several advantages over other available treatments, particularly: potential reduction of pollutant and odors emissions, energy production, better fertilizing value of the manure and reduction of pathogens[12]. The technology is quite common in many European countries as well as in the North America. However, in Bosnia and Herzegovina, there are no farms digesters currently in operation.

Animal waste is available in very large quantities all over the world, and as such, it is a very interesting feedstock for anaerobic digestion. Furthermore, manure can still be used for other purposes such as fertilizing because the most of the nutrients contained in the manure stay in the digestate, which is an excellent fertilizer. Finally, the use of animal waste for biogas production purposes can help in solving some main manure management problems such as odors, air pollution, groundwater pollution, and soil pollution.

[11] IEA Bionergy, Biogas Production and Utilization, Retrieved 15.03.10 , http://www.iea-biogas.net/Dokumente/Brochure%20final.pdf

[12] Grelaud T.,(2007). Economic viability and environmental benefits of anaerobic digestion of farm-animal waste in France

2.2. Anaerobic digestion of energy crops

Another very interesting feedstock for anaerobic digestion is energy crops. An energy crop is a plant grown as a low cost and low maintenance harvest used to make biofuels, or directly exploited for its energy content. If carbohydrate content is desired for the production of biogas, whole-crops such as maize, Sudan grass, millet, white sweet clover and many others, can be made into silage and then converted into biogas[13]. Energy crops allow a growth of agriculture through increased demand of locally grown feedstock. Furthermore, the cultivation of energy crops promotes rural investments and creates new jobs[14].

3. Co-digestion

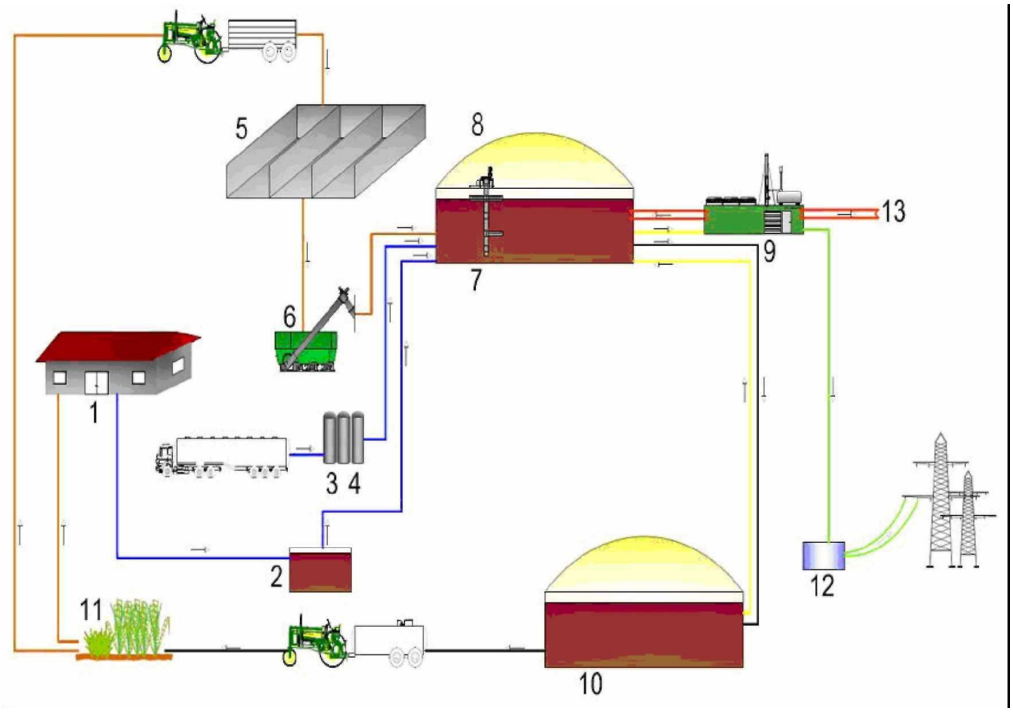
Co-digestion is the simultaneous digestion of a homogenous mixture of two or more substrates. Until a few years ago, anaerobic digestion (AD) was a single substrate, single purpose treatment. However, today AD is better known and therefore easier to control. It has become a multi-purpose process serving at the same time for waste upgrading, energy production, improvement of fertilizer quality and other purposes. It has been realized that AD as such became more stable when the variety of substrates applied at the same time is increased[15]. Structure of biogas plant with co-digestion of corn silage and manure on farm is shown in Figure 3.

[13] Retrieved 20.03.10, http://en.wikipedia.org/wiki/Energy_crop

[14] Braun R., Weiland P., Wellinger A., Biogas from Energy Crop Digestion, Retrieved 17.03.10, http://www.iea-biogas.net/Dokumente/energycrop_def_Low_Res.pdf

[15] Wellinger A., (2009) : Lecture note at MSc. Program – Module 2, Renewable Energy in Central and Eastern Europe

Figure 3. Structure of biogas plant with co-digestion of corn silage and manure on farm [16]



1. area for farming
2. repository for liquid manure
3. containers for collecting bio-waste
4. sanitation tank
5. containers for silage
6. system for bringing solid raw materials
7. digester
8. tanks for biogas
9. cogeneration units
10. warehouse for digestate
11. agricultural land
12. transformer / delivery of electricity into energy grid
13. use of thermal energy

Even though cow and pig manure were the main substrates for most agricultural biogas plants, in recent years there has been an increasing number of biogas plants using manure in combination with energy crops. Raw manure and slurry is

[16] Lorenz, 2008.

commonly used as organic fertilizer for crop nutrition, but the AD process improves their nutritional value as follows:

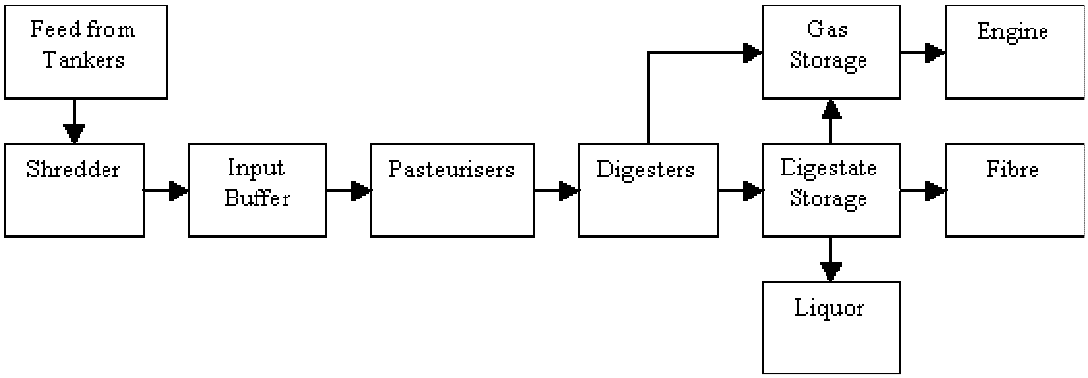
- manure and slurry from different animals (cows, pigs, poultry) are mixed in the same digester, and the result is a better ratio of nutrients,
- AD decomposes complex organic matter (including organic nitrogen) and increases amounts of plant nutrients that can be directly exploit, and
- Co-digestion manure with other substrates (e.g. slaughterhouse waste, waste grease and oil waste from households, plant remains) adds a significant amount of nutrient mixture substrate[17].

Since agricultural biogas production from manure alone (which has a relatively low gas yield) is not economically viable at current oil prices, addition of co-substrates with a high methane potential not only increases gas yields but above all increases the income through tipping fees[18]. Generally co-digestion is applied in wet single-step processes such as intermittently-stirred tank reactors. The substrate is normally diluted to dry solid contents of around 8 to 15%. Wet systems are particularly useful when the digestate can be directly applied on fields and green lands without the separation of solids[19].

About 83 % of the new German agricultural biogas plants are operated with a mixture of energy crops and manure, 15 % use only energy crops, and just 2% were operated with manure only[20]. Most of the biogas plants in Austria and Germany are operated at mesophilic temperatures between 30ºC and 42 ºC, and only 10% of the new plants use thermophilic digestion temperatures between 50 ºC and 55 ºC [21]. Flow Diagram of Mesophilic Process is shown in Figure 4.

[17] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)
[18] IEA Bionergy, Biogas Production and Utilization, Retrieved 15.03.10., http://www.iea-biogas.net/Dokumente/Brochure%20final.pdf
[19] Christensen J., Brochure "Centralized Biogas Plants"
[20] Braun R., Weiland P., Wellinger A., Biogas from Energy Crop Digestion, Retrieved 17.03.10, http://www.iea-biogas.net/Dokumente/energycrop_def_Low_Res.pdf
[21] Braun R., Weiland P., Wellinger A., Biogas from Energy Crop Digestion, Retrieved 17.03.10, http://www.iea-biogas.net/Dokumente/energycrop_def_Low_Res.pdf

Figure 4. Flow diagram of mesophilic process[22]



The effectiveness of AD depends on several key parameters, so it is very important to ensure optimal conditions for the development of anaerobic microorganisms. Their growth and activity are heavily influenced by lack of oxygen, temperature, pH value, the supply of nutrients, intensity of mixing, and the presence of inhibitors. Methanogenic bacteria are strict anaerobes, and for that reason, it is necessary to prevent any flow of oxygen into the digester.

There are two distinct temperature ranges most suitable for gas production, and different bacteria operate in each of these ranges. Mesophilic bacteria optimally function in the 32°C to 43°C range. Thermophilic bacteria are most productive in the 49° to 60°C range. Thermophilic digestion kills more pathogenic bacteria, but it has higher costs due to maintaining higher temperatures, and therefore, thermophilic digesters may be less stable. Bacterial digestion in covered lagoons at temperatures below 32°C is called psychrophilic. Psychrophilic means a preference for lower temperatures; however, digestion slows down or stops completely below 15° or 21°C, so these digesters do not produce methane all of the time[23].

Temperature within the digester is critical, with maximum conversion occurring at approximately 35°C in conventional mesophilic digesters. Approximately, for each 10°C decrease in temperature, gas production falls by approximately 50 percent[24].

[22] Retrieved 5.03.10, http://www.esru.strath.ac.uk/EandE/Web_sites/03-04/biomass/background%20info8.html#Project

[23] Anaerobic Digestion of Animal Wastes: Factors to Consider, http://attra.ncat.org/attra-pub/anaerobic.html#digestion By John Balsam, Updated by Dave Ryan NCAT Energy Specialists Published 2006 ATTRA Publication #IP219

[24] Anaerobic Digestion of Animal Wastes: Factors to Consider, http://attra.ncat.org/attra-pub/anaerobic.html#digestion By John Balsam, Updated by Dave Ryan NCAT Energy Specialists Published 2006 ATTRA Publication #IP219

The length of the AD process is directly connected with the temperature at which the process unfolds. Temperature range and AD process durations are shown in Table 2, Temperature stability is crucial for AD. In practice, the operating temperature is selected by type of substrate, and the necessary temperature is maintained through the floor or wall system heating inside the cupboards.

Table 2. Temperature range and AD process durations

Temperature range	Process temperature	Minimum process duration
Psychrophilic	< 30 ℃	70 do 80 days
Mesophilic	30 do 42 ℃	30 do 40 days
Termophilic	43 do 55 ℃	15 do 20 days

4. Content of organic matter in digester

Biogas plants are built according to the economic and technological parameters. For maximum yield of biogas, produced complete digestion of the substrate, it is needed to have long hydraulic retention time and the corresponding digester size. In practice, the selection system for digestion (digester size and type) is based on a compromise between maximum yield of biogas and justified investment in plant. In this sense, organic matter is an important operating parameter, which indicates how dry organic matter can be entered in the digester, by volume and unit time, which is expressed in the following equation.

BR = m * c / VR

- BR—organic matter [kg / d * m3]
- M—mass of the substrate inserted per unit time [kg/d]
- c—organic matter content [%]
- VR—volume of digesters [MRV *][25].

[25] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)

5. Hydraulic retention time

An important parameter for dimensioning digester is hydraulic retention time (VHR). Hydraulic retention time is the average time interval to keep the substrate inside digester. VHR is correlated with digester's volume (VR) and volume of substrate (V) used in a specified time period and can be calculated using the following equation:

VHR= Vr / V

- VHR—hydraulic retention time (days)
- Vr—volume of digester (m^3)
- V—volume of substrate used in specified time period (m^3/day) [26].

According to the equation, increase in the volume of imported organic matter will reduce the VHR. Time retention of the content in digester must be long enough to ensure that the quantity of bacteria taken out with the processed residue (digestate) is smaller than the quantity of newly developed bacteria (which are part of the substrate which remains in digester).
Normally, the time required for bacteria is 10 days or more. A short time spent in the fermentation process allows processing large amounts of substrate, but it results in lower yield of gas. It is therefore necessary to adjust the degree of degradation of VHR for specific substrate used. If one knows his or her target VHR, daily intake of the substrate, and the time required for its degradation, it is possible to calculate the volume of digester.

Various parameters can be used to evaluate the efficiency of biogas plants and for comparison of different biogas systems such as: temperature, pressure, capacity, flow, digester's volume, quantity of gas, minimum hydraulic retention time, feeding of organic matter, methane concentration in biogas, biogas yield, produced heat and electric energy, grid connection, efficiency, feed-in tariffs, total investment, etc.[27] . For evaluation of biogas plant efficiency different multiple criteria analysis can be conducted. Analyses based on individual indicators can hardly give reliable results. Therefore, it is always necessary to include economic indicators to monitor whether

[26] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)
[27] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)

the investment in a biogas facility is capable to be justified within a reasonable period of time.

6. Anaerobic digester technology

Anaerobic methane digester technology comes in a variety of technical approaches and designs depending on organic materials from which biogas is generated, for example manure, food waste, corn silage, or other organic material.

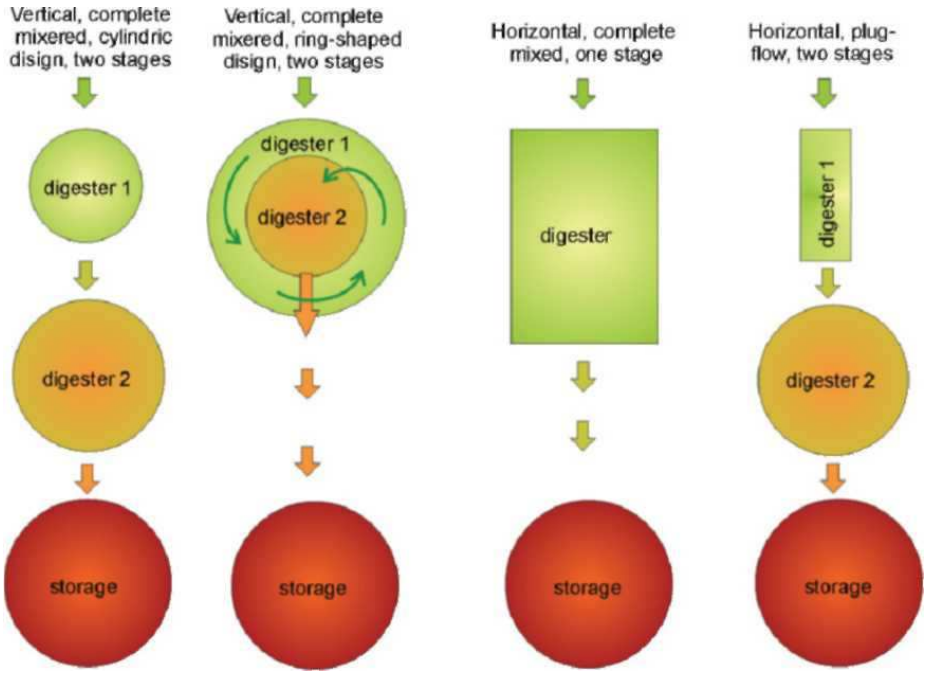
There are two basic types of digesters—batch and continuous. It is simpler to built batch-type. Its operation is based on loading the digester with organic materials and leaving it for certain period to digest. Temperature and other factors determine the retention time. After the completion of digestion, the effluent is removed and the process is repeated. In a continuous digester, organic material is constantly or regularly fed into the digester. The material moves through the digester either mechanically or by the force of the new feed pushing out digested material. That way continuous digesters produce biogas without the interruption of loading material and unloading effluent.[28]

There are three main continuous digester types: vertical, horizontal, and system with multiple tank. Based on the chosen AD substrate mixing system solution, continuous digestors working under mesophilic or thermophilic conditions can be categorized in three groups: **covered lagoons**, **plug flow**, and **complete mix**. If properly designed, continuous digester provides a steady and predictable supply of usable biogas, and therefore they may be more appropriate for large-scale operations. Different digester systems are shown in Figure 5.

In order to maximize biogas yield, continuous flow of organic matter to the anaerobic digester needs to be ensured. For that reason it is necessary to install pump systems and buffer tanks collecting liquid substrates, which will provide a well mixed substrate to the digester.

[28] Anaerobic Digester Types and Designs, Retrieved 02.03.10., http://www.energysavers.gov/your_workplace/farms_ranches/index.cfm/mytopic=30004

Figure 5. Different digester systems[29]



6.1. Covered Lagoon

A covered lagoon digester is a large anaerobic lagoon with a long retention time and a high dilution factor. Typically covered lagoons are used with flush manure management systems that discharge manure at 0.5 to 2 percent solids. The in-ground, earth or lined lagoon is covered with a flexible or floating gas tight cover. Lagoons are not heated and considered ambient temperature digesters. Retention time is usually 30-45 days or longer depending on lagoon size[30].

6.2. Plug Flow Digester

A plug flow digester is a long narrow (typically a 5:1 ratio; 5 times as long as the width) insulated and heated tank made of reinforced concrete, steel or fiberglass with a gas tight cover to capture the biogas. These digesters can operate at a mesophilic or thermophilic temperature. The plug flow digester has no internal agitation and is loaded with thick manure of 11 - 14 percent total solids. This type of

[29] Hopfner-Sixt K. & Amon T.: MONITORING OF AGRICULTURAL BIOGAS PLANTS IN AUSTRIA - MIXING TECHNOLOGY AND SPECIFIC VALUES OF ESSENTIAL PROCESS PARAMETERS, , University of Natural Resources and Applied Life Sciences, Department of Sustainable Agricultural Systems, Division of Agricultural Engineering Peter-Jordanstrasse 82, A-1190 Vienna, AUSTRIA

[30] Retrieved 05.03.10., http://www.biogas.psu.edu/coveredlagoon.html http://www.renewable-energy-concepts.com/biomass-bioenergy/anaerobic-methane-digester/digester-designs/complete-mix-anaerobic-digester.html

digester works well with a scrape manure management system with little bedding and no sand. Retention time is usually 15 to 20 days[31].

In horizontal plug flow digesters the substratum flows semi- continuously through a horizontal tank. Plug-flow digesters are in most cases made of steel and have a volume between 50 and 150 m³ [32].

6.3. Complete Mix Anaerobic Digester

Anaerobic biogas recovery systems consist of one, two or multiple complete mix anaerobic digesters and a covered storage tank depending on the size of the installation and the storage requirements. Typical construction of complete mix systems include reinforced concrete tanks with in / on-wall and in-floor heating. Insulation around the walls and underneath the floor ensures minimal heat loss. Most of the systems provide an outer and inner roof. The outer roof protects from the elements. The inner gas containment roof accommodates the methane. This dual roof construction provides an additional level of insulation in the winter while maintaining flexible gas storage capacity. The retention time in this complete mix system ranges from 20 to 70 days depending on the substrates entering the digester.[33] The complete mixed digester is best suited to process manure with 3 - 10 percent total solids. In that case retention time is usually 10 to 20 days[34].

The vertical digester is a completely mixed digester usually made of reinforced concrete. The substratum is continuously mixed during the digestion process in order to keep the solids in suspension. Biogas accumulates at the top of the digester. The standard size of vertical digesters is between 500 and 3,000 m³. Horizontal completely mixed digesters are usually made of reinforced concrete and have a volume between 1,000 and 2,000 m³ [35].

[31] Retrieved 07.03.10., http://www.renewable-energy-concepts.com/biomass-bioenergy/anaerobic-methane-digester/digester-designs/anaerobic-covered-lagoon.html
[32] Hopfner-Sixt K. & Amon T.: MONITORING OF AGRICULTURAL BIOGAS PLANTS IN AUSTRIA - MIXING TECHNOLOGY AND SPECIFIC VALUES OF ESSENTIAL PROCESS PARAMETERS
[33] Retrieved 11.03.10., http://www.renewable-energy-concepts.com/biomass-bioenergy/anaerobic-methane-digester/digester-designs/anaerobic-covered-lagoon.html
[34] Retrieved 05.03.10., http://www.biogas.psu.edu/completemix.html
[35] Hopfner-Sixt K. & Amon T.: MONITORING OF AGRICULTURAL BIOGAS PLANTS IN AUSTRIA - MIXING TECHNOLOGY AND SPECIFIC VALUES OF ESSENTIAL PROCESS PARAMETERS

7. Cogeneration of heat and electricity

Cogeneration of heat and electricity is considered to be very effective way of biogas use. Before the biogas is used for cogeneration, it is dried and conditioned. Efficiency of modern cogeneration generator is up to 90 per cent, where electricity generation is 35, and heat 65 percent[36]. Cogeneration plants are usually the biogas power plant block type (BTE) with the combustion engines that are connected to a generator. Engine generators can be Otto-gas-engine, gas-diesel engine, or gas-diesel engine with pilot ignition. Gas-Otto-diesel and gas engines operate on the principle of Otto, without ignition of fuel, and differ only in degree of compression. An alternative to these types of engines are Gas micro turbine, Stirling engines, and fuel cells. These technologies are still in development or at the stage of prototyping[37].

Many biogas plants, especially in Germany, use the corn silage in combination with manure as the primary raw material for biogas production. Such plants are the cheapest and simplest since they have known input parameters. One biogas plant from 500 kWe needs to 31 ton of corn silage per day with appropriate amount of manure[38]. Adequate amount can not be accurately determined because quality of manure will depend primarily on the origin (of animals) and then on a number of factors such as nutrition, rearing, use of disinfectants and antibiotics[39]. According to Biogas Manual, one ton of corn silage provides approximately 750 kg of material for digestion and about 200 m³ of biogas with a methane content of around 52%. After retention time of 70 days or more, the digested material is stored and/or directly applied as fertilizer.

[36] Epp C., Rutz D., Köttner M., Finsterwalder T., Kulišić B., (2009.). A Guide for Choosinh Convinient Biogas Plant Location
[37] Epp C., Rutz D., Köttner M., Finsterwalder T., Kulišić B., (2009.). A Guide for Choosinh Convinient Biogas Plant Location
[38] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)
[39] Al Seadi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Kulišić B. Kojaković A., (2008). Biogas Manual, Project BiG>East (EIE/07/214/SI2.467620)

8. Case study—the farm in Livno

The farm where the project is supposed to be implemented is located 5 km away from Livno, South-West Bosnia and Herzegovina (the map in Figure 6), in area which is predominately agricultural. The owner of the future plant is a local private investor. Big>East Economic Model was used to asses the potential gas, heat, and electricity production, and the project's economic viability was projected and examined for the period of 15 years.

There are two favorable factors for this project. First, the area has large agricultural fields currently not used for any production. Second, nearby villages are good opportunity to sell the heat during winter time and the electric power on regular basis.

Figure 6. The map of Bosnia and Herzegovina

The municipality of Livno covers an area of 4.934 km², making it one of the largest in the Federation of Bosnia and Herzegovina. The agricultural area takes about 327.525 ha. Grasslands cover 198.456 ha or 60, 6% of the total agricultural area, and meadows cover 79.261 ha or 24,2 % of the total agricultural area[40]. From this information, the potential for exploiting grass as a co-substrate for biogas production is obvious.

8.1. Cost of biomass

The potential biomass for biogas production is estimated to be 3.000 t/year of corn maize with TS=32%, 14.000 t/year of grass silage with TS=40%, and 3.000 t/year of cattle and pig manure with TS=10%, which makes the total feedstock of 20.000 t/year. There is no other feedstock materials predicted to be used, such as bio waste, grease trap residues, store and restaurant waste, ore household waste. The annual feedstock cost is estimated to be 218.000 €/year, and it is expected to grow by 2% per year. Since the manure feedstock is coming from the farm itself, the cost of 1 €/t represents handling costs. However, the cost of corn maize is assessed to be 25 €/t, and since the region has large areas covered by grass which is not used, the purchase of grass is estimated to be 10 €/t. According to the model, the expected gas production from corn maize is 190 m³/t with methane contents of 53%, and for grass 200 m³/t with methane contents of 53%. Furthermore, the expected gas production from mixed cattle and pig manure is 25 m³/t with methane content of 60%. The costs of biomass and biogas yield are presented in Table 3.

Table 3. Costs of biomass

Raw Materials	Biogas yield (m³/t)	EUR/t	t/y	**EUR**
Maize silage	190	25,00 EUR/t	3000 t/y	75.000
Gras silage	200	10,00 EUR/t	14000 t/y	140.000
Cattle/pig manure	25	1,00 EUR/t	3000 t/y	3.000
TOTAL				**218.000**

8.2. Biogas plant mass balance

The biogas mass plant balance is presented in Table 4. Average total solids of input materials are 6,3% per year. Input into biogas plant is estimated to be 20.000

[40] Ministry of agriculture, water management, and forestry of Herceg-Bosnian County (2007). The Strategy of Agricultural Development in Herceg-Bosnian County (2007-20011)

Mg/year. Average amount of produced biogas per ton of input materials is 172 m³/t. Average quality of the produced biogas is 53,2% of methane. Average annual production of biogas is 3.445.000 m³, which is 393,3 m³ per hour. Based on the mentioned parameters, necessary digestion volume is 3.775,3 m³. Average remaining biogas sludge without separation is 16.038,3 m³/year. Also, average remaining TS in biogas sludge without separation is 16,8%, and average remaining biogas sludge liquid phase (TS=5%) is 30.052,9 m³/year. Finally, average remaining compost (TS=25%) is 14.014,7 t/year.

Table 4. Mass balance of the biogas plant

Mass balance of biogas plant		
	Unit	**Year 1-15**
Average total solids of input materials	%	6,30%
Input into biogas plant	Mg/year	20.000
Average amount of produced biogas per ton of input material	m³/t	172
Average quality of the produced biogas	% CH4	53,20%
Average produced biogas per year	m³/year	3.445.000,00
Average produced biogas per hour	m³/h	393,30
Necessary digestion volume (digester capacity)	m³	3.775,30
Average remaining biogas sludge without separation	m³/year	16.038,30
Average remaining TS in biogas sludge without separation	%	16,80%
Average remaining biogas sludge liquid phase TS=5%	m³/year	30.052,90
Average remaining compost TS=25%	t/year	14.014,70

8.3. Investment costs

Engineering costs wich include: permission engineering, expertices, environmental impact accessment, tendering, detailengineering, site supervision and back offices services are estimated to be 300.000 €. Based on the similar projects in Southeast Europe, the machinery cost is projected to be 700.000 €, and the electrical equipment cost is projected to be 300.000 €. Considering the situation that the biogas plant will be built in Bosnia and Herzegovina, which still has lower

construction costs than EU, the construction, main and auxiliary facilities, and earth works together are estimated to be 850.000 €. The CHP and grid access are estimated to be 600.000 €. Other costs, such as land and infrastructure, TUV approval, and wheel loader are projected to be 250.000 €, 30.000€, and 70.000€ respectively.

Consequently, the total capital investment needed for the plant installation is 3.100.000 €. The summary of the investment costs is shown in Table 5.

Table 5. Investment costs

Investment costs	Investment Costs [EUR]
EPC Contract all inclusive	**3.100.000**
(1) Engineering: Permission Engineering, Expertices, Environmental Impact accessment, tendering, detailengineering, site supervision and back offices services	300.000
(2) Deliveries:	
Machinery	700.000
Electrical Equipment	300.000
Building facility	700.000
Auxilliary Facilities	150.000
Electrotechnic & Control system + Grid Connection	600.000
Land & infrastructure	250.000
TÜV approval	30.000
Wheel loader	70.000
Total CAPEX Sum all inclusive	**3.100.000**

8.4. Financing costs

The investor plans to finance the project with 20% of equity and 15 year loan with 6.5 % interest rate. This way, the total annual cost of capital will be 259.241,55 €. Pre-financing cost is calculated as 5% of the total investment cost, and it makes 155.000 €.

8.5. Maintenance and operating costs

The maintenance expenses are projected as a percent of investment. Machinery maintenance is calculated as 5% of total machinery costs, and electrical equipment

maintenance is calculated as 5% of total electrical equipment costs, which makes annual amounts of 35.000 € and 15.000 € respectively. The main buildings maintenance is calculated as 2% of the building costs, which makes 14.000 € per year, and auxiliary buildings maintenance is calculated as 2%, which makes 3.000 € per year. The land and infrastructure maintenance cost is calculated as 1,5% of the total investment in land and infrastructure, which makes 3.750 € per year. The maintenance expense for the wheel loader is calculated as 2%, and it is projected to be 1.400 € per year. Therefore, the total annual cost of maintenance is estimated to be 102.150 € as presented in Table 6, and it is projected to grow by 2% annually.

Table 6. Costs of maintenance

	Maintenance Costs per Year [%]	Annual Maintenance Costs [EUR]
EPC Contract all inclusive		
Machinery	5,00%	35.000
Electrical Equipment	5,00%	15.000
Building Facility	2,00%	14.000
Auxilliary Facilities	2,00%	3.000
Electrotechnic & Control System + Grid Connection	5,00%	30.000
Land & Infrastructure	1,50%	3.750
Wheel loader	2,00%	1.400
Total Maintenance Cost		**102.150**

The operating costs are made of maintenance, personnel costs, unforeseeable costs, consumables, and costs of own electricity consumption. As presented in Table 7, these costs are estimated to make total of 187.444 € per year. Furthermore, their growth is expected to be 2% per year. The personnel costs represent the salary of one worker who will operate the facility. Based on the labor market situation in Bosnia and Herzegovina, the annual cost of operator is assumed to be 15.000 €. The consumables include items such as loading/moving machinery on site, fuel, tires, rent of telescopic front loader, and similar things. Finally, the projection is that the plant will need about 7% or 512.870 kWh per year of the produced electrical power for own consumption. As it will be explained under the revenues section, these costs are expected to grow by 4% annually.

Table 7. Operating costs

Operating costs	EUR
Maintenance	102.150
Personal costs	15.000
Unforseeable	3.000
Consumables	25.500
Costs for electricity (self demand)	41.794
TOTAL	**187.444**

8.6. Other costs

The other costs consist of 10.000 € for insurance and 24.000 € for administration. Since the investor owns the land, the costs of renting land are 0 €. The other costs calculation is given in Table 8. These costs are expected to increase by 2% per year.

Table 8. Other costs

Other costs	EUR
Insurance	10.000
Administration	24.000
Land rental costs	0
TOTAL	**34.000**

8.7. Revenues

As already mentioned, the plant in Livno is supposed to be a combined heat and power biogas plant, so there will be two possible sources of revenues—revenues of selling heat and revenues from selling electrical power. For possible heat extraction, the thermal efficiency of CHP is projected to be 48% while the electrical efficiency of CHP is projected to be 40%. In the first year of operation, the produced

heat will be sold at price of 0,02 €/kWh, and 93 % of the produced electrical power will be sold at price of 0,08149 €/kWh. The remaining 7% of the produced electricity will be consumed by the facility itself. The price of heat is expected to grow by 2% per year, while in accordance to *The Regulation on the Use of Renewable Energy Sources and Cogeneration* (The Regulation) in Federation of Bosnia and Herzegovina, the price of electricity obtained from renewable sources is expected to grow by 4% as it will be explained in the following chapters.

In June 2010, in Federation of Bosnia and Herzegovina became valid the new regulation called *The Regulation on the Use of Renewable Energy Sources and Cogeneration*. According to this regulation, for cogeneration biogas plants using energy crops and manure with the installed capacity from 50 kW to 1 MW, the coefficient of tariff is 1,30[41]. This coefficient is multiplied with the referent price of 0,06268 €/kWh (0,1226 BAM/kWh), which is also defined in The Regulation.

This way, the guaranteed selling price will be **81,4897 €/MWh**. However, this price will be corrected every year by so called Producer Price Index. According to The Federal Bureau of Statistics[42], over the last ten year, this index in Bosnia and Herzegovina had an average of 4%, and therefore, the price adjustments of 4% is taken into account for calculating revenues . Furthermore, the selling contract and the guaranteed electricity price for new renewable energy plants will be valid for 12 years. After that period, the qualified electricity producer will have the right to sell the produced energy at the market price[43].

The average bio gas yield is expected to be 3.445.000 m^3/y and average energy yield of 18.311.000 kWh/y. The estimated electrical power output is 7.326.712 kWh/year, and therefore, based on the calculation, the estimated electrical power consumption is 512.870 kWh/year. This way, the annual revenues of selling heat in the first year of operation will be 175.786 €, and the annual revenues of selling electrical power in the first year will be 597.052 €. Consequently, the total annual revenues during the first year will be 772.837 €. The information about the energy extraction and revenues for the first year of operation is presented in Table 9, while the information about total revenues over the plant's 15 years of operation is presented in Table10.

[41] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina
[42] Federal Office Statistics, Statistical Yearbook 2009, 2008, 2007, 2006
[43] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina

Table 9. Energy extraction and revenues during the first year of operation

Revenues				
	Comment	Factor/ Price	Unit	Year 1
Possible heat extraction	thermal efficiency of CHP	48,00%	kWh/h	1003
Possible electrical power	electrical efficiency of CHP	40,00%	kWh/h	836
Selling electricity in % of theoretical production		93,00%	kWh/h	778
Revenues of selling heat		0,02	€	175.786
Revenues of selling electrical power		0,08149	€	597.052
TOTAL REVENUES				**772.837 €**

Table 10. Total revenues

Year	Revenues-Electricity (EUR)	Revenues-Heat (EUR)	Total Revenues (EUR)
1	597.052	175.786	772.837
2	620.934	179.301	800.235
3	645.771	182.887	828.658
4	671.602	186.545	858.147
5	698.466	190.276	888.742
6	726.405	194.082	920.486
7	755.461	197.963	953.424
8	785.679	201.922	987.602
9	817.106	205.961	1.023.067
10	849.791	210.080	1.059.871
11	883.782	214.282	1.098.064
12	919.133	218.567	1.137.701
13	735.305	222.939	958.244
14	764.718	227.397	992.115
15	795.306	231.945	1.027.252

8.8. Profitability

Table 11 presents Profit & Loss statement for the first 5 years. The complete Profit & Loss statement with detailed calculations is shown in Appendix A.

Table 11. Profit & Loss statement for the first 5 years

Financial plan Profit & Loss Statement	Operation years 1	2	3	4	5
Electricity	597.052	620.934	645.771	671.602	698.466
Heat	175.786	179.301	182.887	186.545	190.276
Total Revenues	**772.837**	**800.235**	**828.658**	**858.147**	**888.742**
Maize silage	75.000	76.500	78.030	79.591	81.182
Gras silage	140.000	142.800	145.656	148.569	151.541
Cattle/pig manure	3.000	3.060	3.121	3.184	3.247
Total Raw Material	**218.000**	**222.360**	**226.807**	**231.343**	**235.970**
Gross Margin	**554.837**	**577.875**	**601.851**	**626.804**	**652.772**
Personnel Costs	15.000	15.300	15.606	15.918	16.236
Running Costs (Consumables)	*25.500*	*26.010*	*26.530*	*27.061*	*27.602*
Utilities					
Building, Land Rent					
Maintenance Other Maintenance, Operational Costs	102.150	104.193	106.277	108.402	110.570
Electricity (self demand + reservations)	41.794	43.465	45.204	47.012	48.893
Services, Energy					
Insurances	10.000	10.200	10.404	10.612	10.824
Other/Contingencies (unforeseeables, administration)	3.000	3.060	3.121	3.184	3.247
Management Fees	24.000	24480	24970	25469	25978
Total Operational Costs	**221.444**	**226.708**	**232.111**	**237.659**	**243.351**
EBITDA	**333.394**	**351.167**	**369.740**	**389.145**	**409.420**
Depreciations	**192.333**	**192.333**	**192.333**	**192.333**	**192.333**
EBIT	**141.061**	**158.834**	**177.407**	**196.812**	**217.087**
Interest Bank Loan (80% of Investment, rate 6,5%)	259.242	259.242	259.242	259.242	259.242
Financial Result	**259.242**	**259.242**	**259.242**	**259.242**	**259.242**
EBT	**-118.181**	**-100.408**	**-81.835**	**-62.430**	**-42.155**
Tax	0	0	0	0	0
After Tax Profit	**-118.181**	**-100.408**	**-81.835**	**-62.430**	**-42.155**

For calculating depreciations, it is used the straight line method. As shown in Depreciation schedule (Table 12), all items but wheel loader are depreciated over the plant's 15 year lifetime. The wheel loader is depreciated over the period of 10 years.

Table 12. Depreciation schedule

Depreciations	Initial Investment	Depreciation Period	Depreciation Expense
(1) Engineering: Permission Engineering, Expertices, Environmental Impact accessment, tendering, detailengineering, site supervision and back offices services	300.000	15	20.000
(2) Deliveries:			
Machinery	700.000	15	46.667
Electrical Equipment	300.000	15	20.000
Building facility	700.000	15	46.667
Auxilliary Facilities	150.000	15	10.000
Electrotechnic & Control system + Grid Connection	600.000	15	40.000
TÜV approval	30.000	15	2.000
Wheel loader	70.000	10	7.000

The Cash Flow calculation is presented in Table 13. The inflation factor of 6% is used for calculation of the discounted cash flow. The project's Payback Period is 7 years and 6 months.

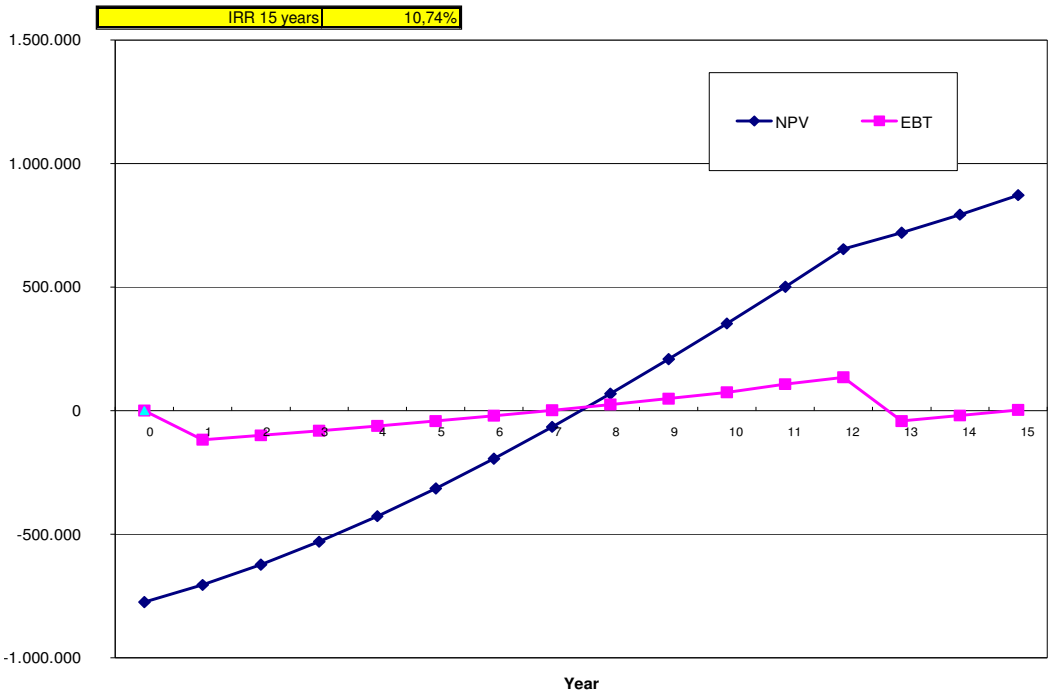
Table 13. Cash Flow

Year	CF (EUR)	Cumulative CF (EUR)	Discounted CF (EUR)	Discounted Cum. CF (EUR)
0	-775.000	-775.000	-775.000	-775.000
1	74.152	-577.924	69.955	-705.045
2	91.925	-485.999	81.813	-623.232
3	110.498	-375.501	92.776	-530.456
4	129.904	-245.597	102.896	-427.560
5	150.179	-95.418	112.222	-315.337
6	171.358	75.940	120.801	-194.537
7	193.367	269.307	128.600	-65.937
8	214.162	483.469	134.368	68.431
9	235.879	719.348	139.616	208.048
10	258.557	977.905	144.377	352.424
11	281.535	1.259.440	148.309	500.734
12	306.256	1.565.696	152.200	652.933
13	143.216	1.708.912	67.145	720.079
14	164.942	1.873.854	72.954	793.033
15	187.418	2.061.272	78.203	**871.236**

As shown in Figure 7, the net present value (NPV) of the project is 871.236 €, and the expected internal rate of return (IRR) of the project is 10,74%, which justifies this

project as being feasible. The original calculations based on which all the results were obtained are shown in Appendices A (Profit and Loss statement), B (Capital Costs), and C (Groups and types of costs). The discount rate of 6%, equity investment of 620.000 €, and pre-financing cost of 155.000 € are used for calculating NPV.

Figure 7. NPV and EBT diagram



8.9. Technology specifications

The digester will be vertical completely mixed steal tank with capacity of 4.000 m³. It will have one central stirrer and one additional stirrer to prevent sediment creation or crust. Low-pressure biogas storage will be provided, as well as desulphurization and drying units. The biogas plants will be completely automated. If any operational problems occur after normal working time, the monitoring system will alerts the duty manager. The manager will be able to control operations from a PC in his or her home. Digestate will be stored in lagoon ponds and covered by membrane covers. CHP unit with capacity of 1 MW will be used for production of heat and electrical power from biogas.

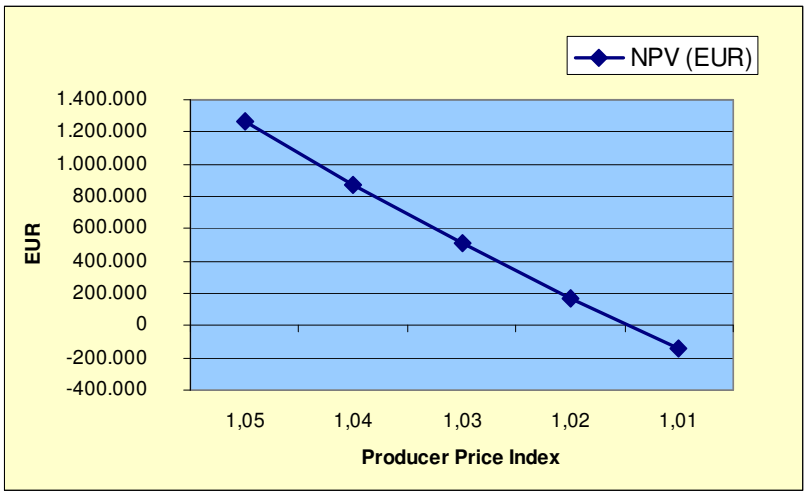
8.10. Risk analysis

The main risks associated with the project are the change in the purchase price of electricity (Producer Price Index), the change in the cost of raw materials (maize and grass silage), and the change in the initial investment. Project's NPV sensitivity on Producer Price Index is presented in Table 14 and Figure 8. As explained in the previous chapters, the guaranteed selling price is 81,4897 €/MW. However, this price will be corrected every year by so called Producer Price Index. According to The Federal Bureau of Statistics[44], over the last ten year, this index in Bosnia and Herzegovina had an average of 4%, and therefore, the price adjustments of 4% is taken into account for calculating revenues. As shown in the fallowing table and figure, the change in Producer Price Index would have significant influence on project's NPV. Any increase in Producer Price Index would increase the project's NPV, and any decrease in Producer Price Index would decrease the project's NPV. The project remains profitable if the Producer Price Index is higher than 1,01.

Table 14. Project's NPV sensitivity on Producer Price Index

Producer Price Index	1,05	1,04	1,03	1,02	1,01
NPV (EUR)	1.266.054	871.236	505.983	167.952	-145.018

Figure 8. Project's NPV sensitivity on Producer Price Index



Moreover, as shown in Table 15 and Figure 9, the change in Producer Price Index would also affect project's IRR. Any increase in Producer Price Index would

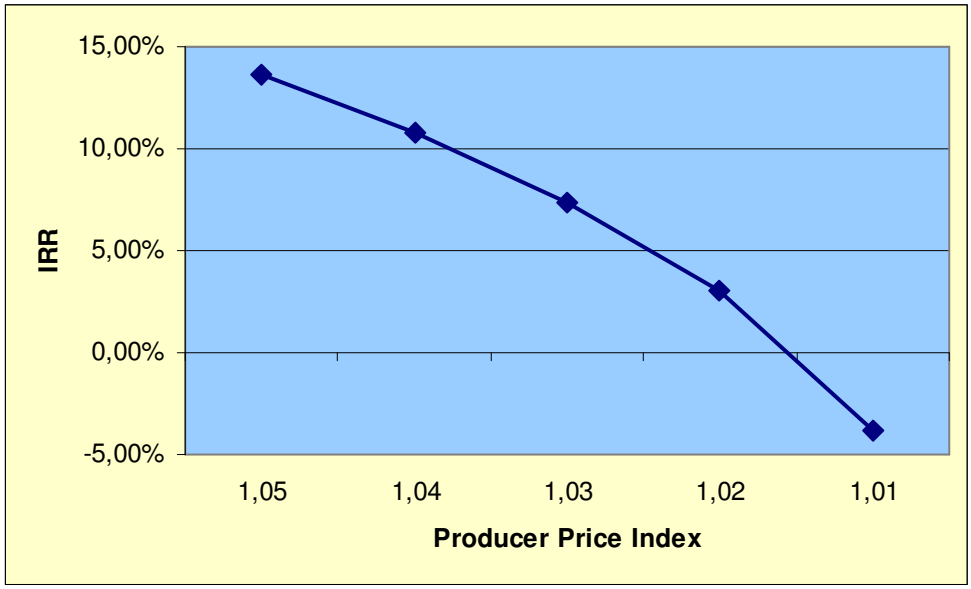
[44] Federal Office Statistics, Statistical Yearbook 2009, 2008, 2007, 2006

increase the project's IRR, and any decrease in Producer Price Index would decrease the project's IRR. The project's IRR stays positive if the Producer Price Index remains above 1,01.

Table 15. Project's IRR sensitivity on Producer Price Index

Producer Price Index	1,05	1,04	1,03	1,02	1,01
IRR	13,65%	10,74%	7,33%	3,02%	-3,78%

Figure 9. Project's IRR sensitivity on Producer Price Index



As discussed in the previos section, the Producer Price Index makes significant influence on the project's profitability. In the similar way, a major change in the raw materials price could generate negative profitability.

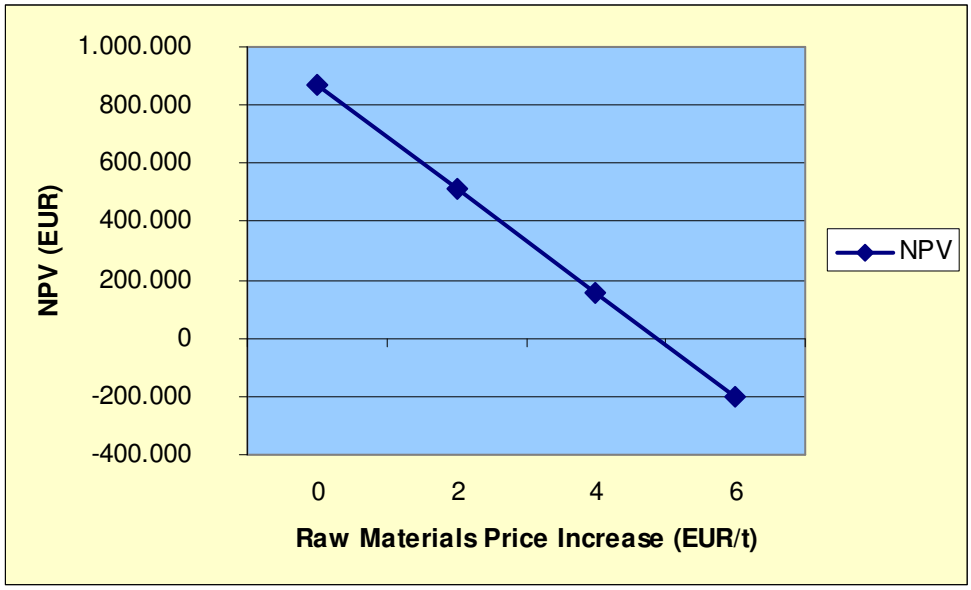
The raw materials represent one of the highest costs in the projects. The potential biomass for biogas production is estimated to be 3.000 t/year of corn maize produced at 25 €/t, 14.000 t/year of grass silage purchased at 10 €/t, and 3.000 t/year of cattle and pig manure at the cost of 1 €/t. Since the manure feedstock is coming from the farm itself, the cost of 1 €/t represents handling costs, and is not expected to change significantly. Yet, the corn maze and grass silage could change if the cost of maize production increases and if the company does not sign firm contracts with grass suppliers.

As shown in Table 16 and Figure 10, change in the costs of raw materials makes big impact on project's NPV.

Table 16. Project's NPV sensitivity on raw materials price change

Raw Materials Price Increase (EUR/t)	0	2	4	6
NPV (EUR)	871.236	514.362	157.488	-199.386

Figure 10. Project's NPV sensitivity on raw materials price change

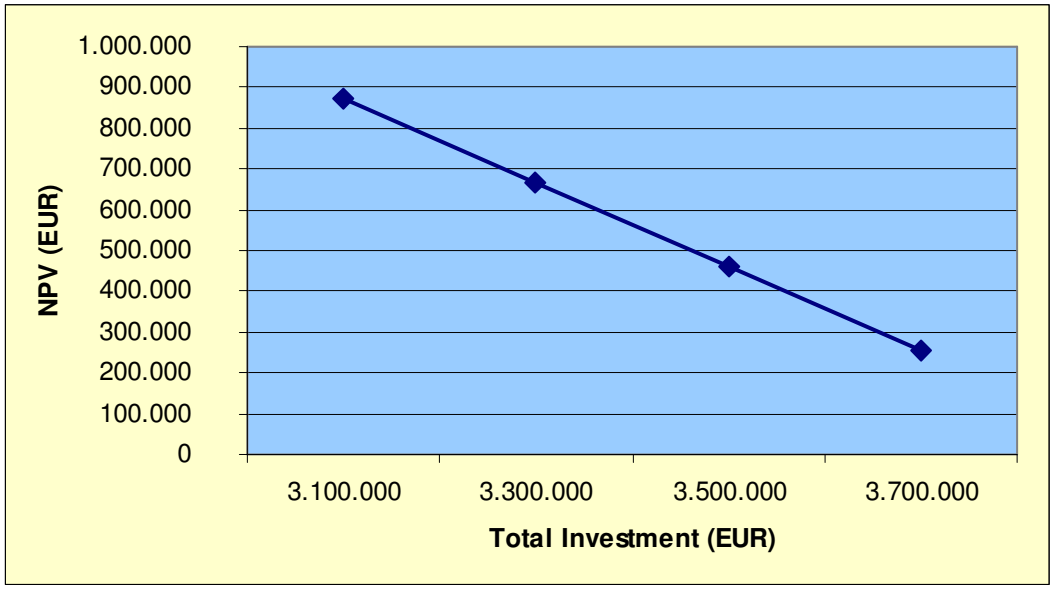


Project's NPV sensitivity on initial investment change is presented in Table 17 and Figure 11. Any increase in the initial investment requires higher equity investment as well as higher loan repayment rate and higher pre-financing, which leads to lower NPV. However, even if the initial investment increases to 3.700.000 €, the projects still remains profitable.

Table 17. Project's NPV sensitivity on initial investment change

Total Investment (EUR)	3.100.000	3.300.000	3.500.000	3.700.000
NPV (EUR)	871.236	665.291	459.348	253.405

Figure 11. Project's NPV sensitivity on initial investment change



The Strengths, Weaknesses, Opportunities, and Threats (SWOT), analysis which identifies the favorable and unfavorable internal and external factors for the project, is shown in Figure 12.

Figure 12. SWOT analysis

STRENGTHS – proximity to sources of feedstock, – signed power supply agreement, – rich RES potential – keeping money, taxes and decision-making within local municipality, – gaining new experience that can be applied on similar projects, – positive image, – reducing carbon-derived energy production, – enhanced educational opportunities.	WEAKNESSES – dependence on biomass price, – lack of experience (relatively young industry), – high initial investment, – nonexistence of research centres and research studies in the sector, – dependency on the foreign technology, – bureaucratic procedures.
OPPORTUNITIES – increase in the demand for electricity, – liberalization of energy markets, – supportive legal and regulatory framework, – the technology is becoming cheaper and more widely available, – eventual electricity and oil price increase.	THREATS – disruption to supplies and operations, – failures in distribution, – changes in tax regimes, – changes in public opinion, – cheap fuel and natural gas.

Some basic financial ratios for the project are presented in Table 18. The Debt Service Cover Ratio (DSCR) is very important for financing purposes. It indicates the number of times interest is covered by the profits available to pay interest charges. For this project, only in the first three years the DSCR is less than 150%, and for the remaining years of operations it is always higher than 150%. However, for the financing purposes it would be desirable to keep this ratio above 200%. This kind of projects requires high capital investment and relatively short depreciation

period, which causes relatively high depreciation expense. This high depreciation expense significantly affects other financial indicators, such as EBIT Margin, EBT Margin, and Net Profit Margin. However, these ratios show steady growth during the privileged 12 years.

Table 18. Financial ratios

Year	EBIT Margin	EBT Margin	Net Profit Margin	Debt Service Coverage Ratio
1	18,3%	-15,3%	-15,3%	128,6%
2	19,8%	-15,3%	-12,5%	135,5%
3	21,4%	-12,5%	-9,9%	142,6%
4	22,9%	-9,9%	-7,3%	150,1%
5	24,4%	-7,3%	-4,7%	157,9%
6	25,9%	-4,7%	-2,3%	166,1%
7	27,3%	-2,3%	0,1%	174,6%
8	28,7%	0,1%	2,2%	183,5%
9	30,1%	2,5%	4,3%	192,9%
10	31,4%	4,7%	6,2%	202,6%
11	33,3%	6,9%	8,8%	212,7%
12	34,6%	9,7%	10,6%	223,3%
13	22,7%	11,8%	-4,4%	155,2%
14	24,1%	-4,4%	-2,1%	163,6%
15	25,5%	-2,1%	0,2%	172,4%

Based on the risk analysis, it is obvious that contracts on electricity and heat purchase and raw material supply are the key to success or failure of the whole project.

8.11. Theoretical schedule for implementation

As shown in Table 19, the estimate is that 6,5 years period is needed for complete implementation of a biogas project in Bosnia and Herzegovina. During the last three years, the investor has done the first phase (Research, Development, and Feasibility Study). The information gained in the three years of research should be sufficient for obtaining a final and realistic bankable study. The next step is getting The Environmental Impact Assessment and Environmental Permit. Federal Ministry of Environment and Tourism by its decision no. 05-23-522-3/10 from April 20, 2010 issued a list of 27 institutions and companies which are authorized to make Environmental Impact Assessment. One year is sufficient to acquire Environmental

Impact Assessment and Environmental Permit. The process of obtaining Concession is expected to last 6 months, while the process of obtaining Status of Eligable Electricity Producer is expected to last 1 year. Finally, the constractions is expected to last 1 year.

Table 19. Installation timeline (years)

PHASE	YEARS
Research, Development and Feasibility Study	3
Environmental Impact Assessment/ Environmental Permit	1
Concession	0,5
Acquiring Status of Eligable Electricity Producer	1
Construction	1
Total Implementation Time	**6,5**

9. Legal framework

In Bosnia and Herzegovina the government has four levels—state, entities, cantons, and municipalities. Each level has certain competencies and imposes laws and resolutions which regulate renewable energy. On the entity level, the city of Livno belongs to Federation of Bosnia and Herzegovina, and on the cantonal level it belongs to Herceg-Bosnian County.

According to the Federal Ministry of Energy, the laws and regulations which refer to renewable energy are:

A. Laws and regulations at the State level[45]:

- Law on Transmission of Electric Power, Regulator and System Operator of Bosnia and Herzegovina (Official Gazette of BiH No.7/02)
- Law Establishing an Independent System Operator for the Transmission System of Bosnia and Herzegovina (Official Gazette of BiH No. 35/04)

[45] Renewable energy policy in Bosnia and Herzegovina, Mustafa Gagula, B.Sc.El.Eng., Federal Ministry of Energy

- Law Establishing the Company for the Transmission of Electric Power in Bosnia and Herzegovina (Official Gazette of BiH No. 35/04)
- Connection Rules of SERC (Market Rules and Grid Cod)
- Law on Concessions in Bosnia and Herzegovina (Official Gazette of BiH No. 32/02).

B. Laws and regulations at Federation of Bosnia and Herzegovina:

- Law on Electricity (Official Gazette FBIH No. 41/02; 38/05)
- Low on Application of Tariff System (Official Gazette FBIH No. 06/04)
- Law on Concessions (Official Gazette FBIH No. 40/02, 61/06)
- Law on Physical Planning and Land Usage on the Level of FBIH (Official Gazette FBIH No. 2/06)
- Law on Environmental Protection (Official Gazette FBIH No. 33/03)
- Law on Air Protection (Official Gazette FBIH No. 33/03)
- Law on Water resources (Official Gazette FBIH No. 70/06)
- Law on Water Protection (Official Gazette FBIH No. 33/03)
- Law on Nature Protection (Official Gazette FBIH No. 33/03)
- General Condition for Electricity Supply
- Decision about a Methodology for the Determination of Purchase Prices for Electricity from Renewable Sources with Installed Power up to 5 MW (Official Gazette of BiH No. 32/02)
- Strategic Plan and Program of Energy Sector Development in the Federation of Bosnia and Herzegovina-2009
- Grid rules distribution.

C. Laws and regulations at local level in Federation of BiH (canton and municipality):

- Law on concessions
- Law on environmental protection
- Law on Physical Planning and Land Usage
- Law on construction.

The following chapters will present the major legal provisions which regulate the use of renewable energy and cogeneration, REN project registration procedure, energy purchasing and fees, land utilization for construction purposes, concession

allocation procedure, and acquiring status of eligible electricity producer, as well as some other important issues concerning REN.

On 1st June 2010, the Government of Federation of Bosnia and Herzegovina adopted *Regulation on the use of renewable energy sources and cogeneration* (the Regulation). The Regulation provides the following definitions[46]:

Biogas—gas formed by decomposition of organic matter.

REN power plants—plants which produce electricity or electricity and heat from renewable energy sources.

Guaranteed prices (Gp) — a price that is paid to producers of electricity from REN for the duration of the contract on purchase of electricity.

Price index / **inflation factor**—the numerical value of price indices for electricity established by the Federal Bureau of Statistics and published in the Statistical Yearbook.

Cogeneration plant—a plant with the simultaneous production of electricity and heat. Cogeneration facility may include the peak boiler, if constituted of a single unit that can not be physically separated.

Qualified producer—the producer of electricity produced from REN source, including public utility company, which has acquired this status by decision of Regulatory Commission for Electricity in Federation of Bosnia and Herzegovina.

Renewable energy sources—energy sources which constantly exist in nature and are completely or partially renewable, in particular hydroelectric energy, wind, biomass, biogas, gas from landfills, agricultural gas, sewage gas, geothermal and non-accumulated solar energy.

Agricultural gas—natural gas originated by biodegradation of organic matter in the absence of oxygen, among other things, bases from farms, agricultural residues such as sugar beet, remains with pastures, particularly energy crops, municipal separated organic solid waste etc..

[46] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina

The facility using renewable energy sources and cogeneration—a building intended for the production of electricity, or electricity and heat from renewable energy sources.

Project for use of renewable energy sources and cogeneration—the preparation and construction of facilities that use renewable energy sources and cogeneration registered in the Register of renewable energy sources and cogeneration.

Referent price (Rp)—the amount obtained as a mean value of valid tariffs of the Public Enterprise "Elektroprivreda BH" dd Sarajevo and the Public Enterprise "Elektroprivreda HZHB" dd Mostar for active energy, higher daily and higher seasonal factor, for the voltage consumption category of 10 (20) kV from tariff system established by the FERC.

Tariff coefficient (C)—the numeric value associated with each group and type of facilities, which are used in calculating guaranteed price (Gp).

The Regulation also defines four categories of REN plants, depending on the installed capacity[47]:

a) **Micro plants**—up to and including 150 kW,
b) **Mini plants**—from 150 kW up to and including 1MW,
c) **Small plants**—from 1MW up to and including 10 MW, and
d) **Large plants**—over 10 MW.

Furthermore, based on the REN source, it defines the Tariff coefficient (C) for each plant category. Since the plant in Livno is predicted to have 1MW of installed capacity, it falls in the group of small plants. For small agricultural biogas plants, the Tariff coefficient is 1,21[48]. However, **small cogeneration** plants connected to distribution grid have Tariff coefficient of **1,30**[49].

The share of 5% of total electricity consumption is defined as target of a minimum share of electricity produced from renewable energy plants until the end of 2012,

[47] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 4
[48] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 5
[49] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 8

and 0.5% of total electricity consumption as target of a minimum share of electricity produced from cogeneration plants until the end of 2012[50].

Eligible REN producers who have concluded an agreement on obligatory electricity purchase will be encouraged by the following measures[51]:

a) Advantage of delivery of electricity produced from REN sources in the network,
b) The obligations of redemption of electricity produced from REN sources,
c) Guaranteed prices.

Also, network operator must take the generated electricity from qualified producers if it does not endanger the operation of power systems[52].

A qualified producer is entitled to conclude a contract on the obligatory electricity redemption with REN operator at the guaranteed price determined by the Regulation. For new plants, the energy redemption contract is concluded for a period of **12 years** of the operation, applying the guaranteed price in accordance with the Regulation. In addition, after the expiration of the contract period, qualified producer loses the right on the guaranteed price, but it has the right to supply all the generated electricity at the average price of electricity in the Federation of Bosnia and Herzegovina or to sell all the electricity produced on the free markets[53].

The Guaranteed price (Gp) depends on the Reference prices (Rp) and the Tariff coefficient (C). The Reference price (Rp) for 2010 is **12,26 pf/kWh** (0,06268 €/kWh). For each subsequent year, until the 31st October of current year, REN operator will correct Rp by the current year Inflationary Factor (Producer Price Index) established by the Federal Bureau of Statistics. Guaranteed price will be the amount obtained by multiplying the Reference price and the corresponding REN Tariff coefficient[54].

Gp = Rp x C

[50] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 10
[51] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 13
[52] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 14
[53] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 15
[54] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 16

The Federal Ministry of Energy established the Register of REN projects. In the Register will be recorded data on the holder of the project, location and type of facilities, technical and technological characteristics and conditions of use depending on the applied technology, basic operating data (installed power plants and planned production of electricity and heat), and other data from the authorization test, the previous solution, and the decision on acquiring the status of qualified producers[55]. The review with the qualified producers register can be seen on FERC's website[56].

Regarding the construction of a REN plant, the Resolutions states that REN plants will be built in accordance with the Electricity Law, the applicable laws governing the planning, construction and environmental protection, and use of natural resources, current laws on agriculture and agricultural land, the law on concessions, the Regulation on the use of renewable energy sources and cogeneration, and on the basis of technical and other regulations which regulate the area of construction[57].

The construction of a REN plant requires energy consent from the competent Ministry, which is issued after the registration in the Register of REN projects. In order to obtain to obtain energy consent, after the issuance of permits for construction, the competent authority is required to submit the request for registration of REN projects to the Ministry[58]. Also, the energy consent can be issued to domestic and foreign companies and individuals. Also, construction of the plant can be a joint project of local investors, investors from the EU member states, the countries that signed the Treaty establishing the Energy Association of Southeastern Europe, as well as third countries[59].

The project carrier listed in the Register of REN projects can apply for connection on transmission or distribution grid to the transmission system operator or to the

[55] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 33
[56] http://www.ferk.ba/download_zaj/pregled_dozvola/licence-proizvodnja-pregled.pdf
[57] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 37
[58] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 38
[59] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 39

distribution system operator in accordance with the applicable regulations that govern this area[60].

The resolution also prescribes the items that have to be included in an Electricity redemption contract[61]. Those are:

- Approximate amount of produced electric energy and production dynamics,
- Location and method of measurement and calculation of electricity supplied,
- Price, billing and payment methods for electricity,
- The duration of the contract, and
- Services / costs of balancing related to deviations from the reported plan.

The Regulation on the use of renewable energy sources and cogeneration presented in the previous chapters defines the major legal provisions which regulate the use of REN and cogeneration, REN project registration procedure, energy purchasing and fees. However, the Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06) defines major provisions regarding the land utilization for construction purposes.

Article 34 of this law says that the utilization of land on the level of the Federation is executed according to the Federation's planned documentation. The utilization of land implies the construction of structures and the execution of other spatial activities under the Federation's jurisdiction. The construction of a structure implies: the construction of a new structure, reconstruction, annex-building, expansion-building, improvement, the execution of other spatial conformances, structure removal, preparatory work, purpose shift of structure or land, and the construction of temporary structures, except running maintenance works, improvement works that can be considered as running maintenance works and the conservation of a structure. Construction and other spatial activities from the 2nd section of this article are approvable only in urban areas and on construction land. Outside of the urban

[60] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 48
[61] Government of Federation of Bosnia and Herzegovina, (2010.), Regulation on the use of renewable energy sources and cogeneration, Federation of Bosnia and Herzegovina, Article 51

area/construction land, the construction, which engages space outside of urban areas, may exceptionally be approved if foreseen in spatial plans, especially[62]:

1) main infrastructures (traffic, energy, water-management, telecommunication and other);
2) medical, recreational, and sport structures;
3) structures required by the defence and Federation Army of Bosnia and Herzegovina;
4) residential and economic structures of an agronomic producer for the requirements of agricultural production or rural tourism;
5) research, exploitation, and spatial regulation of natural resources (minerals, forest, water, agricultural land and other);
6) communal and other structures (waste areas, cemeteries, remembrance marks and similar).

Furthermore the construction may be approved if predefined as in agreement with the planning documentation and other conditions set for a particular space, along with specified laws and regulations based on these laws, by an issued urban planning consent[63].

In addition, the request for the issuing of an urban planning consent needs to contain[64]:

1) data on the plot
2) basic project containing:

- the technical description,
- special judgement,
- all characteristics of the structure,
- lateral section,
- façade;

3) environmental permit (for structures prescribed by specific law);

[62] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 34
[63] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 37
[64] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 39

4) an explanation of the request with all data necessary for determining urban-technical and other conditions. The relevant ministry may demand other supplements as well, depending on the nature of the construction.

If one wants to submit a request for the issuance of building permit, along with the request, the following documents have to be submitted[65]:

1) the urban planning consent;
2) an inference from the land-registry – land-registry particle;
3) a land-registry certificate, contract or decision made by the competent authority on which basis the investor gained the right of utilization for construction, a partnership made with the owner of the property, and/or real estate, the contract on concession by which the construction right is acquired;
4) three copies of the main project;
5) a written report on an executed control of the main project;
6) a written report and confirmation of the performed validation;
7) reports on research works, if they contain information useful for the plotting of the main project, as well as a technological report if necessary;
8) consents and permits acquired during the issuing of the urban planning consent for the subject building;
9) other supplements defined by specified laws.

The investor must report the beginning of the constructional work to the relevant ministry in written form, at least eight day before the construction start. Should the construction work be interrupted for a period longer than three months, the investor must report the continuation of the work in written form[66].

The built construction or its part representing an economic and technical unit that can be independently utilized as it is can be utilized only after the relevant ministry issues the permission for use. This permission is issued after the conducted technical examination[67].

[65] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 55
[66] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 65
[67] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 66

The investor submits the request for the issuing of permission for use to the relevant ministry. Along with the request, the following documents have to be submitted[68]:

1) a copy of the building permit,
2) a copy of the land-registry plan with the plotted position of the structure,
3) a written report from the contractor regarding performed actions and maintenance terms for the structure,
4) a written report regarding performed construction supervision.

The relevant ministry must execute the technical examination of the structure within 30 days from the reception of a valid request for the issuing of a usage approval. The technical examination confirms that the structure has been constructed according to the technical documentation by which the construction approval had been granted, the technical regulations and norms, as well as conditions for the structure in question defined by specified regulations. The relevant ministry appoints a board of experts for the technical examination by judgement, meaning the president and members of the board. The relevant ministry notifies the investor, the president and members of the board within 10 days about the place, day and hour of the technical examination before the given date of the technical examination[69].

Until the adoption of the Spatial Plan of the Federation, the Spatial Plan of Bosnia and Herzegovina for the period from 1981 until 2000 shall be applicable, in part that is not inconsistent with the Constitution of the Federation. Until the adoption of the Spatial Plan of the Federation, areas of importance for the Federation are determined by the Parliament on the proposition of the Government[70].

The Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina presented in the previous chapters defines major legal provisions which regulate land utilization for construction purposes. However, the cantonal Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03) defines major provisions for the concession allocation procedure, the jurisdiction over concession allocation, the concession contract, the rights and

[68] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 67
[69] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 68
[70] Law on spatial planning and planned land utilization on the level of Federation of Bosnia and Herzegovina (Official gazette of Federation of BiH, No 2/06), Article 115

obligations of the concessionaire, conflict resolving, supervision and other matters of importance for the allocation of concessions on the territory of the County.

According to this law, a concession is allocated if the following is insured[71]:

1. a rational utilization of natural resources or goods in general usage;
2. a technical-technological advancement in the activity that is the subject of the concession, meaning a technical-technological unity of the system in the district of the infrastructure, an efficient functioning and rational management of these systems;
3. a protection and advancement of the living environment in consistence with the regulations concerning the protection of the living environment.

A concession can be allotted to a domestic or foreign legal subject. To a foreign legal subject, a concession is allotted in consistence with this law and the laws of the Federation of Bosnia and Herzegovina[72].

A concession can be allotted up to a 30-year term, depending on the subject of the concession and expected economic gain (profit) in the execution of the concession activity. Should exceptional circumstances emerge, which necessitate investments that require a longer period of time, the covenanted time can be extended, but cannot be longer that 50 years. The concession contract can be renewed for a period that cannot be longer than the half of the originally covenanted time. The concession duration terms do not include the time necessary for the conducting of preparation activities for the construction of the structure, meaning for the executive start of the concession activity. The decision concerning the extension or renewal of the Contract is brought by the County's Government on the proposal of the relevant ministry. The time for preparation activities is defined by the concession contract [73].

The proposal for the participation in the concession allocation is submitted to the Concessionaire. A proposal can be submitted by relevant ministries, other authorities of the county board, the competent authority of the local autonomy unit, and by an interested legal subject.

[71] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 3
[72] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 5
[73] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 6

The authorities of the county board, the competent authority of the local autonomy unit, and the interested legal subject submit the proposal via the relevant ministry, which is obliged to enclose its opinion regarding the proposal.

The proposal contains in chief[74]:

- the subject of concession,
- the reasons for allocating the concession, data on necessary financial and other means and terms for their insuring,
- terms of duration of the concession,
- basic conditions for the realization of the concession, purpose of use of the concession subject,
- an estimate of expected income and expenses regarding the subject of concession for the whole period the concession is allotted and technological possibilities for its completion,
- data concerning its effect on the infrastructure and other economic districts, as well as the effect of the concession activity on the unity of the technical-technological system and their efficient functioning and rational management,
- payment options, meaning the providing of a guarantee and other means that insure the completion of concession obligations and the amount of the auction deposit for the participation in the public auction,
- an evaluation regarding the effect of the activity that is the subject of concession of the living environment,
- an evaluation regarding necessary work-places and qualified work-force related to the completion of the concession,
- data regarding the necessity of settling property-rights,
- other data related to specific qualities of the concession subject,
- when submitted by an interested legal subject, the proposal should include personal data (company name, personal name, registration proof.

The resolution regarding the participation in the concession allocation contains[75]:

1. the subject of concession and determination of the area on which the concession activity is to be executed,
2. duration term of the concession,
3. means of allocating the concession,

[74] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 13
[75] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 15

4. conditions to be fulfilled by the concessionaire,
5. type, amount and payment options of the auction deposit,
6. criteria by which the most favorable bid is selected (intrinsic value, meaning the financial rating of the bidder, offered amounts of the concession compensation, as well as the participation amount of the realized income and other),
7. conditions and manner of executing the concession activity (conditions and manner of providing services for the beneficiaries),
8. conditions regarding the protection of the living environment,
9. type and amount of guarantee or other means of insuring the completion of the concession,
10. manner of determining the concession compensation,
11. basic elements of the public auction announcement,
12. other elements of importance for the regulation of mutual rights and obligations of the concessionaires (engagement of local contractors, equipment, workforce and other),
13. other matters of importance for a specific concession.

A concession can be allotted on the basis of a conducted public competition (tender) or competition per bidding, as decided by the concessionaire[76]. Furthermore, should the bidder submit a proposal for a concession allocation, for which no tenders have been invited, the concessionaire estimates the existing interest for the concession in question. The procedure of concession allocation is conducted as prescribed by this Law on concessions[77].

So far, the major legal provisions which regulate use of renewable energy and cogeneration, REN project registration procedure, energy purchasing and fees, land utilization for construction purposes, and concession allocation procedure have been explained. The following section will explain the process of acquiring status of eligible electricity producer, which is defined by regulatory the Commission for Electricity in Federation of Bosnia and Herzegovina (FERC) in its Regulation for licensing[78].

[76] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 16
[77] Law on concessions (Official Gazette of Herceg-Bosnian County, No 14/03), Article 30
[78] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005

This regulation provides the following definitions[79].

- **DERK**—the State Electricity Regulatory Commission,
- **Distribution**—the transport of electricity on low voltage and medium system with the goal of delivery to final customers,
- **Permit to work** (license)—an authorization issued by FERC to perform a certain electricity industry,
- **The electric power company**—a business entity that is engaged in one or more activities of field of production, distribution and supply of electricity,
- **FERC**—the Regulatory Commission for Electricity in Federation of Bosnia and Herzegovina,
- **The holder of permit** (license)—a legal / physical subject who was issued a license to perform electricity industry,
- **A qualified manufacturer**—the manufacturer who in a single manufacturing facility produces electricity using waste or renewable electricity on economically appropriate manner, including combined cycle of heat and electricity production, which is aligned with environmental protection, and who can acquire such a status on the basis of Regulatory Commission's resolution,
- **General Conditions for Electricity Supply**—the terms that define the energy and technical terms, and economic relations between the production and distribution, system users and the end user of electricity, including the applicant for obtaining Electricity consent,
- **Distribution Operator**—a specially organized part of the electric power company that controls the power distribution network,
- **Applicant**—a legal or individual subject who applies for a license,
- **Production**—production of electricity,
- **Manufacturer**—an individual subject or legal entity that produces electricity,

Period of validity of licenses for production of electricity after the functional Separation will be a period of 30 years, starting from the date of functional separation or from the date of the beginning of the exploitation of new distribution facility. In this case, the separation means accounting unbundling of generation,

[79] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 4

distribution, and supply of electricity, and the validity period for the initial license before unbundling will not be longer than two years from the date of issuance[80].

An application for a license to conduct electricity industry needs to be submitted on the following forms:

a) **Form 1**: ZP—an application for a license to produce electricity energy (Appendix D),
b) **Form 4**: ZPDP—an application for prior permission to build a manufacturing facility[81] (Appendix E).

After receiving the request, FERC will determine whether the received request is complete or not. FERC will send written notice to the applicant of the outcome of review requests within the 30 days of receipt of the request. Also, an application is consider as being complete after all the required documents are submitted, One time fee for processing the application is paid, the applicant provides a statement about assuming the obligation to pay the regulatory fees, and the applicant provides a statement of the accuracy of the submitted information under full criminal and financial responsibility[82].

The application for issuance of licenses for production or distribution must be attached along with the following Documents[83]:

a) an excerpt from the court registry, the competent court,
b) registration and tax number of the applicant,
c) the statute of the applicant,
d) the applicant's organizational structure and employees qualification structure based on which the technical eligibility qualifications to conduct the electricity industry can be evaluated,
e) the decision of the competent inspection of the technical condition and safety facilities and environmental permits and occupancy permits for electric power facilities,

[80] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 7
[81] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 9
[82] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 10
[83] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 19

f) certificate of no criminal record of the applicant for infractions and violations in connection with environmental protection, as well as a certificate of no criminal record for the board members of the applicant for criminal offenses, infractions and offenses related to the environmental protection,
g) certificate of the competent court against the applicant is not running bankruptcy or liquidation,
h) proof that the applicant has achieved the right of ownership or legal basis for exploitation of power plants, buildings, and land through which and on which he or she does the electricity industry. In case that the existing electric power companies do not meet this requirement, FERC will determine the deadline,
i) a statement of whether the plant, appliances, and equipment are insured and at which insurance company they are insured,
j) a statement of possessing the ISO certification, and if not, is there a plan when it will be obtained,
k) a certificate or statement of applicant's commercial banks about his or her solvency,
l) a statement of any transaction account of the applicant at commercial banks and bank certificates of applicant's status,
m) a statement of work, balance sheet, income statement, cash flow, and report of an independent auditor for the previous three years,
n) tabular review of power plants and facilities that will perform the licensed activity,
o) the technical parameters of power plants and facilities to be used to conduct the licensed activity,
p) a three-year plan for construction, maintenance, and use of electric power facilities,
q) the applicable agreements concluded with other people who have influence on the technical qualifications, if any were concluded,
r) a valid concession contract for the performance in the electricity sector, if electricity activity is conducted on the basis of concession,
s) for the activities of electricity distribution, it is necessary to submit the number of customers with the structure of consumption, as well as the exact geographic description and map of the area where the distribution is to be performed,

t) a statement of the applicant on existing permits issued by other regulatory commissions or requests for permits submitted to other Regulatory Commissions in Bosnia and Herzegovina or in other countries,

u) any other information considered by FERC, at any stage procedure for making a decision on the permit.

All evidence shall be submitted in original or certified copy, with the proviso that they must not be older 60 days.

Criterion for a decision on issuing licenses for electricity generation is formed so that the license for production of electricity will be issued to the applicant who proves that[84]:

a) meets all technical, operational, safety and other requirements in accordance with applicable regulations and standards,

b) meets all established criteria for environmental protection and ensures a constant control of environmental impacts,

c) ensures the quality of production in terms of safety, reliability, energy efficiency and ancillary services and the quality electricity to customers in accordance with applicable regulations and standards,

d) has a sufficient number of staff with professional qualifications to perform activity,

e) the applicant or the board members are not convicted for economic offense or convicted by the criminal law for fraud or financial irresponsibility and were not convicted for significant permits violations or environment protection,

f) provides all appropriate financial guarantees for the business,

g) complies with market rules prescribed for the electricity market,

h) has ability to ensure the accounting reports to FERC in the form and details required by FERC or other regulatory authorities,

i) has financial and technical capacity for the waste disposal in connection with production and the closure and / or removal of all production facilities in accordance with technical and environmental conditions.

[84] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 21

The construction or reconstruction of any power facility for the production and distribution of electricity should not be undertaken without prior permission for the construction issued by FERC. With the application for a permit prior to construction or reconstruction of the building for manufacturing or distribution of electric energy it is necessary to provide the following documents[85]:

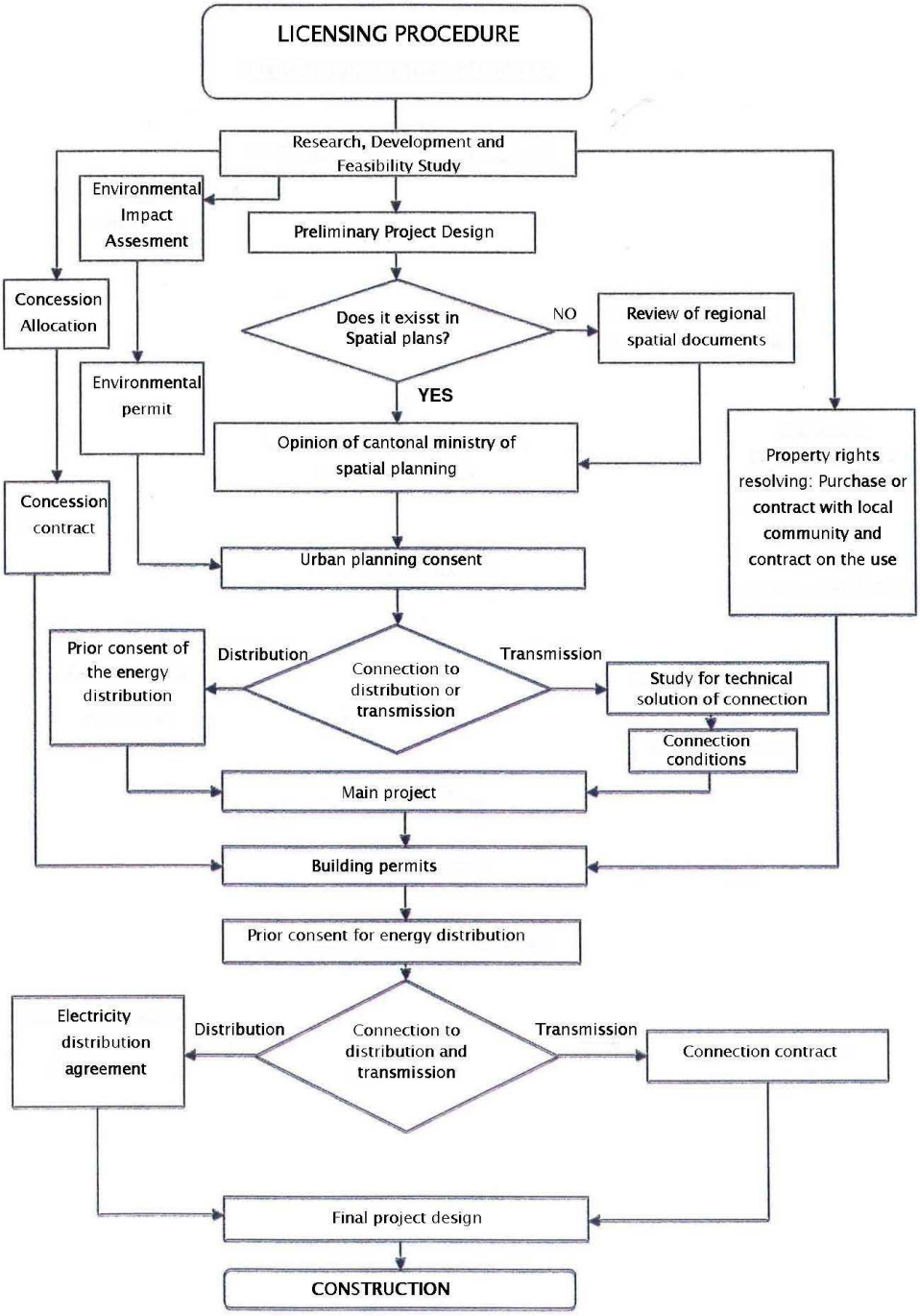
a) a certificate of registration issued by a competent court,
b) registration and tax ID number of the applicant,
c) the statute of the applicant,
d) a certificate or statement of commercial banks or credit institutions about the applicant's solvency or the possibility of securing funding for construction of the building,
e) a statement of any transaction account of the applicant at commercial banks and bank certificates of their status,
f) certificate of no criminal record of the applicant for infractions and violations in connection with economic offenses and environmental protection, as well as a certificate of no criminal record for board's members for criminal offenses, infractions and violations related to economic offences and environmental protection,
g) a feasibility study (where necessary),
h) environmental permit,
i) approved the investment and technical documentation for the facilities for whose construction is Permit is sought,
j) evidence on resolved legal-property relations for construction real estate,
k) the relevant concession agreement for the performance of the electricity industry if the industry is done on the basis of concession allocation,
l) Business Plan,
m) a statement of the applicant on existing permits issued by other regulatory commissions or requests for permits submitted to other Regulatory Commissions in Bosnia and Herzegovina or in other countries,
n) any other information that FERC deems necessary to make a decision upon request.

[85] Commission for Electricity in Federation of Bosnia and Herzegovina, Regulation for licensing, 28 April 2005, Article 36

10. Licensing procedure

Any investor interested in investing in the renewable energy projects in the Federation of Bosnia and Herzegovina has to go through quite complicated licensing procedure. This procedure is a summary of the previous chapter (Legal framework), and it is presented in Figure 13.

Figure 13. Licensing procedure for a renewable energy plant



11. Conclusion

Probably, biogas will not change the structure of energy sources on a large scale, but it will significantly contribute to environmental hygiene by eliminating organic materials exposed to decay and enabling primary energy to be returned and used for different end-users applications. Even though biogas projects require large initial investments, in most cases, the payback on investment is expected to be 6-8 years. For this specific project, the payback time on investment is 7 years and 6 months. And, as it is presented in Table 20, this project is financially justified.

Table 20. Calculation summary

		Amount	Unit
1	**Investment costs**	**- 3.100.000,00**	**€**
2	**Feedstock data (year 1)**		
	Quantity of maize silage TS=32%	3.000,00	t/year
	Quantity of grass silage TS=40%	14.000,00	t/year
	Quantity of cattle/pig manure TS=10%	3.000,00	t/year
	Feedstock in biogas plant-total	**20.000,00**	**t/year**
	Average cost of feedstock per year	- 251.231,00	€/year
3	**Plant data**		
	Average biogas yield	3.445.000,00	m³/year
	Average energy yield	18.311.000,00	kWh/year
	Estimated electrical power output	7.326.712,00	kWh/year
	Estimated electrical power consumption	512.870,00	kWh/year
	Produced amount of compost TS=25%	- 14.014,00	t/year
	Produced amount of liquid digestate TS=5%	30.053,00	t/year
4	**Revenues on energy**		
	Average revenues on selling electricity	751.100,68	€/year
	Average revenues on selling heat	202.662,25	€/year
5	**Plant working costs**		
	Average total business costs	- 770.267,10	€/year
6	**Average Earning Before Interests**	**252.737,64**	€/year
7	**Internal Return Rate of project (IRR)**	**10,74**	%
8	**Annual Capital costs**	**- 259.241,55**	**€/year**
9	**Project's NPV**	**871.236**	**€**

Biogas plants represent decentralized energy sources attracting local entrepreneurs, especially the farmers who can cover their complete needs for heating, cooling, and electrical needs, and moreover, they can make significant additional income after selling the excess energy. This additional financial security not only could keep them competitive in the market, but it could also provide competitive advantage and provide sustainable agricultural development.

The chemical and physical conditions within the substrate and in the bioreactor determine the output of biogas, and therefore influence the profitability. For that reason, numerous process parameters should be controlled by qualified professionals on daily basis to make sure that the optimal conditions are reached.

In order to secure reliable feedstock for the plant, besides the own capacity (cattle and pig farm, corn fields), the investor will have to create firm contracts with other individual farmers. These contracts should define the commitments and obligations of both interested sides. Based on the risk analysis, it is obvious that besides the contracts on electricity and heat purchase, the contracts on raw material supply are the key to success or failure of the whole project.

Since this kind of project is something new for the market and farmers in Bosnia and Herzegovina, the investor will also have to put significant effort to train and educate local partner farmers to make sure the right practice is applied and the optimal quality of feedstock is produced.

Like the other sources of renewable energy, biogas production could contribute to energy diversification in Bosnia and Herzegovina. It could also reduce consumption of fossil fuels, help in environment protection, and create new jobs in manufacturing and agriculture. The country's energy system will be further adjusted and connected to the EU market.

Usually, production and use of biogas from anaerobic digestion has a positive effect on environmental and socio-economic benefits not only for the involved farmers, but also for the society as a whole. Exploiting the internal value chain of biogas can improve the local economic conditions, provide jobs in rural areas, and increase purchasing power in the region, and therefore help in improving the living standards and contribute to the economic and social development.

Like the other European countries, Bosnia and Herzegovina has the target assigned for 2020, and in order to fulfill the target, it will have to introduce significant number of the renewable energy projects in relatively short period of time. This project justifies investments in biogas production in the energy market of Bosnia and Herzegovina.

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Appendix A—Profit & Loss statement

Project	Farm Based Biogas Plant-Livno															
Project Number	1															
Profit & Loss Statement																
				YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10	YEAR 11	YEAR 12	YEAR 13	YEAR 14	YEAR 15
Revenues from sellings			increase/y															
Electricity ; Guaranteed electricity price for biogas cogeneration	81 EUR/MWh	7.326.712 kWh/y	**4,0%**	597.052	620.934	645.771	671.602	698.466	726.405	755.461	785.679	817.106	849.791	883.782	919.133	735.307	764.719	795.308
Electricity green certificates 1.-3. year	0 EUR/MWh	0 kWh/y	**0,0%**															
Electricity green certificates 4. year	0 EUR/MWh	0 kWh/y	**0,0%**															
Electricity green certificates 5.-15. year	0 EUR/MWh	0 kWh/y	**0,0%**															
Heat	20 EUR/MWh	8.789 MWh/y	**2,0%**	175.786	179.301	182.887	186.545	190.276	194.082	197.963	201.922	205.961	210.080	214.282	218.567	222.939	227.397	231.945
0	0,0 cent/kWh	0 kWh/y	**0,0%**															
CO2 certificates	0,00 MT/y	0,0 EUR/MT_CO2	**2,0%**															
Revenues 1	0,0 cent/kWh	0 kWh/y	**0,0%**															
Raw materials																		
Maize silage	3000 t/y	25,0 EUR/t	**2,0%**	75.000	76.500	78.030	79.591	81.182	82.806	84.462	86.151	87.874	89.632	91.425	93.253	95.118	97.020	98.961
Gras silage	14000 t/y	10,0 EUR/t	**2,0%**	140.000	142.800	145.656	148.569	151.541	154.571	157.663	160.816	164.032	167.313	170.659	174.072	177.554	181.105	184.727
Cattle/pig manure	3000 t/y	1,0 EUR/t	**2,0%**	3.000	3.060	3.121	3.184	3.247	3.312	3.378	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.958
0	0,0	0,0 EUR/t	**2,0%**															
0	0,0	0,0 EUR/t	**2,0%**															
0	0,0	0,0 EUR/t	**2,0%**															
Operating costs																		
Maintenance	0,00%	102.150 EUR	**2,0%**	102.150	104.193	106.277	108.402	110.570	112.782	115.037	117.338	119.685	122.079	124.520	127.011	129.551	132.142	134.785
Personal costs	1	15.000 EUR	**2,0%**	15.000	15.300	15.606	15.918	16.236	16.561	16.892	17.230	17.575	17.926	18.285	18.651	19.024	19.404	19.792
Unforseeable	0,0%	3.000 EUR	**2,0%**	3.000	3.060	3.121	3.184	3.247	3.312	3.378	3.446	3.515	3.585	3.657	3.730	3.805	3.881	3.958
Consumables	0	25.500 EUR	**2,0%**	25.500	26.010	26.530	27.061	27.602	28.154	28.717	29.291	29.877	30.475	31.084	31.706	32.340	32.987	33.647
0	0	0 EUR	**2,0%**															
Consultancy services before operation/y	0	**100.000 EUR**	**2,0%**															
Costs for electricity (self demand)	0	41.794 EUR	**4,0%**	41.794	43.465	45.204	47.012	48.893	50.848	52.882	54.998	57.197	59.485	61.865	64.339	51.471	53.530	55.672
Other costs																		
Insurance	EUR	10.000	**2,0%**	10.000	10.200	10.404	10.612	10.824	11.041	11.262	11.487	11.717	11.951	12.190	12.434	12.682	12.936	13.195
Administration	EUR	24.000	**2,0%**	24.000	24.480	24.970	25.469	25.978	26.498	27.028	27.568	28.120	28.682	29.256	29.841	30.438	31.047	31.667
Land	EUR	0	**2,0%**															
Project Preparation costs	EUR		**2,0%**															
0	EUR	0	**2,0%**															
EBITDA				**333.394**	**351.167**	**369.739**	**389.145**	**409.420**	**430.600**	**452.723**	**475.829**	**499.959**	**525.157**	**551.466**	**578.934**	**402.458**	**424.183**	**446.891**

Depreciations																	
(1) Engineering: Permission Engineering, Expertices, Environmental Impact accessment, tendering, detailengineering, site supervision and back offices services	300.000	15 years	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
(2) Deliveries:																	
Machinery	700.000	15 years	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667
Electrical Equipment	300.000	15 years	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000	20.000
0	0	15 years															
Building facility	700.000	15 years	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667	46.667
Auxilliary Facilities	150.000	15 years	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000	10.000
Electrotechnic & Control system + Grid Connection	600.000	15 years	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000	40.000
0	0	15 years															
0	0	15 years															
0	0	15 years															
TÜV approval	30.000	15 years	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
Wheel loader	70.000	10 years	7.000	7.000	7.000	7.000	7.000	7.000	7.000	7.000	7.000	7.000	0	0	0	0	0
EBIT			**141.060**	**158.833**	**177.406**	**196.812**	**217.087**	**238.267**	**260.390**	**283.496**	**307.626**	**332.823**	**366.133**	**393.600**	**217.124**	**238.850**	**261.558**
Prefinancing costs		155000															
MEZZANINE: Remaining Redemption		0 years															
MEZZANINE repayment rate																	
LOAN: Remaining Redemption		15 years															
LOAN repayment rate			259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242	259.242
Working Capital LOAN		0 years															
Working Capital Loan repayment rate																	
- Interests EQUITY	**0,0%**																
0	**0,0%**																
- Interests LOAN	**6,5%**																
ß	**0,0%**																
costs for interests operating account	6,00%	3 m EURIBOR + 2%															
income for interests operating account	1,50%	3 m EURIBOR - 2%															
EBT			**-118.181**	**-100.408**	**-81.836**	**-62.429**	**-42.155**	**-20.975**	**1.148**	**24.254**	**48.384**	**73.582**	**106.891**	**134.359**	**-42.117**	**-20.391**	**2.316**
- Corporate taxes		10%	0	0	0	0	0	0	115	2.425	4.838	7.358	10.689	13.436	0	0	232
Earnings After Corporate Taxes			**-118.181**	**-100.408**	**-81.836**	**-62.429**	**-42.155**	**-20.975**	**1.033**	**21.829**	**43.546**	**66.224**	**96.202**	**120.923**	**-42.117**	**-20.391**	**2.084**

DCF -methode															
Earings After Corporate Taxes		-118.181	-100.408	-81.836	-62.429	-42.155	-20.975	1.033	21.829	43.546	66.224	96.202	120.923	-42.117	-20.391	2.084
+ Depreciation		192.333	192.333	192.333	192.333	192.333	192.333	192.333	192.333	192.333	192.333	185.333	185.333	185.333	185.333	185.333
CAPEX																
Subsidies Grants from EU structure fund	0%															
Free Cash Flow		**74.152**	**91.925**	**110.498**	**129.904**	**150.179**	**171.358**	**193.367**	**214.162**	**235.879**	**258.557**	**281.535**	**306.256**	**143.216**	**164.942**	**187.418**
cum free cash flow		74.152	166.077	276.575	406.479	556.657	728.016	921.382	1.135.544	1.371.424	1.629.981	1.911.516	2.217.772	2.360.988	2.525.930	2.713.348
decrease rate factor	0,06000	1,060	1,124	1,191	1,262	1,338	1,419	1,504	1,594	1,689	1,791	1,898	2,012	2,133	2,261	2,397
Discounted Free Cash Flow		69.955	81.813	92.776	102.896	112.222	120.801	128.600	134.368	139.617	144.377	148.309	152.200	67.145	72.954	78.203
Discounted Cumulative Free Cash Flow		69.955	151.768	244.544	347.440	459.662	580.463	709.063	843.431	983.047	1.127.424	1.275.733	1.427.933	1.495.079	1.568.033	1.646.235
Cross Profit/Loss Margin = (Revenues-Raw Materials)/Revenues																
obracun gubitka = (prihodi - sirovina)/prihodi		**71,8%**	**72,2%**	**72,6%**	**73,0%**	**73,4%**	**73,9%**	**74,3%**	**74,6%**	**75,0%**	**75,4%**	**75,8%**	**76,2%**	**71,1%**	**71,6%**	**72,0%**
		18,3%	**19,8%**	**21,4%**	**22,9%**	**24,4%**	**25,9%**	**27,3%**	**28,7%**	**30,1%**	**31,4%**	**33,3%**	**34,6%**	**22,7%**	**24,1%**	**25,5%**
		-15,3%	**-15,3%**	**-12,5%**	**-9,9%**	**-7,3%**	**-4,7%**	**-2,3%**	**0,1%**	**2,5%**	**4,7%**	**6,9%**	**9,7%**	**11,8%**	**-4,4%**	**-2,1%**
Net Profit Margin		**-15,3%**	**-12,5%**	**-9,9%**	**-7,3%**	**-4,7%**	**-2,3%**	**0,1%**	**2,2%**	**4,3%**	**6,2%**	**8,8%**	**10,6%**	**-4,4%**	**-2,1%**	**0,2%**
Liquidity Calculation																
Revenues from sellings		**772.837**	**800.235**	**828.658**	**858.147**	**888.742**	**920.486**	**953.424**	**987.602**	**1.023.067**	**1.059.871**	**1.098.064**	**1.137.701**	**958.245**	**992.116**	**1.027.253**
-Raw materials		**-218.000**	**-222.360**	**-226.807**	**-231.343**	**-235.970**	**-240.690**	**-245.503**	**-250.413**	**-255.422**	**-260.530**	**-265.741**	**-271.056**	**-276.477**	**-282.006**	**-287.646**
-operating costs		**-179.650**	**-183.243**	**-186.908**	**-190.646**	**-194.459**	**-198.348**	**-202.315**	**-206.361**	**-210.489**	**-214.698**	**-218.992**	**-223.372**	**-227.840**	**-232.396**	**-237.044**
-other costs		**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-192.333**	**-185.333**	**-185.333**	**-185.333**	**-185.333**	**-185.333**
Redemption																
Equity	620.000															
mezzanine																
Loan	2.480.000															

Appendix B—Capital costs

Project: Farm Based Biogas Plant-Livno	Project Number:	1	Project Leader:
Subsidies: 0%	Depreciation period	15 years	
Fuel: Biogas			

#VALUE!

Group of costs and Type of costs	Investment costs [EUR]	Average Life [years]	Maintenance costs per year [%]	Annual Maintenance costs [EUR/a]
A. Capital costs troskovi investicije				
A.1 **EPC Contract all inclusive**	3.100.000			102.150
A.1.1 (1) Engineering: Permission Engineering, Expertices, Environmental Impact accessment, tendering, detailengineering, site supervision and back offices services	300.000		0,0%	0
A.1.2. (2) Deliveries:				
A.1.2.1 Machinery	700.000		5,0%	35.000
A.1.2.2 Electrical Equipment	300.000		5,0%	15.000
A.1.2.3				
A.1.2.4 Building facility	700.000		2,0%	14.000
A.1.2.5 Auxilliary Facilities	150.000		2,0%	3.000
A.1.2.6 Electrotechnic & Control system + Grid Connection	600.000		5,0%	30.000
A.1.2.7				
A.1.2.8				
A.1.2.9 Land & infrastructure	250.000		1,5%	3.750
A.1.2.10 TÜV approval	30.000			
A.1.2.11 Wheel loader	70.000		2,0%	1.400
Total CAPEX Sum all inclusive	**3.100.000,00 €**			**102.150,00 €**

Appendix C—Groups and types of costs

Project: Farm Based Biogas Plant-Livno | Project Number: 1 | Project Leader:

Subsidies: 0% | Depreciation period 15 years

Fuel: Biogas

Average biogas yield		**3.445.000**	m³/y	from Balance of Heat
Average energy yield		**18.311.000**	kWh/y	
Electrical power output		**7.326.712**	kWh/y	from Balance of Heat
Electrical power-self demand	7%	**512.870**	kWh/y	One Boiler solution
Heat output		**8.789.280**	kWh/y	

	Group of costs and Type of costs	Investment cost [EUR]	Repayment period [years]	Interests [%]	annual costs [EUR/a]	comments
A.	**Capital costs**					
A.1	EPC Contract all inclusive	3.100.000				
	Total capital costs	3.100.000,00 €				
	Financing					
	Equity	620.000				
	Mezzanine	0				
	Loan	2.480.000	15 years	6,5%	259.242	
		intermediate sum A1 ... A11			259.242	without grants
	Total capital costs	3.100.000,00 €			**259.242**	with subsidies (grant)

B.	**Raw Materials**	Biogas yield (m³/t)	EUR/t	t/y		
B.1	Maize silage	**190**	25,00 EUR/t	3000 t/y	75.000	
B.2	Gras silage	**200**	10,00 EUR/t	14000 t/y	140.000	
B.3	Cattle/pig manure	**25**	1,00 EUR/t	3000 t/y	3.000	
B.4						
B.5						
B.6						
		B1 ... B6			**218.000**	

C.	Operating costs					Remark
C.1	Maintenance				102.150	2% of Construction/Buildins/Earth works, 5% of machinery, 5% of electrical equipment, 5% of CHP and grid access
C.2	Personal costs	1 persons			15.000	1 operator
C.3					3.000	
C.4	Consumables		60 EUR/h	425 h	25.500	loading/moving machinery on site: Fuel, Tires, rent of a telescopic front loader
C.5						
C.6						
C.7	Costs for electricity (self demand)				41.794	
		intermediate sum C1 ... C7			187.444	

D.	Other costs ostali troskovi					
D.1	Insurance	of Investment			10.000	
D.2	Administration				24.000	
D.3	Land Rental costs				0	
D.4					0	
		intermediate sum D1 ... D4			34.000	

E.	Total costs				669.286	

F.	Revenues					
F.1	Electricity ; Guaranteed electricity price for biogas cogeneration	7.326.712 kWh/y	81,490 EUR/MWh		597.052	
F.2	Electricity green certificates 1.-3. year				0	
F.3	Electricity green certificates 4. year				0	
F.4	Electricity green certificates 5.-15. year				0	
F.5	Heat	8.789 MWh/y	20,000 EUR/MWh		175.786	
F.6						
F.7	CO2 certificates					
F.8	Revenues 1					
		intermediate sum F1 ... F5			772.837	

Appendix D—Form 1 – ZP (Request for issuance of work permit-licenses for electricity production)

FORM 1 - ZP

BOSNIA AND HERZEGOVINA
FEDERATION OF BOSNIA AND HERZEGOVINA

REGULATORY COMMISSION FOR ELECTRICITY IN
FEDERATION OF BOSNIA AND HERZEGOVINA

MOSTAR
Blajburških žrtava 33

REQUEST FOR ISSUANCE OF WORK PERMIT–LICENSES FOR ELECTRICITY PRODUCTION

Applicant:
(Name and address of applicant)

.....
.....
.....
.....
.....

We apply for issuance of work permits - licenses for the electricity industry of **Production of electrical energy** in accordance with the provisions of the Law on Electricity, "Official Gazette of FB&H, No. 41/02

A. APPLICANT'S GENERAL INFORMATION		
Name		
Headquarters office		
Address		
ID		
Telephone	Fax	
E-mail		
Person in-charge	First Name	
	Surname	
	Address	

Have you been performing the electricity industry for which you are seeking a license, or some other electricity industry? YES NO		
The existing electricity industries of the applicant	1	
	2	
	3	
	4	

Form 1: Request for issuance of licenses for electricity production Page 1 of 4

B. BASIC TECHNICAL DATA (Separated by units)				
Unit	Location	Fuel Type	Installed Capacity (MW)	Annual Production (MWh)

C. BASIC FINANCIAL DATA FROM LAST REPORTING PERIOD INCOME STATEMENT		
No.	DESCRIPTION	BAM (Bosnian Mark)
1	Business income from core activities	
2	Business expenses from core activities	
3	Business gain - loss	
4	Other income	
5	Total income (1 + 4)	
6	Other expenses	
7	Total expenses (2 + 6)	
8	Financial balance – gain/loss (5 – 7)	
9	Taxes and contributions from profit	
10	Net income – gain/loss (8 – 9)	

FINANCIAL DATA FROM LAST REPORTING PERIOD BALANCE SHEET				
No.	DESCRIPTION	BAM		% Write-off
		Historic Value	Present value	
1	Buildings and land			
2	Equipment and facilities			
3	Other fixed assets			

OTHER FINANCIAL DATA		
No.	DESCRIPTION	BAM
1	Depreciation expense	
2	Average cash balance (Debit transactions by bank accounts and Treasury)	
3	The amount of total indebtedness for loans	
4	Repaid loan amount	
5	The amount of loans payable and accrued interest on loans (short-term loan plus a portion of long-term loans)	

D. PROFESSIONAL QUALIFICATION OF EMPLOYEES			
Education level	Employees profession	Number of employees	Type of contract

E. STATEMENTS			
No.	**Statement**	**YES**	**NO**
1	Legal / individual subject which I represent is registered for the electricity industry for which I am requesting permission		
2	Legal / individual subject which I represent really has the listed qualified workers		
3	Legal / individual subject which I represent has funds specified in the request		
4	Legal / individual subject which I represent can obtain financing in the amount necessary for the performance of the electricity industry		
5	Legal / individual subject which I represent has actual facilities, installations, facilities and equipment necessary for conducting the electricity industry		
6	Legal / individual subject which I represent is not taken away the license to conduct the electricity industry in the last 10 years prior to application		
7	Legal / individual subject which I represent has not been convicted, nor against it there have been the criminal proceedings related to the performance of the electricity industry		
8	During the period preceding the filing of the application to conduct the electricity industry, to legal subject which I represent there was issued decision of the competent authority for removal of shortcomings. If yes, legal / individual subject has removed those shortcomings		

F. EVIDENCE ATTACHED TO THE APPLICATION			
No.	EVIDENCE (original or certified copy)	ATTACHED (X)	
1	An excerpt from the competent court registry		
2	ID and tax number of the applicant		
3	The Statute of the applicant		
4	Resolutions of competent inspection of the facilities technical condition and safety, as well as environmental permits and occupancy permits for applicant's electric power facilities		
5	Organizational Structure of the applicant and the qualification structure of employees		
6	Certificate of the applicant's criminal record for infractions and misdemeanors in connection with environmental protection, as well as a certificate of no criminal record for the applicant's board members for criminal offenses, infractions and misdemeanors in connection with environmental protection in the field of applicants activity		
7	A certificate of the competent court that there is no process of bankruptcy or liquidation in process against the applicant		
8	Evidence that the applicant has achieved the right of ownership or legal basis for the exploitation of power plants, buildings and land, through which and on whom the electricity industry is done		
9	Statement of whether the plant, appliances, and equipment are insured and at which insurance company they are insured		
10	Statement of possessing the ISO certification, and if not, is there a plan when it will be obtained		
11	Certificate or statement of applicant's commercial banks about his or her solvency		
12	Statement of any transaction account of the applicant at commercial banks and bank certificates of applicant's status		
13	Statement of work, balance sheet, income statement, cash flow, and report of an independent auditor for the previous three years		
14	Tabular review of power plants and facilities that will perform the licensed activity		
15	Technical parameters of power facilities and plants that will be used to conduct licensed activities		
16	Tree-year plan for construction, maintenance and use of electric power facilities		
17	Existing contracts with other people who have influence on the technical qualifications, if any were concluded		
18	The relevant concession agreement for the performance of the electricity industry if the industry is done on the basis of concession allocation		
19	Statement of the applicant on existing permits issued by other regulatory commissions or requests for permits submitted to other Regulatory Commissions in Bosnia and Herzegovina or in other countries		

Appendix E— Form 4 – ZPDP (Request for issuance of prior permission to build a manufacturing facility)

Form 4 - ZPDP

BOSNIA AND HERZEGOVINA
FEDERATION OF BOSNIA AND HERZEGOVINA

REGULATORY COMMISSION FOR ELECTRICITY IN
FEDERATION OF BOSNIA AND HERZEGOVINA

MOSTAR
Blajburških žrtava 33

REQUEST FOR ISSUANCE OF PRIOR PERMIT TO BUILD A MANUFACTURING FACILITY

Applicant:
(Name and address of applicant)

.....
.....
.....
.....
.....

We apply for issuance of prior permit to build a manufacturing facility in accordance with the provisions of the Law on Electricity, "Official Gazette of FB&H, No 41/02

A. APPLICANT'S GENERAL INFORMATION		
Name		
Headquarters office		
Address		
ID		
Telephone	Fax	
E-mail		
Person in-charge	First Name	
	Surname	
	Address	

Have you been performing the electricity industry for which you are seeking a license, or some other electricity industry? YES NO		
The existing electricity industries of the applicant	1	
	2	
	3	
	4	

Form 4: Request for prior permit to build a manufacturing facility Page 1 of 5

B. BASIC TECHNICAL DATA

B1. LOCATION AND TYPE OF POWER PLANT

- Indicate the exact location of power plant and describe in detail the wider geographical area in which it is planned to the build power plant.

- For hydro power plant, describe the confluence of river, accumulation, give the names of settlements that will eventually be flooded, list the roads that will eventually be submerged.

- For thermal power plant, along with its location, describe the space intended for the disposal of slag.

- For wind and solar power plants, indicate the area of space that will be used.

- Attach a revised investment and technical documentation for the planned production facility, excerpt from a three-year investment plan, feasibility study, urban and building consent, and building permission for subject production facility.

- As an attachment to the request, submit a map of suitable scale with marked facility location facility.

B2. DESCRIPTION OF THE POWER PLANT'S PRODUCTION SECTION

I. For hydro power plants

Name of plant					
Name of basin					
Type of plant					
Type of dam		Height of dam		Width of dam	
Name of accumulation		Area and volume			
Name, length, and water supply cross-section profile					
Name, length, and water drain cross-section profile					
Type of turbine		Turbine's nominal power			
Type of generator		Generator's nominal power			
Planned annual electricity production (MWh)					
Option to run power plant without external supply	YES		NO		

If the plant has several production units, provide the same information for each production unit

II. For thermal power plants

Name of plant			
Number and unit capacity for each block			
Type of fuel		Fuel calorific power	
Producer and type of boiler			
Type of turbine		Turbine's nominal power	
Type of generator		Generator's nominal power	
Planned annual electricity production (MWh)			
Specific fuel consumption per kWh of produced electricity for each block			
Efficiency of each block			

If the plant has more blocks, provide the same information for each block

III. For renewable energy plant	
Name of plant	
Type of plant	
Number and unit power of generator	
Average annual electricity production (MWh)	

B3. CONNECTION TO PPOWER SYSTEM
- Indicate the voltage level and connection points of power plant to electrical system - Indicate the measuring location and voltage of delivered electricity - Provide distribution relationship, installed power, the type and kind of substation - Describe the characteristics of the place for measurement of delivered electricity

B4. INFORMATION ON THERMAL ENERGY BUYERS OR PROCESS STEAM BUYERS
- If the power supplies buyers with heat or with process steam please list customers by name, mode of delivery of thermal energy, thermal and electrical energy equivalent to the delivered energy. - Describe the heat measurement points and characteristics of heat measurement points

E. STATEMENTS			
No.	**Statement**	**YES**	**NO**
1	Legal / individual subject which I represent is registered for the electricity industry for which I am requesting permission		
2	Legal / individual subject which I represent really has the listed qualified workers		
3	Legal / individual subject which I represent has funds specified in the request		
4	Legal / individual subject which I represent can obtain financing in the amount necessary for the performance of the electricity industry		
5	Legal / individual subject which I represent has actual facilities, installations, facilities and equipment necessary for conducting the electricity industry		
6	Legal / individual subject which I represent is not taken away the license to conduct the electricity industry in the last 10 years prior to application		
7	Legal / individual subject which I represent has not been convicted, nor against it there have been the criminal proceedings related to the performance of the electricity industry		
8	During the period preceding the filing of the application to conduct the electricity industry, to legal subject which I represent there was issued decision of the competent authority for removal of shortcomings. If yes, legal / individual subject has removed those shortcomings		

F. EVIDENCE ATTACHED TO THE APPLICATION			
No.	EVIDENCE (original or certified copy)	ATTACHED (X)	
1	An excerpt from the competent court registry		
2	ID and tax number of the applicant		
3	The Statute of the applicant		
4	Certificate or statement of applicant's commercial banks or credit institution about his or her solvency or his or her ability to secure financing for building the plant		
5	Statement of any transaction account of the applicant at commercial banks and bank certificates of applicant's status		
6	Certificate of the applicant's criminal record for infractions and misdemeanors in connection with environmental protection, as well as a certificate of no criminal record for the applicant's board members for criminal offenses, infractions and misdemeanors in connection with environmental protection in the field of applicants activity		
7	Feasibility study (when needed)		
8	Environmental permit		
9	Approved investment and technical documentation for the facilities for whose construction the permit will be will required		
10	Evidence of the resolved property-legal relations in connection with real estate on which the construction is intended		
11	The relevant concession agreement for the performance of the electricity industry if the industry is done on the basis of concession allocation		
12	Business plan		
13	Statement of the applicant on existing permits issued by other regulatory commissions or requests for permits submitted to other Regulatory Commissions in Bosnia and Herzegovina or in other countries		