Final Report of the BiG>East Project

Promoting Biogas in Eastern Europe

Mobilization of decision makers and training for farmers

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BiG>East Partnership

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Abstract

In order to support the biogas market in Southern and Eastern Europe the BiG>East project "Promoting Biogas in Eastern Europe – Mobilization of Decision Makers and Training for Farmers" was supported by the European Commission under the Intelligent Energy for Europe Programme. The general objective of BiG>East was to promote the production and use of biogas as a secure and sustainable energy source in six target countries of Eastern and Southern Europe: Bulgaria, Croatia, Latvia, Romania, Slovenia, and Greece (BiG>East target countries). The BiG>East project aimed to build capacities and transfer knowledge from project partners of Western Europe with extensive biogas expertise to farmers, biogas plant operators, and decision makers in Southern and Eastern Europe. This was achieved by the organisation of 13 mobilisation campaigns for decision makers, 18 training courses for farmers, and several study tours. Show cases were elaborated to support the mobilisation campaigns, and training material (biogas handbooks) was prepared for the training courses. The present paper shows the experiences and lessons learnt during the implementation of the 31 month BiG>East project.

1 Introduction

Europe's current situation with increasing fossil energy prices and rising dependency on energy imports makes it highly necessary to produce and valorise biogas in terms of heat, electricity and fuel. Currently, the biogas sector in Western Europe is faced by rapid technical and non-technical developments and innovations, and biogas markets are growing at a considerable pace. In Germany, the biogas market is booming and there are currently about 4,500 biogas plants installed. Also Austria and Denmark have considerable biogas markets.

Although the biogas potential is very promising, especially if organic wastes are used, the biogas market in Southern and Eastern Europe is still very small. Some of the target countries have already established renewable energy laws (including the support of biogas production), others still lag behind.

The discrepancy between the different biogas markets in European countries is shown in Figure 1. The main agricultural biogas production is, among other countries, in Germany, Austria and Denmark. In contrast, very few or no agricultural biogas plants exist in Bulgaria, Croatia, Latvia, Romania, Slovenia, and Greece.

In order to support the biogas market in Southern and Eastern Europe the BiG>East project "Promoting Biogas in Eastern Europe – Mobilization of Decision Makers and Training for Farmers" (Contract No. EIE/07/214) was supported by the European Commission under the Intelligent Energy for Europe Programme.

The present report is the final report of the BiG>East project. It summarises the main results, activities, and achievements of the BiG>East project. This report is based on individual reports elaborated by the BiG>East consortium which are available on the BiG>East website for download (www.big-east.eu).

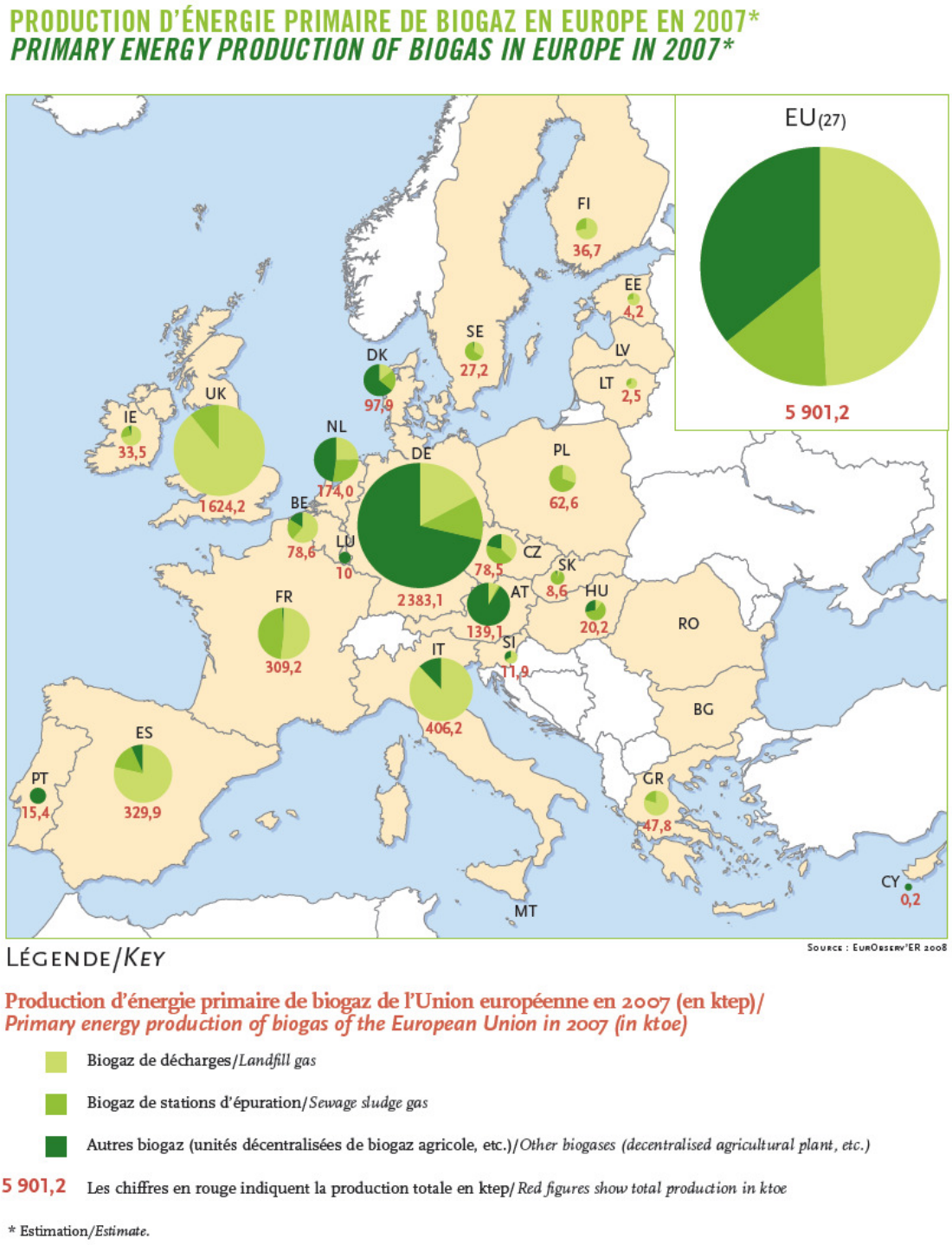

Figure 1: Primary energy production of biogas in Europe 2007 (EurObserv'ER Barometer)

2 The EU BiG>East Project

The general objective of BiG>East was to promote the production and use of biogas as a secure and sustainable energy source in six target countries of Eastern and Southern Europe: Bulgaria, Croatia, Latvia, Romania, Slovenia and Greece. This was achieved by knowledge transfer from project partners with extensive biogas expertise of Western Europe to farmers, biogas plant operators and decision makers in Southern and Eastern Europe. Furthermore,

studies on national legislations, policies, barriers, biogas potential, agricultural structures, and utilisation opportunities of biogas in the BiG>East target countries were assessed.

The BiG>East project was coordinated by WIP Renewable Energies and included twelve organisations which elaborated the following tasks of the BiG>East project:

- Studies on the biogas potential and barriers in the target countries
- Development of training handbooks for farmers in English and national languages
- Implementation of pilot training courses for farmers
- Identification of promising sites for the set-up of new biogas plants
- Organisation of mobilization campaigns for decision makers and funding bodies
- Dissemination of project results via workshops, technical study tours and presentations

The BiG>East project was launched at the Kick-Off-Meeting in Munich in October 2007. The two-days meeting was accompanied by a study tour to two innovative biogas plants in Germany in order to build capacity among the consortium.

3 Feedstock Potential in Southern and Eastern Europe

In each of the target countries (Bulgaria, Greece, Latvia, Romania, Slovenia) a study on biomass/biogas potential was elaborated in the framework of the BiG>East project. Any policy regarding the introduction of biogas into the energy strategy of different countries should be based on the real feedstock availability. Nevertheless, total biomass production alone (in terms of quantities) is not a strong indicator of the real biogas potential. In order to identify the categories of biomass available in each investigated region, and their potential to become feedstock for biogas production, the agro-ecosystems material flows were assessed.

In order to estimate the feedstock availability in each target country different feedstock sources for biogas production like waste and energy crops have been evaluated. A template including a software application was created by the BiG>East partner Mangus for all the other BiG>East partners in order to collect all the necessary data for the evaluation of the biogas potential based on the total biomass and biomass classes. In many cases the data were extracted from Eurostat.

During this study, it was discovered that in some countries there exists still a lack of reliable statistical data for assessing the biogas potential. More in-depth research on the biogas potential in Eastern Europe is needed, in order to present this to decision and policy makers.

When assessing the potential, “available biomass” has to be defined. In this study, energy crops were not considered due to sustainability reasons. Only the following biomass types were included:

- organic wastes from agriculture (both primary and secondary production)
- other organic residues (urban waste, food industry and sewage sludge)

With reference to previous studies, generally about 30 % of the organic wastes from agriculture and urban wastes could be used for biogas production. Based on this assumption, about 30 TWh/year is the real potential for biogas production for Bulgaria, Greece, Latvia, Romania, and Slovenia together. **This is around 10 % of the electrical power consumed in the five countries, which could be generated by organic wastes. This is very close to the EU 2020 year target share for renewable energies.** Due to technical reasons, Croatia was not included in this comparative analysis.

4 State of the Art of Biogas in Southern and Eastern Europe

As shown in chapter 3, Southern and Eastern Europe represents a great potential for biogas production and utilisation due to its significant agricultural sector and waste streams. However, this potential still remains unexploited. The biogas business sector identified these target countries as high potential biogas markets, but all share the same main barrier for its development: lack of suitable framework conditions for the set-up of new biogas plants. This missing framework conditions are related to three main areas:

- Lack of suitable policies and legislation
- High administrative burdens
- Difficult access to financing sources

If these barriers are not removed, the biogas development in these countries remains low. On the other hand, the production and wide-range utilisation of biogas could offer many benefits for Bulgaria, Croatia, Latvia, Romania, Slovenia and Greece, contributing to national and European legislation and targets as included in the Council Directives on: nitrate (Council Directive 91/676/EEC), waste (2006/12/EC), and landfill of waste (1999/31/EC), as well as in the regulation on fertilizers (2003/2003/EC). The production of biogas in Southern and Eastern Europe may especially contribute towards the 20% renewable energy target of the Directive “on the promotion of the use of energy from renewable sources” (RED) (2009/28/EC) which recognises that “the use of agricultural material such as manure, slurry and other animal and organic waste for biogas production has, in view of the high greenhouse gas emission saving potential, significant environmental advantages in terms of heat and power production and its use as biofuel. Biogas installations can, as a result of their decentralised nature and the regional investment structure, contribute significantly to sustainable development in rural areas and offer farmers new income opportunities”.

In the framework of the BiG>East project, an analysis on the different situations for biogas production was made in Bulgaria, Croatia, Latvia, Romania, Slovenia and Greece. In each target county a detailed assessment of existing biogas installations was conducted (Figure 2) in 2008. This included the number, size, and location of biogas plants. It is shown that the biogas market in Bulgaria, Croatia, Latvia, Romania, Slovenia and Greece is very low.

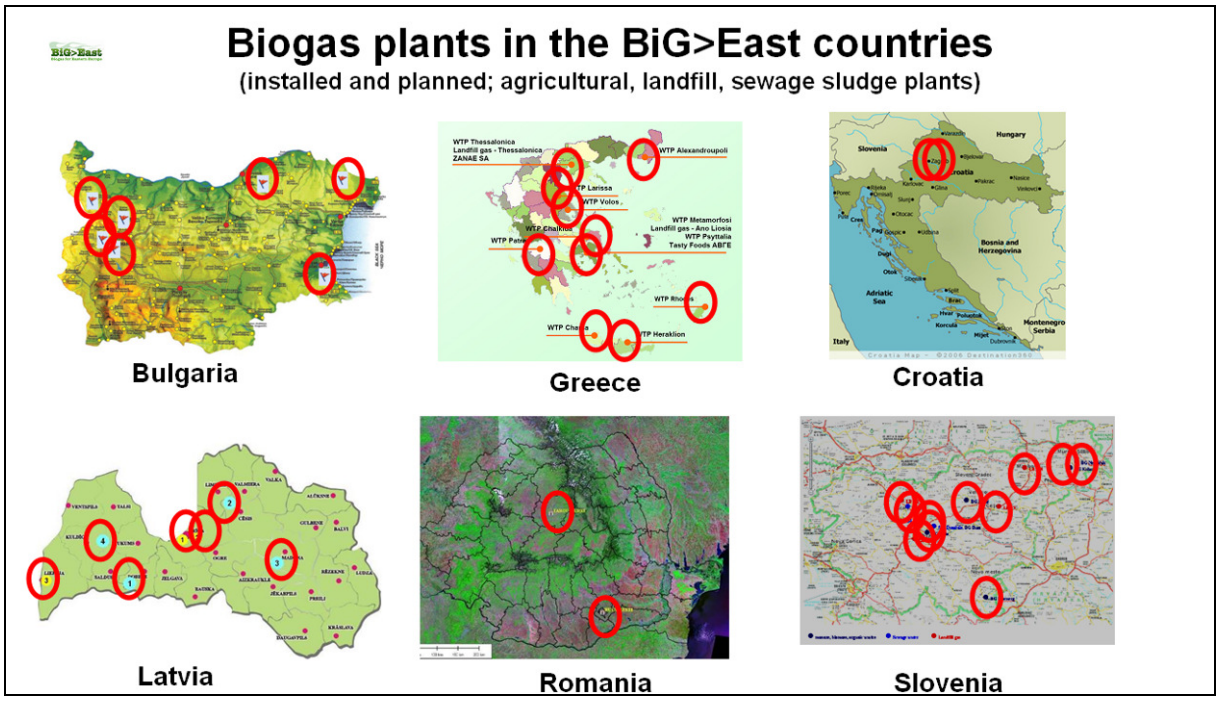

Figure 2: Existing and planned biogas plants in the BiG>East target countries (status 2009)

4.1 Biogas in Bulgaria

Bulgaria has excellent natural conditions for the development of agriculture and forestry. The favourable climate for the production of different crops and the existence of agricultural lands and animal farms contribute towards well-development agriculture and animal husbandry. This provides an opportunity for development of biomass potential for the production of biofuels and biogas, providing that the necessary support mechanisms are laid down in legislation.

In the "Renewable and Alternative Energy Sources and Biofuels Act", adopted in June 2007, there are no regulations in respect to biogas, yet. Thus, the Bulgarian regulation does not provide specific biogas support instruments as feed-in tariff, quota regulation/certificate mechanisms, tax incentives/investments grants and other financial resources. Future development of the biogas sector is highly dependant on the willingness of politicians and policy makers that formulate policies and introduce legislations.

Despite of interest in biogas projects is growing, in the last few years there are no operating agricultural biogas plants in Bulgaria, yet. Currently, four biogas plant are under construction and three are in the planning phase.

4.2 Biogas in Croatia

In Croatia, the BiG>East project was launched just in time when the Croatian legislation for the electricity production from renewable energies, including a feed-in tariff system, was introduced a year ago.

The legal framework for electricity production from renewable energies are present in Croatia. The feed-in tariff for biogas plants is organised in three different categories:

- biogas plants on agricultural waste, energy crops, etc.,
- biogas plants using landfill gas and
- biogas plants using sewage sludge from waste water treatment plants.

Among those categories, the feed-in tariff differs between the size of the plants which are smaller or larger than 1 MW. The feed-in tariff for agricultural biogas plants is abundant with 16.43 and 14.25 €c/kWh for 1 MW and > 1 MW plants, respectively, for 2007. The feed-in tariff is updated each year for the consumer price index. For 2010, the feed-in tariff is 18.23 and 15.80 €c/kWh for 1 MW and > 1 MW plants, respectively. Electricity from renewable energies generally have prioritised grid access for 12 years.

However, although this legislation is enforced, the procedure for obtaining the "eligible producer status" appears to be challenging for all renewables, including biogas. The eligible producer status makes the producer of electricity from renewable sources eligible for the feed-in tariff.

The biomass sector in Croatia is promising and foreign investors from countries with saturated biogas markets show their presence in Croatia. At the beginning of BiG>East, only one biogas plant was in operation: a landfill gas plant, established in 2004. The second biogas plant, adjacent to the Zagreb's waste water treatment plant, was in the building phase. In the media, many new agricultural biogas plants were announced and promoted as clean energy projects which also bring employment to rural areas. Unfortunately, 30 months later, only one agricultural biogas plant started its operation.

Currently 17 biogas projects are pending for getting the "eligible producer status" at the Croatian Registry of Renewable Energy and Cogeneration. 13 of them have not exceeded the maximum period valid for application (2 years). In addition, there are 14 biogas projects prepared for IPARD funds. In total, there are about 27 agricultural biogas plants in the course of investment which is about 81.5 M€.

4.3 Biogas in Greece

The biogas market in Greece is slightly more developed. During 2007 the produced biogas in Greece derives mainly from landfills, wastewater treatment plants and a couple of industrial applications. Although Greece has a promising potential of organic wastes and especially animal manure there was no farm scale biogas plant in operation at the beginning of the project (2007). During 2007 fifteen biogas plants were in operation in Greece. Most biogas was produced in the area of Athens due to the operation of the Municipal Wastewater Treatment Plant (MWTP) of Psytallia and the Sanitary landfill (SL) of Ano Liosia, which treat liquid and solid wastes respectively.

During the BiG>East project three industrial and two agricultural biogas plants have been constructed in Greece. Furthermore, in the framework of the calls for permits to generate electricity by Independent Power Producers (IPPs) by the Hellenic Regulation Authority for Energy (RAE), ten applications for such permits (biogas plants) were submitted during

12/2008-02/2010 for agricultural and industrial biogas projects (installed capacity of appox. 17.6 MW).

The law for Renewable Energy Systems in Greece (law 3468/2006) was dedicated to the promotion of RES and in order to speed up the licensing procedures and to reform the electric energy production from renewable energy sources. During December 2009, a new RES law was drafted by the Ministry of Environment and after a period of public consultation the law was be approved by the Greek parliament (May 2010). This law amends the law 3468/2006 in order to further promote RES and speed up the licensing procedure. The proposed feed-in tariffs for electricity production from RES and CHP systems has special provisions for biogas (article 5 sets a feed-in tariff of 220 €/MWh for agricultural and industrial biogas plants up to 3MW, and 200 €/MWh for plants above 3MW).

4.4 Biogas in Latvia

Due to the available biomass resources, the biogas potential of Latvia is very promising. The "BiG>East" project was initiated in Latvia at the right time of the Latvian biogas sector development. The national Biogas Development Program has been recently introduced. Biogas as sustainable and high potential energy source started to be recognized by different institutions and by the society in general.

At the end of 2007, when the BiG>East project started, only three biogas plants were in operation – two landfill gas plants and one installation using the sludge from a wastewater treatment plant. The first biogas plant using agricultural feedstock was at the stage of development. Together with improvements in RES legislation and introduction of a feed-in tariff in Latvia, at the beginning of 2008 a number of new biogas projects started to develop, the majority of which being agricultural biogas projects.

In 2009 there were 58 companies (with total installed electrical capacity 52,87 MW) that received quotas for the mandatory purchase of biogas electricity. However, in 2010 only 4 companies have started or completed construction of biogas plants and it is expected that by the end of the year some 6-8 more companies could finish the construction works. The remaining projects are still pending mainly due to the lack of financial resources and difficulties in public acceptance.

Financing options for biogas producers are available from different sources:

- From the Ministry of Environment, supporting projects where fossil fuels are replaced with RES.
- From the Ministry of Economy in form of feed-in tariff (two options are available – for electricity generated in CHP plants and for electricity generated using biomass (RES-E)).
- From the Ministry of Agriculture the support is provided for energy production from agricultural or forestry origin biomass.

Nevertheless, the comparatively good framework conditions did not ensure as rapid development of biogas market in Latvia as expected.

Figure 3: Visits of the first Latvian agricultural biogas plants by BiG>East members, and by participants of the mobilisation campaigns and training courses

4.5 Biogas in Romania

The situation in Romania is different since Romania has a track of biogas research and production since many years. Research in the biogas sector in Romania started more than six decades ago. The first biogas promotion project in Romania was designed to cover the essential steps from research stage to pilot plants and to the implementation to large scale. The project focused on two main directions:

- large capacities coupled with water treatment plants
- development of facilities for use in the farming sector (including small units)

The follow up of the national plan for biogas has passed the next steps (1958-1982):

- Research for the identification of methanogenic bacteria for animal and household waste.
- Research for obtaining biogas from organic sludge.
- Biogas industrial type facilities developed at waste water treatment plans. Usual capacity 2,000m^3 per day
- Almost all major cities have been implemented the developed technology. The total biogas production capacity from this sector was estimated at 85,000m^3 biogas per day (30 million m^3 per year).
- Pilot facilities for animal waste with a capacity of 30 m^3 per day
- Pilot semi-industrial capacity for biogas production from pig farms with a capacity of 580 m^3 per day
- Development of small capacities (households) for biogas production. Capacity 5-10 m^3 per day but also 20, 30, 40 and 50 m^3 per day

- Anaerobic digestion of biodegradable wastes from pig farms. Typical capacities were around 7,000-8,000 m^3 per day

The results of the 30 year program was the development of 400 biogas facilities, with a total energy production of 0.18 TWh per year.

The main drawback of this project was the fact that the owner was the state through state owned companies. After the fall of the regime in 1989, a long process of reorganisation, privatisation and liquidation of those companies occurred, having as result a gradual depreciation and abandonment of the biogas facilities. Today, none of these 400 pants is operating any more. Available information of these facilities is very scarce.

Small efforts for promotion of biogas were done by NGO's, private companies and the State Agency starting in 2006. At the moment, no more than 2 plants, both with a pilot type status exist in Romania:

- ISPCAIA Bucharest, built in 1980 for animal manure treatment (2 t/day) – it produces 900 m^3/day biogas;

- Tirgu Mures Waste Water Treatment Plant built from October 1997 to May 2001 (construction duration 3.5 years) - it is designed to produce thermal power / electric power (711 kW_{th} / 455 kW_{el}) - this installation was made possible due to non reimbursement financial support by the Dutch government (project's name was "Dutch Drinking Water and Wastewater Project").

Except these two facilities, in Romania there are currently no commercial biogas plants in operation, nor in the planning phase, nor under construction.

4.6 Biogas in Slovenia

Exploiting biogas from agriculture is a relatively new approach in Slovenia. First installations were implemented on two bigger farms and the interest has increased after the feed-in law was introduced in 2002. Since then the biogas use is promoted by a higher price of the produced electricity. Mainly the bigger farms and their investors saw opportunities for building biogas plants. The result is that they are planning larger plants of 1 MW_{el} and above. Also almost all potential biogas plants that are currently in preparation or in construction phase are larger than 1 MW_{el}.

However, in 2008, Slovenia was faced (like the whole EU) with high increases of agricultural prices, especially for maize. Many of the new or potential biogas plant depend on the input from the market and the economy has changed. This problem is mainly related to bigger plants.

Although, energy utilization of biogas from the anaerobic digestion sewage, manure or agricultural waste and landfill gas is already present in Slovenia, it still has a negligible impact on the share in the overall energy mix.

4.7 Waste for Biogas in BiG>East countries

The BiG>East countries represent a large opportunity for the utilisation of biogas technologies in order to treat organic waste. Implementation will enable efficient and environmentally sustainable waste disposal, while at the same time generating a significant amount of energy in a manner that aids the region's responsibility to reduce and offset its carbon footprint. Generally, the countries involved have in place an infrastructure and framework for waste collection. However the waste is not separated, and largely ends up in landfill sites. The EU standards for collection and handling have been largely adopted and there are some (usually small or pilot) programs for separating and recycling. With this basic framework and mentality in place it only requires another step to see the waste streams properly used in order to benefit, rather than causing environmental, space and economic problems. Most countries are seeing a rise in the amount of waste produced, yet naturally a decline in the availability of space for traditional disposal methods.

There are adequate waste streams to support a variety of biogas technologies and the population density is sufficient that economies of scale can be achieved. The biogas facilities shall be located close to existing waste, industrial and agricultural facilities, thereby introducing very little additional transport costs. The countries also have large agricultural sectors which provide both waste streams, and markets for biogas process by-products such as compost and liquid fertiliser. The overall goal however must be to reduce waste and to recycle as much waste as possible.

To implement biogas waste treatment and energy production facilities the collection, sorting and recycling economy must be brought up to a standard that treating efforts make sense from the economic point of view. Thereby, tipping fees have to be considered.

With infrastructure and logistics largely in place, and with available waste streams and a healthy agricultural sector, the conditions are very favourable. Options for suitable sites of facilities are numerous and flexible, since the facilities can be centralised or decentralised. All countries involved have ample and well established landfill sites, waste management sites and agricultural farms suitable for co-location of biogas plants. Distributed systems offer more benefits as they can be tailored to specific sites and waste requirements while transport costs are minimised or eliminated. In Germany experience has shown that power generation can be fed into the municipal electricity grid successfully even with very small capacity plants.

Slovenia already has in place some good waste sorting and separation infrastructure and there is a relatively low amount of household waste going into landfill. There are good rates of waste recovery and recycling. Some kitchen waste is collected in brown bins and used in biogas plants and for compost. Some supermarket waste is collected and diverted from municipal waste for compost. There are already biogas plants operating in conjunction with agricultural facilities.

In Greece, restaurants and hotels currently do not pay for waste disposal except of the municipality fees which are calculated per square meter of the premises as in the other countries, too,, thereby providing no incentive to separate or reduce the amount. Nevertheless there are some facilities for mechanical recycling and recovering and a couple of composting systems at local level.

Latvia also has little or no utilisation of waste streams although some supermarket waste is recovered. In the agricultural sector there are no waste-to-energy processes although like most

other countries in the group some wastes from agriculture are returned to the land as fertiliser. There are limited yet growing biogas to heat and electricity plants on landfill sites.

Croatia produces a relatively large amount of waste per capita although there is a reported 10% return through recycling with the balance being land filled. Croatia has a feed in tariff system but low tipping fees.

In Bulgaria, approximately 85% of waste is land filled and there is some separation of waste in operation and recycling centres in larger cities. Agricultural holdings are relatively small with much of the production done for self consumption therefore there are fewer opportunities for large farm based biogas plants. Depending on the terrain and road infrastructure this problem can be somewhat overcome however, using community based systems where farmers from the surrounding area all bring their inputs of slurry, silage etc to one location.

In Romania, there is very little separation and recovery in operation with only around 5% of household waste being recovered.

4.8 Opportunities for Biogas Utilisation in the BiG>East Countries

The most suitable system which should be implemented in the BiG>East target countries is currently a combined heat and power plant operating with combustion engines. The combined heat and power production technology is a well known, robust technology for the utilisation of electricity and heat. CHP generation from biogas is considered a very efficient utilisation of biogas for energy production. Before CHP conversion, biogas is drained and dried. An engine based CHP power plant has an efficiency of up to 90% and produces 35% electricity and 65% heat. However, also grid-injection of biomethane may be a future opportunity in the target countries, but is much more challenging, especially from the legislative and financing viewpoint.

For the utilisation of biogas in the target countries, it should be feasible, that all systems and components can be constructed or installed by using domestic labour and engineering services. The technology should also be simple rather than sophisticated, since simple technologies are more robust, easier to maintain and better suitable for the local infrastructure in cases where it is at an early stage of development.

4.9 Biomethane Injection in BiG>East countries

A dedicated task in the BiG>East project was to investigate opportunities for biogas upgrading to biomethane quality and injection into the natural gas grids in the target countries.

In summary, biomethane grid injection in the target countries is still not applied due to the fact that even conventional biogas production and use in CHP plants is not yet well developed. However, this situation may change soon, as costs of upgrading technologies will be reduced. Furthermore, biomethane injection may become a good opportunity especially for industrial-scale biogas plants in the waste sector and for cases where heat from CHP plants could not be used.

Bulgaria

Bulgartransgaz is the only gas transmission operator for the territory of Bulgaria. Bulgartransgaz is member of Gas Infrastructure Europe (GIE).

The biggest privately owned gas company in Bulgatia is Overgas Inc. The company provides construction and operation of gas distribution networks and sale of natural gas to end customers. Overgas has major part in 28 companies. From 96 licenses for distribution and delivery of natural gas for the country, subsidiary companies of Overgas have 56 licenses in 50 municipalities. The total length of the gas distribution network is over 1,600 km.

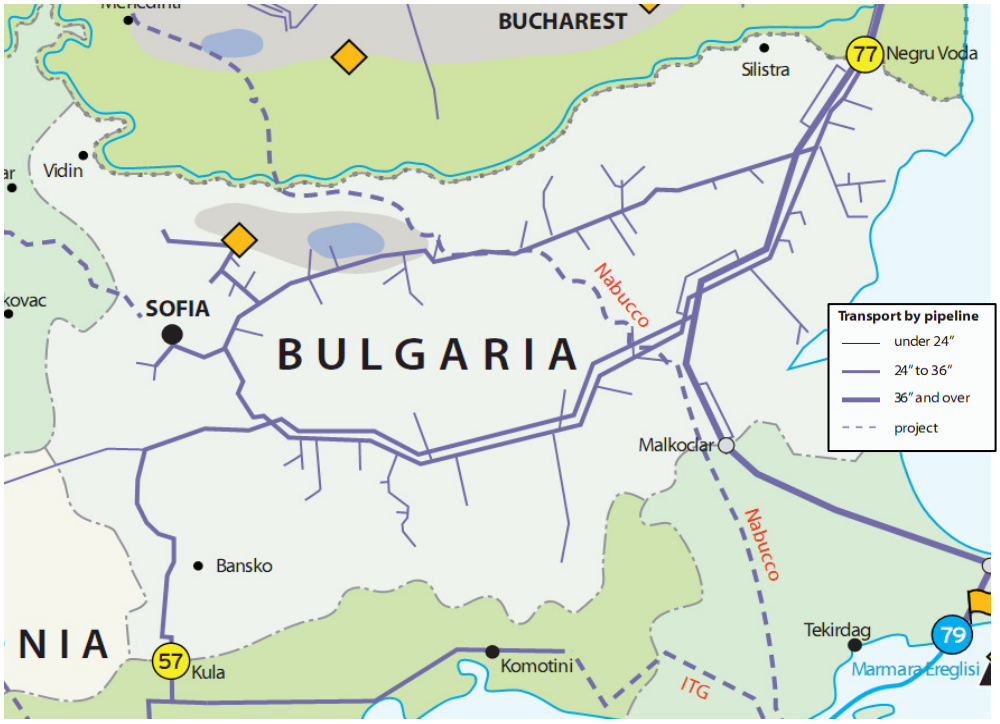

Figure 4: Bulgarian gas network; Source: ENPRO Bulgarian gas network; Source: ENPRO

The Bulgarian Law of Energy governs the public relationships related to the activities of generation, import and export, transmission, transit, and distribution of natural gas. It also governs the authorities of state bodies in defining of the energy policy, regulation and control functions. According to Article 197 (1) "The transmission company shall be obliged to connect to its network at an interconnection point of its choice, the distribution companies, extraction companies, companies for gas storage."

The conditions and procedure for gas production enterprises to get access to the natural gas transmission/distribution networks are regulated by "Rules for conditions for access to the natural gas transmission and/or gas distribution networks", promulgated SG No 67 of 2 August 2004. According to article 5 (1) "gas transmission and gas distribution company could not refuse access to the gas transmission/ distribution networks".

Croatia

There are 2 grid levels recognised in Croatia: transportation (high pressure 50 to 70 bar) and distribution (middle pressure 1 to 4 bar and low pressure < 1 bar). The transportation gas system (existing and planned) is shown in the figure below.

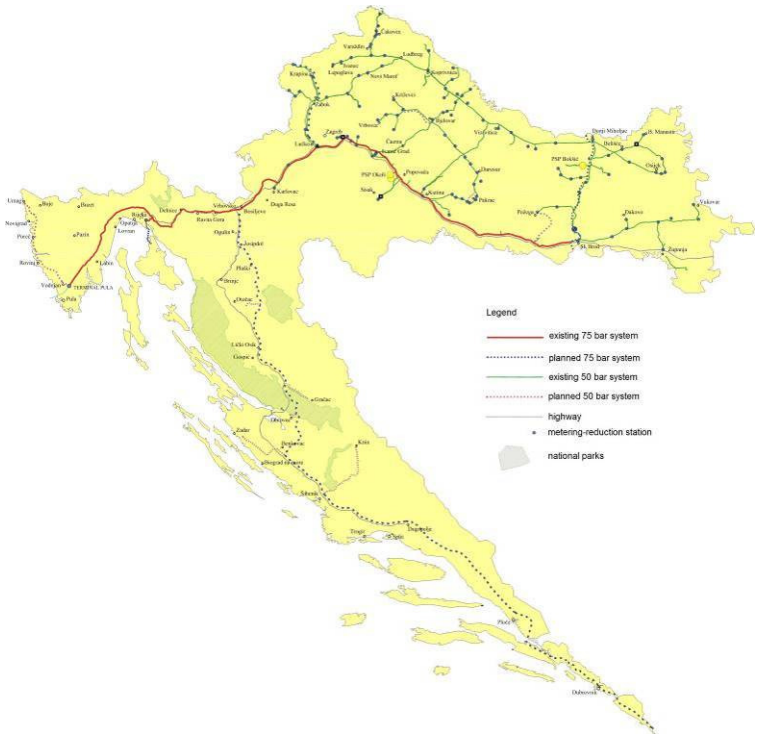

Figure 5: Croatian gas transportation system; Source: EIHP

Natural gas transportation is the primary activity of the company PLINACRO Ltd., which is the owner and operator of the gas transmission system. PLINACRO is fully owned by the Republic of Croatia.

In 2006, 3,097 billion m^3 of natural gas have been transported, of which 2,680 billion m^3 from entry to exit measuring-reduction stations, and 417 million m^3 to underground storage Okoli. During the peak demand approximately 530,000 m^3/h were transported, while the maximum quantities of 630,000 m^3/h have been delivered to customers.

The natural gas transmission system comprise 2,034 km of pipelines, 142 exit measuring-reduction stations with 210 measuring lines and 19 entry measuring stations. The whole system provides gas for 14 out of 21 counties including the City of Zagreb.

Regarding the distribution level, there are 36 natural gas distribution companies in Croatia, and the total gas pipeline length is 15.980 km. In addition, two companies distribute city gas and LPG/air mixture, with the total network length of 239 kilometres. Thus, the total distribution network in Croatia is 16,219 km long.

In Croatia there are three different levels of natural gas grids.

- Low pressure grid: Max. utilization pressure < 1 bar

- Medium pressure grid: Max. utilization pressure 4 bar; Min. utilization pressure 1 bar
- High pressure grid: Max. utilization pressure 70 bar; Min. utilization pressure 50 bar

Biogas is recognised in the Law on Gas Market (OG 40/07) which refers to biogas in the Article 1, paragraph 2 as: "(2) The rules determined by this Law and corresponding regulations are applicable on biogas, gas from biomass and other types of gas if it is possible both technically and safe transport through the gas system of the gases in question."

As of May 2008 there existed no corresponding regulations that describe biogas use in the gas market. Gas transport, distribution, storage, supply, supply of tariff customers, LNG terminal management were regulated energy activities, while gas production, supply and sales of natural gas were market activities.

Greece

The introduction of natural gas into the Greek Energy System can be compared in magnitude with the electrification of the country. Natural gas is an effective and modern form of energy, environmental friendly and safe. The implementation of this major energy project was undertaken by the Public Gas Corporation of Greece (DEPA) S.A. The Greek gas sector is still in the early stages of development and the Greek State is the key player of the market through direct or indirect ownership of the key-players.

The main gas company in Greece is DEPA which is currently the only importer of gas. The framework of the gas market liberalization (Law 3428/05) allows other companies to have access to the high pressure pipeline in order to engage commercial activities or to have access to foreign suppliers. At the end of 2005 DEPA proceeded with a legal separation of its activities. A company under the name "National Natural Gas System Operator SA (DESFA S.A.)" was established and undertook the operation, management, exploitation and development of the national natural gas transportation system in Greece.

The Gas Supply Companies (EPAs) have undertaken the mission to distribute gas to consumers with annual consumption up to 100 GWh gross calorific value and operate, maintain and expand the "city networks.

Natural gas enters Greece via high pressure pipelines. Their course continues through medium pressure networks (19 bar) that deliver gas to industrial consumers, but also through low pressure networks (4 bar) that provide door-to-door gas to domestic, commercial and industrial consumers.

Medium pressure networks have been developed and are still being developed in Attica, Thessaloniki, Larissa, Volos, Inofyta, Thiva, the greater of Halkida, Lamia, Platy in Imathia, Katerini, Kilkis, Serres, Drama, Xanthi, Kavala. Alexandroupoli and Komotini. Low pressure networks have been developed and are still being installed in Attica, Thessaloniki, Larissa, Volos, Inofyta, Kilkis, Xanthi and Komotini. Medium and low pressure networks are expanding in areas like central Greece and Evia, Eastern Macedonia and Thrace and Central Macedonia by the EPAs.

According to LAW No. 3428/27.12.2005 "Liberalization of Natural Gas Market" (Official Gazette 313/A/2005) article 39: "The use of Natural Gas Systems pursuant to the provisions of this law is also allowed for the transmission of biogas, gas produced from Biomass and

other kinds of gases, provided that it is so possible from a technical point of view and the technical specifications are met, after taking into consideration the quality requirements and the chemical features thereof".

Figure 6: The Greek Natural Gas System; Source: DESFA, 2008

Latvia

Natural gas supply in Latvia is provided by JSC „Latvijas Gāze". This company is the only gas transmission operator in Latvia. JSC „Latvijas Gāze" has received an exclusive licence (valid until 10.02.2017) to distribute natural gas in whole territory of Latvia using medium and low-pressure grid with projected pressure up to 1.6 MPa (16 bar). The gas transportation system (existing and planned) is shown in the Figure below.

Latvian gas transportation system has connections with three countries – with Russia, Estonia and Lithuania. The whole Baltic gas transportation system is not connected to EU gas transmission network and Russia is the only gas supplier.

The existing Law on Energy of Latvia makes no provision for third party access to natural gas transmission, distribution and storage infrastructure. According to this law, natural gas market in Latvia will be opened in 1st January 2010.

Latvian gas transportation system is specific because gas is supplied from large underground gas storage (UGS) with active volume of 2.2 billion m^3, ensuring 170 % of annual self-consumption, located in Inčukalns. In summer gas from Russia using two parallel gas transmission pipelines is delivered to UGS and in winter gas is taken from the storage avoiding gas import in a period with a highest consumption. In winter maximal gas output

from Inčukalns UGS is 24 million m^3/day, where approximately half is sold to the Latvian market and the other half to foreign countries.

Figure 7: Latvian gas transportation system; Source: JSC Latvijas Gāze Annual Report 2006

Latvian gas transportation system initially was constructed to ensure the gas consumption of 3 billion m^3/year. In 2006, natural gas consumption in Latvia was about 1.75 billion m3. The total length of the natural gas pipelines on 1st January 2007 reached 5,872 km, including the gas transmission pipelines (1,281 km) and the gas distribution pipelines (4,591 km) (JSC Latvijas Gāze Annual Report 2006).

There are no regulations on the technical criteria and experiences for Latvia for biomethane injection. However, it is almost certain that in order to inject biomethane into the natural gas grid, biogas has to have the same characteristics as natural gas. Physical characteristics of natural gas (please see in the Table below) were prescribed in the Cabinet of Ministers Regulation No.23 "Regulation on Gas Supply and Use" (not in force since 17.03.2005). The new Cabinet of Ministers Regulation No.99 "Regulation on Natural Gas Supply and Use" (in force since 16.02.2008) insinuates that natural gas parameters and quality is defined by contracts between the gas supplier and gas user.

According to the EC Gas Directive 2003/55/EC Member States should ensure that biogas are granted non-discriminatory access to the gas system, provided such access is permanently compatible with the relevant technical rules and safety standards. These rules and standards should ensure, that biogas can technically and safely be injected into, and transported through the natural gas system.

There is no legal base for biomethane injection in Latvia. In order to inject biomethane in natural gas grid, it is necessary to amend the Law on Energy in chapter 8 "Gas supply system"

ensuring that natural gas transmission operator gives permission for appropriate quality biomethane injection.

With reference to information obtained from JSC "Latvijas Gāze" so far no offers for biomethane injection were received. However, JSC "Latvijas Gāze" is constantly following experiences of other countries on this subject.

Romania

The total gas consumption in Romania was about 17 billions cubic meters in 2006 and only 30 % have been imported. The rest was based on internal production.

From the total consumption 20 % is utilized as raw material and 80 % as fuel. It has to be noted that the import of natural gas (especially from the Russian Federation) started in 1979 with almost 2 % from the total consumption increasing up to 29 % in 1996 and more than 32 % in 2003. The prognosis for 2025 is that 77 % will be imported.

Romania will be more and more dependent on the import of natural gas. One strategic objective for the sustainable development and a constant concern of the Ministry of Economy and Trade is the promotion of more diverse import sources of natural gas. This objective is also a pillar in the sustainable development strategy for Romania till 2025.

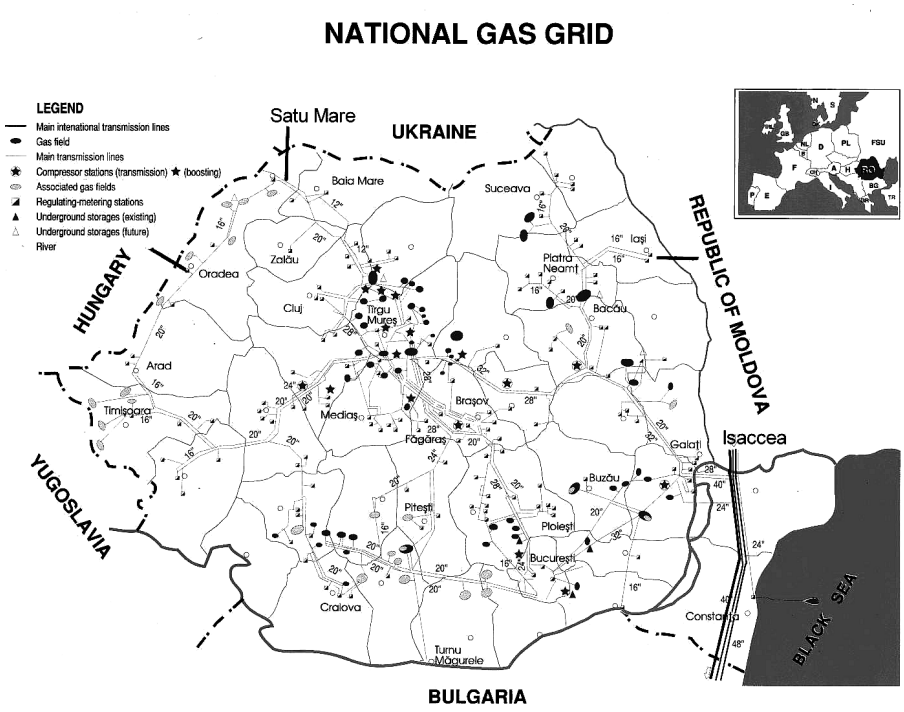

Figure 8: National gas grid – Romania; Source: Mangus

In 2000 Romania reorganized the state owed company Romgaz into several smaller companies: Exprogaz and Depogaz with activities in the extraction and respectively in the gas storage, Transgaz with activities in the transport of natural gas on the national territory and

Distrigaz Nord and South with distribution to the industrial and household consumers. Later in 2001 Exprogaz and Depogaz merged into Romgaz. In 2005 51 % of the Distrigaz Nord and South were sold for 300 millions Euro each. In the production sector the Romgaz is dominating with almost 52 % followed by Petrom with 46 %, Amromco with 1.5 % and Wintershall Mediaş with 0.12 %. (ANRGN report, 2006). In the distribution market 34 operators work for 2.5 millions clients from 1,700 localities. Distrigaz Nord (48 %) and Sud (47 %) are the dominant players followed by other companies (Congaz 0.97 %, Petrom Distributie 0.84 %). Imports are mainly directed towards Distrigaz Sud (31 %) and Nord (27 %). All the imports in Romania are from Gazprom in Russia.

Romania has also increased the total storage capacity of over 3 billions cubic meters in 8 storage facilities from only 1.3 billions cubic meters in the year 2000.

The national distribution network has a coverage of about 60 % from the total 3,140 localities only 1,822 having natural gas distribution systems in place at the end of 2006. The network increased during 2000-2006 with more than 665 localities due to investment effort in this area of about 646 million euro. The natural gas transmission system comprise mainly through Distrigaz North and South 13,830 km of pipelines from the total pipeline length. The total length of the pipelines.

Transportation of gas in Romania is done on the so called transportation highways (pressure over 6 bar) and distribution (middle pressure 6-2 bar and intermediary pressure 2-1 bar and low pressure under 0,05 bar).

The quality of the natural gas is mentioned in the “technical code for natural gas” and in the SR ISO 13686 quality of natural gas. In order to have access to the natural gas grid biomethane will have to fully comply with the standards of natural gas.

The gas composition requirements for grid injection is regulated by the “Natural Gas Law”, Law 288/2005 and for the standard by National Regulatory Body for Natural Gases, through “Technical code for the natural gas sector”.

Slovenia

The company Geoplin d.o.o. is a supplier of natural gas in Slovenia. Gas is bought in Russia and Algeria. Geoplin is also in charge of the international gas transport to Slovenia and operates national gas pipelines. The company suppliers almost all distribution companies for gas and industry.

From 1 January, 2005, Geoplin plinovodi d.o.o. operates the Slovenian gas pipeline transmission system as natural gas system operator (www.geoplin-plinovodi.si).

For local distribution of the gas some public companies in bigger cities (such as Ljubljana, Maribor, Celje and other) and private companies based on concession are responsible. There are three different levels of natural gas pipelines in Slovenia.

- Low pressure grid: Planed pressure 4 bar; Max. utilization pressure 100 mbar; Min. utilization pressure 50 mbar

- Medium pressure grid: Planed pressure 4 bar; Max. utilization pressure 4 bar; Min. utilization pressure 0,5 bar

- High pressure grid: Planed pressure 16 bar; Max. utilization pressure 16 bar; Min. utilization pressure 6 bar

Higher utilization pressure than minimum can be used in calculations of safety-regulation elements only in consensus with system operator.

The company Geoplin Plinovodi operates the Slovenian gas pipeline transmission system as natural gas system operator. The pressure of the gas transmission pipeline is 3 bar. If a biogas plant will be connected to the pipeline, this plant is treated as natural gas supplier. The plant operator should contact Geoplin Plinovodi if the injection point is in the transmission pipeline. Otherwise it should contact the local distribution company.

The official grid injection point is the location where gas quality and characteristics are measured and controlled. If the requirements are not satisfied, the connection will be stopped. Since there are no biomethane grid-injection projects is Slovenia there is a lack of experiences.

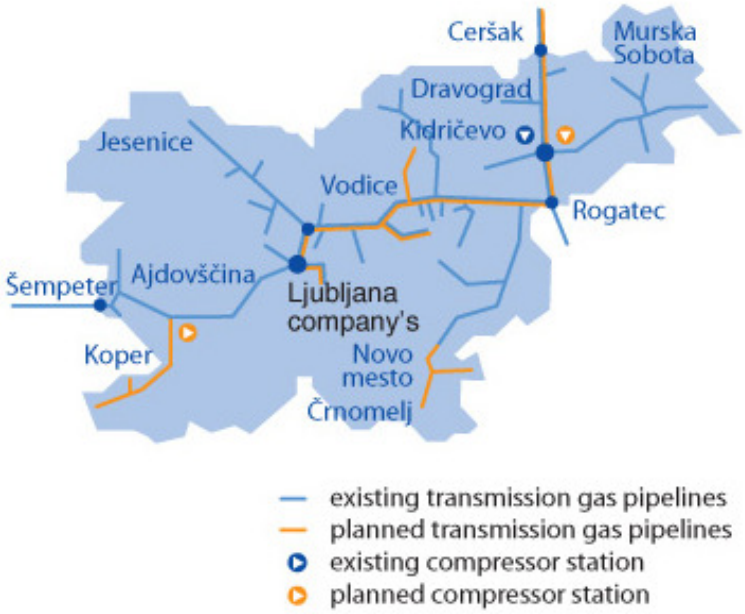

Figure 9: Slovenian gas network; Source: Geoplin d.o.o.

5 Barriers of Biogas Development

In the framework of the BiG>East project, the main barriers and policies were assessed for each target country. This was necessary for streamlining the mobilisation campaigns and training courses. The barriers include market, financial, social, legal and administrative barriers, and other biogas related barriers. The following chapters present the barriers in the BiG>East target countries and strategies on how to overcome them.

5.1 Barriers in Bulgaria

The main barriers of biogas implementation in Bulgaria are:

- Lack of suitable laws regulating biogas production and feed-in tariffs.
- Farmers, industry and the general public have low awareness about the benefits of biogas production in Bulgaria;
- There is insufficient information and knowledge of the applicable legislation and regulations and poor coordinating among the governmental and the non-governmental sectors;
- There is a lack of sufficient information on relevant ongoing projects and difficult access to state support available for funding and co-funding;
- Bulgaria does not provide any financial incentives for the production of heat from RES.
- At the moment in Bulgaria there is lack of qualified experts in the field of biogas.

Public Policy Measures to Support Biogas

In order to increase the share of RES and especially the share of biogas, there is a need for a clear policy for sustainable use of RES in Bulgaria. Policy priorities in the energy sector are currently reflected in the National Plan for Economic Development and the Energy Strategy of Bulgaria. They are in harmony with the requirements of European directives. Currently the Bulgarian government is preparing a draft law to encourage the use of RES.

Reliable information about the potential of biogas, biogas technologies and the environmental, social and economic aspects of biogas production have to be ensured.

5.2 Barriers in Croatia

Biogas is the least explored renewable energy source in Croatia. On national level, little specific interest was devoted on the one hand due to its linkage with the agricultural sector that has been passing structural problems, and on the other hand due to weak waste collection practices that is primarily managed by public non-profit orientated utility companies at local level.

One of the main barriers for biogas production from waste materials are the unclear framework conditions for waste management. A waste management reform should improve this but it is difficult to predict when the aimed changes will occur in practice. Households are not obliged to separate waste which currently makes landfill gas utilization the only alternative.

Today the Croatian energy policy is directed towards increased efficiency, security of supply and diversification, market deregulation, the use of renewables and environmental protection. The lack of legislative framework for renewable electricity production, has been resolved with the adoption of the package of five sublaws which define incentives and obligations for renewable electricity production. However, these sublaws are not covering the renewable heat production. It is still unclear when heat related sublaws will be enforced. The law on Biofuels in Transport was adopted the same day as the EU Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC. Consequently, it had to be amended with adjustments in order to transpose the messages stated in the Directive. Until now, sublaws and amendments are in the process of realisation and are expected to be adopted in 2010. Biogas (biomethane) is recognised as one of biofuels to be subsidised. However, in difference to 1st generation biofuels (biodiesel and bioethanol from oilseeds and sugar/starch crops), the subsidizing scheme for biogas is postponed due to little demand market. In the national trajectory, biogas is expected to enter the biofuels market from 2015. The possibility of feeding biogas in the natural gas grid is mentioned only by the main law on Natural Gas Market and there is no official information if somebody is working on biogas sublaws. Thus, the legislative barriers are expected to continue in the near future.

Furthermore, renewable energy policy is well developed at the highest levels while local and regional levels are mostly not able to follow the stated policies at local level. Recently, local authorities are establishing regional developing and energy agencies in order to facilitate the utilisation of EU programmes. Unfortunately, the majority of those agencies are not well informed about biogas concepts.

Another barrier is the lack of reliable data on the biogas potential in Croatia. The official statistical bodies do not provide suitable data for the estimation the biogas potential which would be important to mobilise policy makers. The Croatian Energy Strategy (2009) claims a national biogas potential at 2.6 PJ per year and reflects only the biogas potential from the manure (manure of 20% gross livestock units). It is reasonable to assume that biogas potential is much higher since manure has low energy value and biogas yields. Biogas from sludge from waste water treatment plants and landfills has not been officially evaluated. Croatian energy strategy (2009) states: “Republic of Croatia will support production and utilisation of biogas, domestic production of biogas plants and installation of distributed energy sources” but it does not provide preferred useful energy forms (electricity, heat, CHP, district heating, biofuel) from biogas.

A main market barrier for agricultural biogas project is the small average size of animal farms. In 2003, 96% of milk suppliers had less then 15 cows per farm while only 14 producers had more than 100 milk cows. This is also similar to pig production. About 90% of pig production occurs in about 200,000 small farms. Less than 3,300 (1.5%) producers on family farms have more than 50,000 pigs.

Biomass utilisation in Croatia is well promoted among renewables and many projects are pending for their implementation. However, among different biomass types, biogas was not

enjoying special attention. For that reason, the main social barrier for a biogas project is the low level of knowledge, information and awareness of biogas possibilities. This includes the advantages and positive externalities of biogas production for local communities and of national GHG and RE targets. The low level of awareness is the crucial social barrier at all levels of the society.

Regarding the project preparation procedure, the newly adopted renewable energy legal system for electricity is still under examination. So far, even projects in highly developed stage (i.e. operating wind farms) were unable to gain the "eligible producer status" and to enjoy the feed-in tariff system. The main problem is related to the electricity grid connection and to the mandatory domestic component in the project. Preparation cost could be 50% financed by a loan from the Croatian Bank for Development and Reconstruction in cooperation with the Environmental Protection and Energy Efficiency Fund. At the time of closing this report, the Croatian feed-in system for RES-E is under revision and the results are expected within 2010.

In summary, in Croatia, scattered and small farms, structural problems of the agricultural sector, long permission procedures, low enforcement of environmental laws on farm waste management, lack of suitable legislation on renewable heat production, and the lack of updated statistical data to assess the potential are the main market barriers for agricultural biogas production.

Measures to Support Biogas

Biogas is a complex renewable energy source which calls for attention of different groups of stakeholders: potential feedstock suppliers (farmers, food processing industries, utility companies), investors, local and regional authorities and developing agencies together with general public that might be affected by biogas plants.

Biogas project development in Croatia greatly depends on the communication and joint actions between the Ministry of Agriculture and Rural Development (agricultural biomass), the Ministry of Environmental Protection, Spatial Planning and Civil Engineering (waste) and the Ministry of Economy, Labour and Entrepreneurship (RES). This needs to be supported.

A public awareness campaign specially designed for dedicated stakeholder groups, such as ministries, local and regional authorities, food processing industry, agriculture, national agencies and associations, could greatly contribute to biogas market development in Croatia.

Current restructuring of the waste management policy in Croatia should be perceived as a window of opportunity to include biogas production in start up investments. The same is true for waste water treatment plans. This places a focus on local and regional authorities and their information on biogas features (i.e. best practice technology, investment).

Biogas is new in the Croatian energy market. Foreign equipment producers have representative offices in Croatia, but the language barrier makes it difficult to gain full information on the equipment. Most equipment representatives are coming from Austria, Germany and The Netherlands – markets with developed biogas technology. There is significant scepticism towards equipments' efficiency which could be eliminated by more information on biogas technologies and by targeted mobilisation campaigns for different stakeholders.

Capacity building among all stakeholders involved in the development of biogas market seems to be a crucial measure to support sustainable biogas market development in Croatia.

stakeholders.

5.3 Barriers in Greece

During the last years renewable energy development in Greece is positively affected by the country's very good resource potential and the state policy. The legislative framework has significantly improved by the introduction of new legislation. However, although the legislative framework (e.g. energy and environmental policy, EU and country commitments, new law for RE matters, etc.) and the financial environment have changed the picture and new biogas plants were constructed, there are still barriers (mainly non-technical) which affect further biogas exploitation and deployment in Greece. These include the public perception, experience and awareness mainly on farm scale and industrial biogas applications, lack of price for the heat production, licensing procedure, lack of "gate fees" for waste disposal, externalities like eutrophication, groundwater pollution, replacement of fossil fuels which are not assessed and monetized, and price of biogas/electricity.

Market roadmap

Besides technical barriers it is very important to identify barriers related to the market and to financial and administrative issues. The necessary actions to overcome such barriers are described in the following paragraphs.

The main market for biogas production in Greece is the electricity market (WWTP and landfill gas) and the heat market is small (internal use to the AD plants for the process heat). Nowadays there is a mature "Energy Market" in Greece concerning the AD technology (e.g. technology vendors, plant designers and operators). Nevertheless further strengthening and growth of the local energy industry is needed. This will promote the implementation of biogas projects and will reduce the high investment costs.

Agricultural and animal wastes are a matter of special concern due to the high potential and their spatial distribution almost all over Greece. In some cases there is still lack of knowledge about the technical potential of wastes in a certain area and their biogas exploitation alternative. Parameters like continuous supply of raw material and feedstock composition are fundamental for the biological process and biogas production. In some cases the seasonal production of some wastes like agro-industrial residues (e.g. citrus processing industries, or olive oil mill residues) has to be evaluated for the successful use in biogas plants. In such cases long-term contracts between biogas plant operators and feedstock suppliers must be guaranteed and the use of different wastes is necessary.

Nowadays there is a mature "Energy Market" in Greece. Despite this, the development of a full liberalized electricity market in Greece suffered a significant delay. Apart of the need of Full Liberalization of the Electricity Market, elimination of end users barriers is needed (e.g. development of heat market, biogas use as a transportation fuel, injection to the natural gas grid etc).

Biogas projects still need high investment costs. Taking also into consideration that a) project financing remains a major concern, b) the revenue comes mainly from the new pricing tariff system for electricity production for RES, c) externalities are not assessed and monetized, d)

there in no “gate fees” in Greece, e) the “polluter pays” principle is not efficiently applied, further improvement of the financial and economical instruments for the support of RES and especially biogas project are needed (e.g. examination of differentiation of public funds, introduction of tradable green certificates, higher electricity price according to the form of Biomass). This will attract new biogas projects.

Policy roadmap

On political level a stronger commitment concerning the exploitation of biogas as a sustainable energy and environmental choice is needed. This commitment will affect the other levels too (e.g. regulatory, institutional, administrative, financing etc).

Although the RES law (law 3648/2006) sets a new reality in the electricity generation, and among others, simplifies the licensing procedures, the regulatory and institutional framework for the promotion of biogas must further be improved (e.g. further administrative simplification and coherence, specific legislation concerning biogas). Furthermore, the pricing tariff system for electricity production from RES and CHP systems sets a tariff of 73 €/MWh (75,82 €/MWh for the year 2007) for biogas plants. The electricity prices are rather low and a higher electricity price should be examined based on the type of biomass.

During December 2009, a new RES law was drafted by the Ministry of Environment and after a period of public consultation the law was approved by the Greek parliament (May 2010). This law amends the law 3468/2006 in order to further promote RES and speed up the licensing procedure. The proposed feed-in tariffs for electricity production from RES and CHP systems has special provisions for biogas (article 5 sets a feed-in tariff of 220 €/MWh for agricultural and industrial biogas plants up to 3MW, and 200 €/MWh for plants above 3MW).

Nowadays there is still lack of knowledge and adequate information not only for the farmers but also for the industries (owners) and the general public about the possible energy exploitation of wastes, their final uses (e.g. electricity, heat, injection to the natural gas grid, transport fuel) and benefits. Public awareness in all levels is needed.

A biogas plant must be adapted to the particular regions and must be accepted from neighbours and the general public. Thus apart form its economical and technological viability a biogas plant must have also “environmental and social compatibility” based on thorough examination of the project and public awareness and participation.

The penetration of anaerobic digestion schemes in Greece concerning farm scale applications (biogas exploitation from animal manure and agricultural residues) is not still mature. A strategic biogas plan must be incorporated within the national and regional energy and environmental policy. The agricultural policy (Ministry of Agricultural Development and Food), environmental protection (Ministry of Environment) and energy investments (Ministry of Development) concerning biogas exploitation should be further coordinated.

5.4 Barriers in Latvia

The following barriers to biogas projects in Latvia were identified:

- Lack of regulations and legal bases for biogas development (incl. biogas use in transport and injection into natural gas grid) and lack of continuous, targeted, well-considered and well-planned state support for biogas projects in Latvia, e.g. by setting the biogas target for 2020 and providing of investment guarantees for biogas project developers.

- Lack of local energy agencies, as well as lack of trained staff and experts in municipalities and local governments for the evaluation of energy related projects.

- Liberalization of electricity market in Latvia is more a theory than a reality, causing the dependence from one dominating electricity generation, transmission and distribution company and thus establishing connection to electricity grid is a very time consuming, expensive and bureaucratic procedure.

- Lack of statistical data and lack of information on the spatial distribution of the biogas potential.

- Low awareness on biogas and its environmental benefits in the Latvian society.

- High investment costs necessary for biogas project implementation;

- Lack of reliable information on food industry waste and other biomass amounts that are suitable for biogas production;

- Institutional disagreement and insufficient coordination among different organizations and institutions (incl. Ministries of Environment, Agriculture and Econ-omy);

- Lack of practical experience in using recently introduced support mechanisms (for example, Cabinet of Ministers Regulations No.198 and No.221);

- Lack of knowledge and experience on construction and operation of biogas plants;

- Difficulties to find appropriate heat consumers;

Public Policy Measures to Support Biogas

Yet, there is an indicative biogas production target specified by the biogas development program for Latvia, this statement is not strong enough to facilitate the development of all kind of biogas utilization. Setting of clear national biogas target is necessary. This can be done when developing the National Renewable Energy Action Plan under the section of sectoral targets and trajectories.

To extend the use of biogas potential, additional investigation on a spatial distribution of biogas feedstock in Latvia is necessary. The biogas potential could be utilized more efficiently, if RES projects would be incorporated in regional and spatial planning. Biogas production plants should be developed close to intensive industrial or agricultural territories.

Existing investigations on available waste material is showing that significant parts of waste material could be used for biogas production. In order to broaden the use of this waste, it is necessary to make improvements in municipal waste sorting practices. In order to extend the possibility for biogas production from organic waste, it is necessary to establish some tighter legislative framework to facilitate municipal and household waste sorting practices.

To ensure additional waste flow for biogas production, a regulation that prohibits the delivery of expired food from supermarkets and kitchen waste from restaurants and catering industry to landfills has to be introduced. The situation could be significantly improved together with the implementation of Landfill Directive (1999/31/EC) in Latvia. For municipal waste landfills it is planned to implement this Directive latest until 2013 when the biodegradable municipal waste going to landfill must be reduced to 50% of bio-degradable waste produced in Latvia in 1995.

In order to inject biomethane in the natural gas grid, it is necessary to amend regulations to ensure that natural gas transmission operator gives permission for appropriate quality biomethane injection.

A long-term policy framework on biogas use in transport (e.g. tax allowances for vehicles using biogas) is necessary.

In order to continuously update existing biogas potential studies and to find new possibilities for biogas production in Latvia, improvements in collecting statistical information on biogas feedstock and biological waste is necessary.

Annual statistics and reports on agricultural biogas production are necessary in order to monitor biogas targets.

The development of local and regional energy agencies is necessary to facilitate communication between potential biogas producers, biogas project developers, and investors.

In order to overcome the administrative barriers related to permit procedures and grid connections, the development of a guideline for permit procedures is necessary.

To overcome the lack of knowledge and experience in contract negotiations with biogas technology suppliers, it is necessary to develop a guideline which also provides some good examples on common practices.

So far, provided state support for biogas projects was inconsistent and unregulated, therefore successful biogas sector development in future will be ensured only when the state support will be continuous, targeted, well considered and well planned.

Liberalization of the electricity market in Latvia would give not only in theory but also in practice a positive impact regarding biogas development. Free competition in electricity market could reduce the existing administrative and financial barriers for establishing a grid connection. Biogas plant owners could choose the best price for selling the electricity.

In order to develop biogas market in Latvia, there is a need for local technology producers and biogas experts with knowledge on biogas production under the country specific conditions. Since biogas technologies are complex and require specific know-how, one of the best ways for potential local biogas technology producers would be to make partnerships with foreign companies already having the specific experience and knowledge.

The awareness on the environmental, economical and social benefits of biogas in Latvia is still low. It is necessary to promote the awareness on biogas in all levels, including public in general, potential biogas producers, decision-makers, politicians, and authorities.

5.5 Barriers in Romania

A series of obstacles to the investment in the renewable energy sources from financial to technical up to social and environmental acceptance are still in place. First of all is the cost of the investment. Even with the recent increase in the cost of oil the costs of the renewable energy will be an issue to the potential investors. Despite the existence of a clear strategy at European and national level there is a need of real actions (available funds for developing new infrastructures) supporting both the costs and the long term economic benefits.

It seems that the green certificate quotas adopted by Romania is not the most suitable one for the actual position of the RES (other than hydro-electrical power plants) with very low funds attracted.

There is one specific barrier different from other countries, and this is the link with the former plan for the use of renewable energy sources that started in Romania in the late 1970. There are multiple barriers to the development of agricultural biogas projects: the decline of the agriculture in general following the privatization, the decline of specific sectors (livestock – pig & cow complexes), the fragmentation of the properties and the technologies used in agriculture – that are questioning the size of the biogas installations. The lack of information about biogas in general and the economic benefits of using it is another barrier for the development of biogas installations.

Policy Measures to Support Biogas

The process of transformation/changes in the energy market in Romania has started several years ago with some important steps like: liberalisation of the electricity market generation, transmission and distribution, establishment of a market operator and appointment of a trading system operator, road map for electricity privatization of the distribution companies as well as the production, development of green certificate market (almost 3 years ago), the development of the day-ahead market.

The regulations apply to both energy generated from renewable sources (such as wind, geothermal, hydro, biomass, waves) and energy generated from hybrid plants, using renewable and conventional sources. To benefit from the facilities provided by law, the production units using renewable sources have to obtain a certificate for the guarantee of origin attesting the provenience of the electricity.

A system of mandatory green quota, representing the proportion of electricity generated from renewable sources out of the aggregate gross domestic electricity consumption combined with the trading system for green certificates has been established. All electricity suppliers have the obligation to acquire electricity from renewable energy sources at least in the quotas indicated by law. If they do not comply with the above requirement important penalties are applied. The mandatory quotas have been established until 2010 in line with the target assumed by Romania during the negotiations for EU accession, starting from 0.7% for 2005 and ending at 8.3% for 2010-2012.

However, no indicative biogas production target is specified by the National program for RES in Romania. There is only a general support for RES in Romania in form of Green Certificate allocation (one certificate per megawatt produced in such facilities). As the up-front costs are high in the case of biogas facilities this financial support is not enough to facilitate the development of biogas. A clear national biogas target and financial support mechanism for its implementation is needed.

Biogas potential could be utilized more efficient, if RES projects would be incorporated in regional and spatial planning. Small to medium scale biogas facilities should be encouraged so that they better use the decentralized energy potential, making available the energy to the local level communities at affordable prices and with low environmental impact support in this way the sustainable development.

Improvements in collecting statistical information on biogas feedstock and biological waste is necessary in order to continuously update existing biogas potential studies and to find new opportunities for biogas production in Romania.

In order to overcome the administrative barriers related to permit procedure and establishment of grid connection, the development of a roadmap or guidance for permit procedure is necessary. For instance, to inject biomethane in natural gas grid, it is necessary to amend regulations to ensure that natural gas transmission operator gives permission biomethane injection.

5.6 Barriers in Slovenia

Biogas production started in Slovenia at the end of the 1980-ies. The first two biogas plants were anaerobic wastewater sludge digestion and big pig farm plants. At the beginning there was a considerable lack of providers of services and equipment in this area and it was linked exclusively to foreign companies, which many times did not know the country specific conditions and regulations. There was a language barrier as well. At the time this was a major market hindrance.

Especially at the farm level the financial barrier was long the highest one in the past. High investment cost and the lack of financial instruments was in many cases the cause for not building biogas plants. This improved with the structural funds and the so-called measure 311 in 2008 from the Ministry of Agriculture, which gives farmers financial support in terms of up to 50% investment subsidies for the projects of RES utilization. This however reflects in lower electricity purchase price. Many of the (bigger) investors are therefore now looking at the purely commercial bank loans and many times find them more attractive.

Another barrier is the problem to reach an agreement among neighbouring farmers to work together in building a common biogas plant. They would rather build one for each. Cooperation among farm owners and potential investors is more likely but in these cases farmers' profits are much lower.

Farmers are no longer interested in supplying the manure for biogas plants in order to only get back the digestate which is a better fertilizer than the manure. They expect getting a payment for their manure.

According to the Ministry of Environment and Spatial Planning biogas plants are bound to IPPC (Integrated Pollution Prevention and Control) regulation. This means an additional

permit and time needed. This is a counterproductive and unnecessary measure as it penalises the farmer who wants to improve environmental output of the farm trough converting manure into environmentally friendlier digestate.

Another barrier is the lack of knowledge and information on biogas of the general public. A biogas plant in general is many times seen as an additional problem and threat for the local community rather than a good – sustainable way of waste use and energy production from RES. This is also partially the blame to the past mistakes, the lack of public participation in project development and the "only-good-news-is-bad-news" style in the media that got a considerable promotion recently. Nevertheless in the recent years awareness is raising both at general public as well as at farmers and industry.

On the other hand, there is also a lack of official documents describing real technical potential for biogas, especially for biogas from agriculture. There are detailed studies for (wood) biomass and only few institutions have estimated the potential for different locations. A new energy geographical information system for Slovenia - EnGIS was prepared in 2008 (where potential will be calculated based on the location of bigger farms (more than 50 live stocks) and actual land use. Application will be used to prepare different strategies for future development based on the potential. Detailed information will be available to the Ministry and to some level to municipalities. General and generated potential will be for public.

Potential investors that are already thinking about biogas installations have made contact with domestic companies offering services (consultancy or even building a whole plant) and also with foreign (especially from neighbouring Austria). In general knowledge on biogas technology is relatively good what bigger investors (big farms, industry) are concerned and quite poor on the individual – farmer level.

6 Biogas Show Cases in Eastern Europe

A good measure to convince decision makers to invest in biogas plants is to prove the viability of new biogas plants at dedicated locations. Therefore, promising sites for the set-up of new biogas plants were identified in all target countries. A detailed assessment of these identified sites was performed, using a guideline which was specifically elaborated for this purpose.

In total, 12 so called Biogas Show Cases were elaborated for the most suitable sites in the target countries. The main intention of this work was to provide a concrete prove about the technical applicability and economical feasibility of biogas production at the specific site. Besides specifications about biomass availability, energy demand, suitability of the site, and organisation structure of the specific location, these Biogas Show Cases also included recommendations about suitable technical applications and about economical issues. In the following chapters, the BiG>East Biogas Show Cases are presented.

6.1 Show Cases in Bulgaria

Show Case 1: pig farm – JSC Kalchevo

The potential biomass for biogas production is 36,500 m^3/year liquid pig manure and 3,000 t/year silage (maize or sunflower). The average produced biogas per year would be 1,000,000 m^3. Electrical output would be about 250-300 kW. Potential heat produced would be about 300 kW of which about 60 % could be utilized considering current heat consumers. Biogas plant could be based on a vertical complete mix digester.

Economic calculations are performed for a low to medium standard plant (3,100 €/kW). It is shown that at current feed-in tariffs of 0.07 €/kWh_{el} biogas project could not be profitable. Investment costs are 850,000 € that is equivalent to 104,000 €/year for 15 years at 8% bank interest rate. Calculated yield from electricity sale is 158,500 €/year at 0.07 €/kWh_{el}. Yield from heat sale is 26,000 €/year at 0.015 €/kWh_{th}. General operation cost (maintenance, personnel) are 81,500 €/year. Biomass cost is 95,000 €/year (28 €/t). Therefore Internal Return Rate and Total Earnings are negative. Different strategies to improve the economy of the project are discussed.

Show Case 2: Mekom JSC, Silistra, Sitovo pig farm.

The potential biomass for biogas production is 43,000 m^3/year liquid pig manure and 5,500 t/year slaughter wastes. The average produced biogas per year is 1,550,000 m^3. Electrical output would be about 350-450 kW. The potential heat produced is about 450 kW.

The biogas plant could be based on a vertical complete mix digester. Appropriate sanitation and conditioning of slaughter wastes is important in order to comply with the regulations.

Economic calculations are performed for a high standard plant (4,500 €/kW). Hypothetical feed-in tariff of 0,09 €/kWh_{el} is used. Investment cost is 1,800,000 € that is equivalent to 215,000 €/year for 15 years at 8% bank interest rate. Calculated yield from electricity sale is 296,500 €/year at 0,09 €/kWh_{el}. Yield from heat sale is 38,500 €/year at 0,015 €/kWh_{th}. Operational costs (maintenance, personnel) are 136,800 €/year. Biomass costs are not considered. Internal Return Rate is 5,2 %. Total Earnings are negative -33,550 €/year. Losses could be reduced if careful planning of the biogas plant is performed.

6.2 Show Cases in Croatia

Show Case 1: Business zone Velika Ciglena

It the first show case, Poslovni park Bjelovar, a regional development agency had the idea to have biogas as energy supply in their new business zone. In and around the business zone Velika Ciglena, several industries are located which would be suitable for the provision of feedstock.

An egg and chicken company is about 10 km far from the selected site of this show case but needs to dump the chicken manure since it is located at the outskirts of city of Bjelovar. According to the Environmental Impact Assessment study (elaborated in order to gain the permission for reconstruction of chicken houses), the company produces 9,566 t/year manure of egg laying hens and 882 t/yr of laying chickens. This corresponds to a biogas yield of

1,175,400 m^3/year. The company is obliged to store the manure for 6 months. The storage facility is actually an empty chicken house.

The organic residues of the zone's business activities of greenhouses will be positive but of little influence on biogas yield. Waste from biscuits and waffle factory in the outskirts of Bjelovar may be also used as feedstock

In general for this show case, chicken litter represents 41% of available biomass. Until recently, it was not possible to digest higher portions than 1/3 of chicken manure in the total substrate mixture. The main reason for that is the high nitrogen content that inhibits the microorganisms' activity in the digester.

In August 2008, Rueckert NaturGas have developed the first biogas plant that can accept 70 % chicken manure in its anaerobic digestion process. The plant in Baasdorf (2.1 MW electricity) is running on 70% chicken manure, 20% of maize silage and 10% of grass silage from landscaping. Until now, they have 4 references for biogas plants running on high shares of poultry litter.

EIHP has contacted Rueckert Naturgas, though its sales representative for Slovenia and Croatia (e 21 d.o.o.), to provide basic plant costs for high proportion of chicken manure. Until closing the deliverable, the costs were not available but they are known at the time of closing the project: 6 926 €/kW (VAT excluded) or 3.45 M€ for a 500 kW biogas plant. The investment is not feasible for Croatian market.

Show Case 2: Centralised biogas plant in Medjimurska County

The Medjimurska County is among the most developed counties in Croatia. It is one of the most intense farming areas in Croatia and famous for its numerous scattered poultry producers. The area has abundant surface and underground waters which requires special manure management. Having in mind its development strategy with focus on tourism, the County is trying to be proactive in manure management. In autumn 2009, the Department for Economy have invited agricultural husbandries that have documentation for building waterproof manure storage at their farms to apply for subventions. The department also reminds farmers on the negative consequences of inadequate or absent manure management. In this show case one or several centralised biogas plant could be an excellent tool for manure management.

6.3 Show Cases in Greece

Show Case 1: Schimatari

Based on the mapping of the two Prefectures (Evia and Viotia) a promising site for biogas exploitation is in the greater area between Evia island and the mainland. The planned biogas plant shall be operated with the input material of liquid manure from pigs, cows and chicken manure, fat, blood from slaughterhouse, dairy waste (Whey), katsigaros (waste of olive oil production) and food waste (total feedstock of about 200,000t/year). The input materials come from agricultural and industrial companies in the nearby area of the plant. The plant could be built on the mainland in the greater area of Schimatari - Inofyta.

The plant shall be based on co-digestion of different types of feedstock in a two step process – first step thermophilic digester made at silo digesters at approx. 50-52°C, and secondary

digesters made at storage tanks operated on lower temperature (in practice 40-45°C). The total amount of CH_4 production is approx. 3.7 Mm^3 (approx. installed capacity 1.7 MW_{el}). In this case it is assumed that the biogas is utilised in a gas engine for electricity sale to the grid (14 GWh/year) and for heat production (16 GWh/year). The heat is mainly used for the process (approximately 60%) and no external heat sale is assumed (an alternative is the excess heat to be used in the nearby area, e.g. for space heating or other uses of the military campus). The plant as proposed will require an area of approx. 2.6 ha.

Show Case 2: Agrinio

Based on the mapping of the Prefecture of Aitoloakarnania a significant biogas potential in the region comes mainly from manure in the area of Agrinio and dairy waste (whey) with co-digestion of maize silage, thus a biogas plants can be located in the greater area of Agrinio city. The planned biogas plant shall be operated with the input material of liquid manure from pigs, dairy waste (whey), maize silage, katsigaros (waste of olive oil production), fat, and blood from slaughterhouses. The input materials come from agricultural and industrial companies in the vicinity of the plant. The farmers' harvest is directly brought to the place of the plant and discharged into the reception bunker (total feedstock of about 320,000 t/year). The plant can be located in the nearby area of Agrinio (eg. Spolaita or Stratos community at a distance of 10 km of Agrinio).

The plant is based on co-digestion of different types of feedstock in a two step process – first step thermophilic digester made at silo digesters at approx. 50-52°C, and secondary digesters made at storage tanks operated on lower temperature (in practice 40-45°C). The total amount of CH_4 production is approx. 9.7 Mm^3 (approx. installed capacity 4.4 MW_{el}). In this case it is assumed that the biogas is utilised in a gas engine for the production of electricity for sale to the grid (36.7 GWh/year) and for heat production (41.8 GWh/year heat production). The heat is mainly used for the process (approx. 36%) and no external heat sale is assumed (an alternative is the excess heat to be used in the greenhouses in the nearby area). The plant as proposed will require an area of approx. 3 ha.

Further steps for the implementation of the Show Cases

The owner of the plant can be either a private investor or consortium or even a Public Private Partnership (PPPs). Until now in Greece it seems that private investment with funds is a more flexible solution. The ownership has to be clarified and the structure of agreements between the plant owner and the ones dealing with the plant has to be structured. The important issue in setting up the organisation is that the ones that have an influence on normal operation also take the risk and gain the advantages.

It is assumed that the plant is constructed by local contractors in relation to an engineering project/specification and a split tender in more packages. The engineering can be based on commercial plants in Europe. The advantages of taking in local contractors are possible low prices, advantages for local economy and easier later service and possible rebuilding. To control construction a local site manager is recommended as well as to engage the future operation manager at least 3 month before technical completion of the plant.

The manure shall be picked up from the farms and transported to the biogas plant. The transport can be made in own tankers or the service can be purchased from an external contractor. It is assumed that industrial actors supply the waste products to the plant themselves or by contractors. The logistics of silage (in AGRINIO) depends on the agreement

between the plants owner and the farmers (eg. storage facilities in the biogas plant or partially storage to the farms).

The projects will be positive for the local agriculture and the local environment as well as the overall environment. The project can also be a positive as a show case for development of commercial biogas plants in Greece. To enable implementation of the plant it has to be made bankable. This requires that assumptions used in this show case have to be confirmed by contracts or Letters of Intent (LoI). Based on these confirmations the project economy can be reviewed.

The investor or the consortium has to agree on form of organisation, possible own finance and guarantees etc. In general all agreements and Letters of Intent will be made as depended agreements/LoI where they will be in operation when (if) the project is implemented.

The projects can be feasible under the right conditions in relation to biomass input and finance (mostly if can be combined with compost sale and treatment fees). It is recommended that the principle agreement of finance and the overall organisation is made as the first step because it will give the best possible situation for the biogas company negotiating agreements on in particular supplies of waste.

When the finance and the overall organisation is agreed the overall clarifications can be made stepwise as well as a stepwise detailing of the project so that the biogas organisation can assess impacts of the agreements made and decision taken during the detailing and clarification in a detailed feasibility study/action plan.

It is worth mentioning that there is investment interest in all the identified sites for biogas exploitation. In the framework of the calls for permits to generate electricity by Independent Power Producers (IPPs) by the Hellenic Regulation Authority for Energy (RAE) an application was submitted in December 2008 for a biogas plant with installed capacity of 1,36 MW_{el} in the Community of Fiki (Trikala Prefecture). In August 2009 an application was submitted in Viotia (Tanagra) for a biogas plant with installed capacity of 2.1 MW and in February 2010 an application was submitted in Agrinio (Stratos) for a biogas plant with installed capacity of 3.4 MW.

6.4 Show Cases in Latvia

Show Case 1: Biogas plant in poultry farm "Ķekava"

As first Show Case in Latvia, the poultry farm "Ķekava" was selected, located in Ķekava Parish in Rīga district. The total area of poultry farm is around 100 ha. Main feedstock used for biogas production is poultry manure, slaughterhouse waste and meat processing waste (all of them resulting from farm's production processes) and additionally grass silage is necessary to stabilize the biological process during the digestion.

Unlike traditional agricultural biogas plants, the use of slaughterhouse waste and meat processing residues for biogas production requires additional treatment in order to comply with EU rules on sanitation, digestate quality and safety. Therefore, in addition to equipment used for two stage digestion process, also sanitation unit, conditioning and waste removal equipment has to be installed. Biogas will be used in CHP unit with estimated capacity of 530 kW_{el} (electricity) and 590 kW_{th} (heat).

JSC “Putnu fabrika “Ķekava”” (poultry farm) will be the owner of project. There is a basic possibility to buy additional land and feedstock if necessary. Liquid manure can be sold based on existing contracts for manure management.

Show Case 2: Biogas plant “RZS Energo”

As second site for biogas production – biogas plant “RZS Energo” near to the animal farm “Rudeņi” is selected. The plant is located in Sesava parish in Jelgava district – at the border to Lithuania. Territory available for biogas production site – digesters, gas storage, CHP unit, auxiliary facilities and territories is 10,000 m^2. Main feedstock used for biogas production will be cattle manure, cattle dung and maize silage.

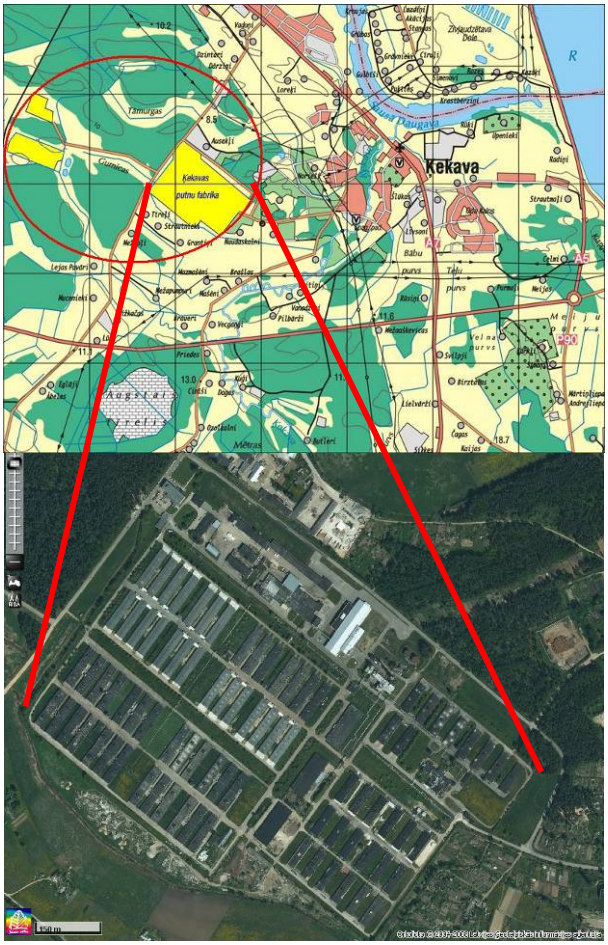

Figure 10 Location of “Ķekava” poultry farm

Biogas plant is intended as typical agricultural biogas plant based on co-digestion of different kind of feedstock. Two steps process will be used, where the first step is thermophilic digestion at temperatures above 50^{o}C and the second step is post-digestion at lower temperatures (40-45^{o}C). Biogas will be used in CHP unit with estimated capacity of 540 kW_{el} (electricity) and 600 kW_{th} (heat).

Concerning the use of heat, there are several alternatives – heat could be used for farm “Rudeņi” self-consumption, for grain drying, for district heating in settlement located near the farm or even the new business possibilities like building of greenhouses are under discussion.

Farm “Rudeņi” and one of the managers of farm “Rudeņi” will be the owner. The land is property of farm “Rudeņi”. Land rent contract for 20 year period is made.

Figure 11: Aerial view of the "RZS Energo" plant

6.5 Show Cases in Romania

Show Case 1: Sahateni

The Sahateni site is located in the Buzau district, 110 km North-East from Bucharest which is a predominately agricultural area. The biogas plant shall be integrated in a oil crop milling and biodiesel plant. the biodiesel production is estimated at about 2,000 l/day. The main feedstock for the biogas plant will be rapeseed and sunflower cakes from the pressing facility, as well as glycerol from the biodiesel plant. In addition, maize straw and other agricultural waste may be used. The village in the vicinity is planned to be the supplied with the heat from the biogas plant.

It is planned to co-digest the feedstock in two stages; in a termophilic digestion step of 50-52 °C and in a low temperature digestion step of 40-45°C. The estimated capacity will be about 199 kW_{el} and 163 kW heat. About 40-50% of the heat will be sold to village for heating.

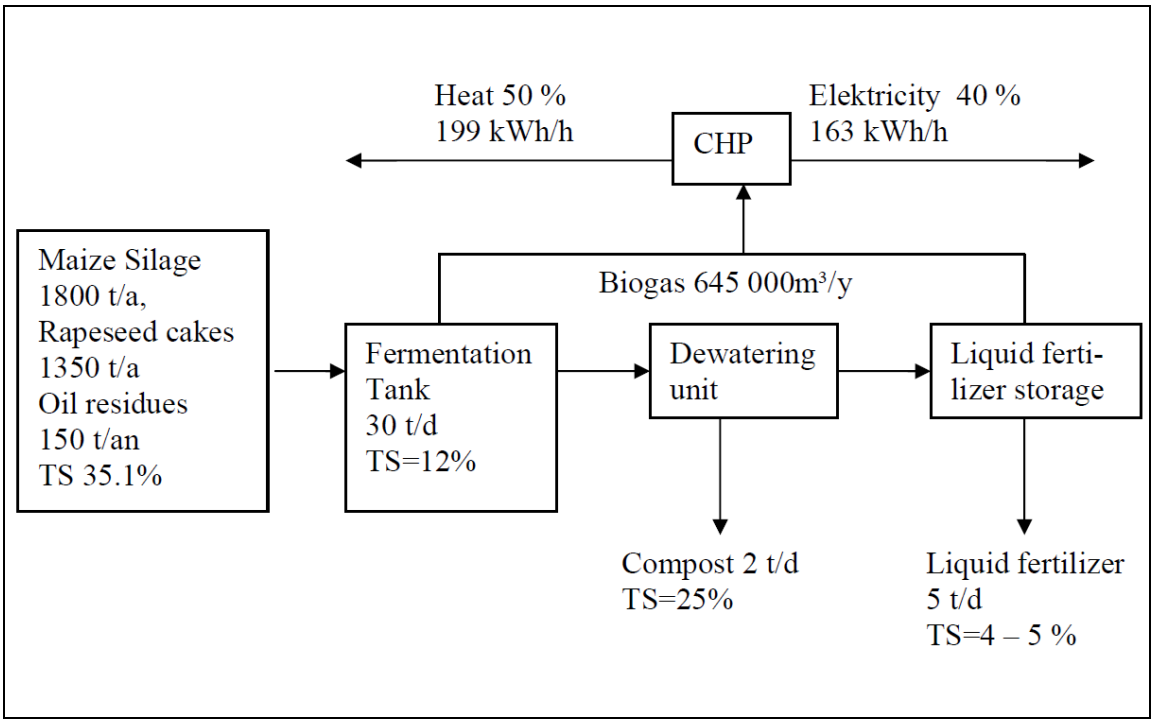

Figure 12: Mass-balance diagram for the Sahateni Show Case

Show Case 2: Dulbanu

The site of the second Romanian Show Case is also located in the Buzau district, 110 km North-East from Bucharest. The Show Case is an agricultural research and production facility of the Romanian Academy for Agricultural Sciences. The farm has 600 ha property and includes cattle breeding (80 cows). The facility has research laboratories is developing a program for integrated agriculture. Thus, a biogas plant would perfectly fit into this concept. The main feedstock would be cow manure as well as corn and cereal straw. The heat will be used during winter for greenhouses and chicken breeding. The plant size will be about 123 kW_{el} and 148 kW heat.

The owner of this plant shall be a public investor (National Agricultural Academy of Science) and other investors. A Public private partnership is foreseen.

6.6 Show Cases in Slovenia

Show Case 1: Klinja Vas

A pigs breeding facility in Klinja Vas near Kočevje it was chosen as a first show case. The Farme Ihan company, which is the biggest pigs raising company in Slovenia was one of the pioneers in producing biogas in Slovenia. It is located in the southern part of Slovenia in the Dolenjska region. It is less industrialised and of prevalent agricultural nature and with a good biomass potential. The suitable site for this show case was selected by including the size of the stock breeding activity and by the potential utilisation of the produced heat.

The Farme Ihan company used to sell around 25,000 piglets a year. The farm is now in a reconstruction phase and the planned annual capacity will be doubled. The estimated manure

available as a feedstock input is 80t per day. The desired dry matter content of pig slurry is 8%. If the feedstock source would be broadened by green biomass and food waste, the capacity of the biogas plant could be more than doubled to 500 kWe.

The planned digestion process of the plant is a mesophilic process at around 36oC and is based primarily on pigs slurry. The total amount of yearly biogas production is approx. 700,000 m^3 (approx. installed capacity 200 kW_{el}). The biogas is utilised in a gas engine (CHP unit) for the production of electricity for sale to the grid (14 GWh/year) and for heat production (16 GWh/year). The heat is mainly used for the process (approximately 55%) and no external heat sale is foreseen. The existing farm size is big enough for the proposed plant.

Show Case 2: BC Naklo

For the second show case the Biotechnical Centre Naklo was chosen. It is located near the main town Kranj. The Biotechnical Centre Naklo comprises includes education facilities and eco-farming. The biomass available is both cattle manure and green biomass that originates on spot. The quantities are quite small though. It was estimated that farm on its own is able to produce enough input for about 100 kW biogas CHP production unit and double that if input from the surroundings is taken into account. That is however not the case as this would endanger the eco status of the BC Naklo farm.

The planned digestion process of the plant is a mesophilic process at around 36°C and is based on cattle manure and biomass. The total amount of the annual biogas production is approx. 400,000 m^3 (approx. installed capacity 100 kW_{el}). The biogas is utilised in a gas engine (CHP unit) for the production of electricity for sale to the grid (850 MWh/year) and for heat production (1 GWh/year). The heat is mainly used for the process (approximately 55%) and no external heat sale is foreseen. The existent farm size is big enough for the proposed plant.

Figure 13: Aerial view of Biotechnical centre Naklo

7 Biogas Training Handbooks

In countries with developed biogas markets, such as in Germany, Austria and Denmark, there is plenty of information on biogas available – usually in national language. This included dissemination material for the public, guidelines, books, training material and handbooks. A good example is the material developed and disseminated by the German Agency for Renewable Resources (FNR). Most of this material is available for free. Also on a more scientific level, there are many papers and books on biogas available. Finally, in countries with developed biogas markets, a large range of biogas planning companies and equipment providers are available which provide technical information on biogas production.

In contrast to this, in the BiG>East target countries, there is a lack of available information material on biogas, especially in national language. Furthermore, there is a lack of a single source of information about the anaerobic digestion process, the technical and non-technical aspects of planning, building and operating biogas plants as well as about biogas and digestate utilisation. If this information is available in national language, it is scattered throughout literature, thus a unified approach and information clearinghouse is needed.

Therefore, a biogas handbook was developed by the BiG>East consortium. The BiG>East expert group elaborated an English biogas handbook which was translated into the languages of the target countries.

This biogas handbook is intended as a "how to approach"-guide, giving basic information about biogas from AD, with the main focus on agricultural biogas plants. The handbook is therefore primarily addressed to farmers and to future agricultural biogas plant operators, but also to the overall biogas stakeholders.

The handbook consists of three main parts. The first part, "What is biogas and why do we need it", provides basic information about biogas technologies, describing the microbiological process of AD and its main applications in the society, the utilisation of biogas and digestate and the technical components of a biogas plant. The second part, entitled "How to get started", shows how to approach the planning and building of a biogas plant, highlighting also the safety elements to be taken into consideration as well as the possible costs and benefits of such a plant. This part is supported by an Excel calculation tool. The third part consists of "Annexes" and includes explanation of terms, conversion units, abbreviations, literature and the address list of authors and reviewers. In addition to this, each translated national handbook also includes information of biogas production on national level.

Since most of the national handbooks are first national standard references on biogas in local language, they have a long-term impact on the overall biogas development in the country. The handbooks will remain for long time in several libraries. The handbooks are available for free download on the BiG>East website. The ISBN numbers are as follows:

- English Biogas Handbook: ISBN 978-87-992962-0-0
  (hardcopy number: SDU 200; GERBIO 550)
- Bulgarian Biogas Handbook: ISBN 978-87-992962-1-7 (hardcopy number: 200)
- Croatian Biogas Handbook: ISBN 978-87-992962-2-4 (hardcopy number: 200)
- Greek Biogas Handbook: ISBN 978-87-992962-3-1 (hardcopy number: 200)

- Latvian Biogas Handbook: ISBN 978-9934-8058-0-6 (hardcopy number: 500)
- Romanian Biogas Handbook: ISBN 978-87-992962-5-5 (hardcopy number: 200)
- Slovenian Biogas Handbook: ISBN 978-87-992962-6-2 (hardcopy number: 300)

In addition to the electronic version of the handbook, 2,300 hardcopies were printed. The handbooks were used in the BiG>East training courses and in some mobilisation campaigns. The added value of the handbooks on national level was acknowledged by many stakeholders. The translation of the handbook in other languages (Arabic, Spanish) is foreseen.

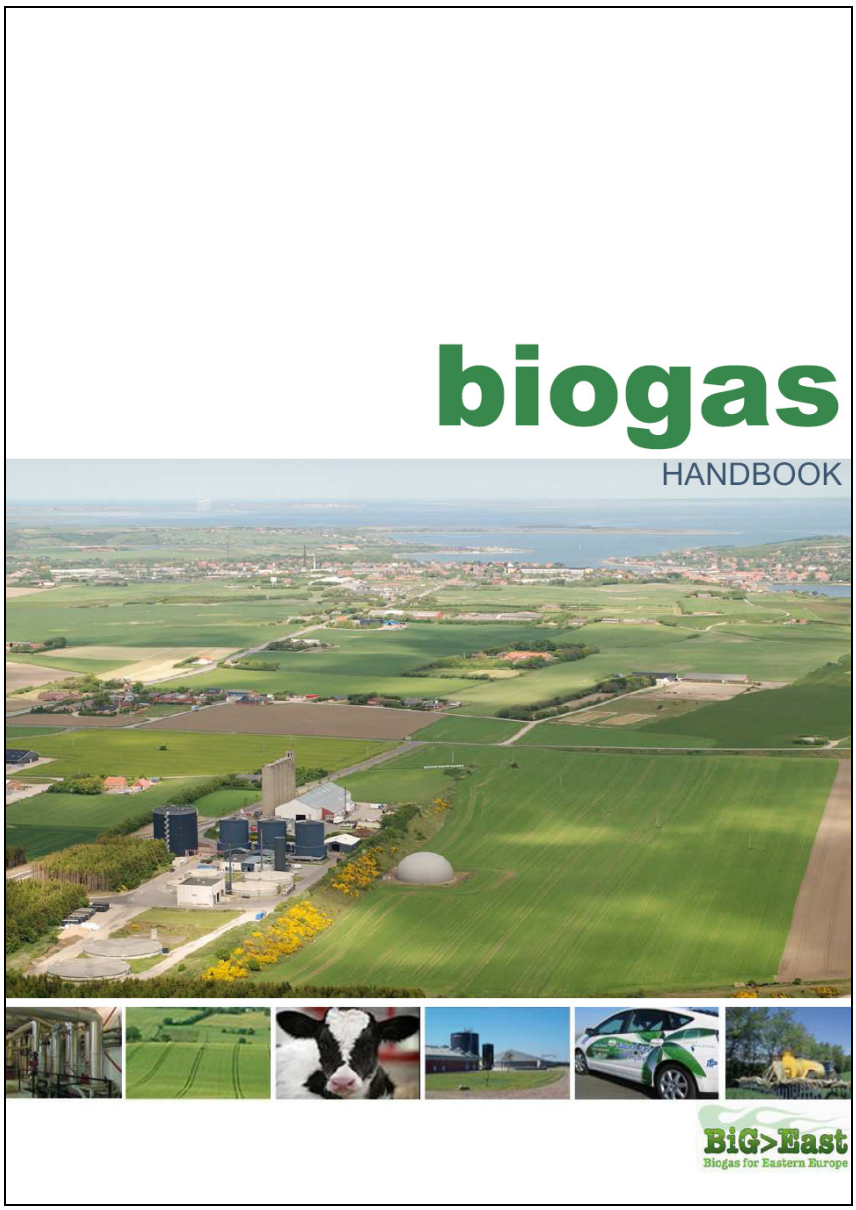

Figure 14: English version of the BiG>East Biogas Handbook

8 Biogas Training Courses

In the framework of the BiG>East project, 18 biogas training courses were organised in Bulgaria, Croatia, Latvia, Romania, Slovenia and Greece. Most of these countries had no experience in biogas training and the BiG>East courses were among the first courses in most of these countries. Thereby, the European dimension of the BiG>East project added value, since the partners who were responsible for the organisation of the training courses had support from the other project partners.

Generally, the training courses included presentations from different experts, either project partners or invited external speakers. The presentations covered the topics of the BiG>East biogas handbook which was distributed among the participants. A challenge for the training courses in which foreign speakers gave lectures was the (simultaneous) translation from English into national languages.

Some training courses in Bulgaria, Croatia, and Romania were organised on the occasion of agricultural fairs. The advantage was that the main target group, farmers, could be easily motivated to join the training courses. The disadvantage was that the fluctuation of participants per course was larger, and the cooperation with some fair organisers was difficult.

Another example for the organisation of the training courses is the close cooperation with the Latvian Biogas Association and Latvian Farmers Association "Zemnieku Saeima" which was very beneficial for the implementation of the Latvian training courses. Also in Greece, the training courses were organised in cooperation with national organisations, namely, with the Pan-hellenic Confederation of Unions of Agricultural Co-operatives (PASEGES) and the local Unions of Agricultural Cooperatives of Agrinio and Larissa-Tirnavos-Agia.

As a conclusion of the third course in Bulgaria, it was decided to initiate a Bulgarian Biogas Association, which aim is to personally inform the Minister of Agriculture about the benefits of biogas production and to move towards concrete actions in order to finance the construction of biogas plants.

In the cases of Bulgaria, Slovenia, Latvia, and Greece several visits to existing biogas plants completed the training courses. These visits were considered as very valuable by the participants, since it provided a practical example of biogas production.

In summary, the following training courses were organised:

- **Bulgaria:** 2 one-day courses have been organised on 19 and 21 February 2009 on the occasion of the International Agricultural Exhibition in Plovdiv, Bulgaria (AGRA 2009). IP stressed that the organisation of a two-days training course was difficult due to the farmers who were not willing to participate in long courses. The third training course was organised on 11/12 December 2010 in Stara Zagora. In total **71 participants** attended the courses.

- **Croatia:** The three training courses in Croatia were organised on 21/22 November 2009 in Nedelišće, 23/24 November in Zagreb, and on 15/16 January 2010 in Zagreb. In total, more than **65 participants** (farmers, representatives from the Ministry of Agriculture, and future biogas plant operators) attended the courses.

- **Greece:** The training courses in Greece were organised on 17 February 2010 in Agrinio, on 24/25 February 2010 in Larissa, and on 17/18 March in Thessaloniki. In total about **89 participants** attended the courses.

- **Latvia:** The training courses in Latvia were organised on 11/12 January 2010 in Riga, 13/14 January 2010 in Auce, and 15/16 January 2010 in Madona. In total **70 participants** attended the courses.

- **Romania:** The first training course in Romania was organised on 13-14 April 2009 in Bucharest, the second one on 8-9 December 2009 in Buzau, and the third one on 10-11 February 2010 in Ploiesti. In total **65 participants** attended the courses.

- **Slovenia:** In Slovenia, two two-days training courses were organised on 23 February and 2 March in Ljubljana and 9 and 16 March in Hoče, as well as a practical training course on 20 March 2010. The venues were the Agricultural Institute of Slovenia in Ljubljana and the Faculty of Agriculture and Biosystem Science in Hoče near Maribor. The third training course was a field trip to three biogas plants (the oldest in Slovenia - big pigs farm Ihan, the only farm level biogas plant in Letuš 150 kW and the newest in Turnišče 1MW on energy crops). In total more than **90 participants** attended the courses.

8.1 Training courses in Bulgaria

The first and second training courses in Bulgaria were implemented at the International Agricultural Exhibition AGRA, that took place at the International Fair Plovdiv from 18 to 22 February 2009. The one-day courses were held on 19 and 21 February 2009. The third training course in Bulgaria was a two-day training course and took place at the Agricultural Institute of Stara Zagora. The course was held on 11 and 12 of December 2009. During this course a study tour was organised. This included the visit of livestock farms (sheep farm for 200 sheep, dairy farm of 200 cows, feed processing plant and turkeys farm).

The Bulgarian training courses were made according the content of the Bulgarian Biogas Handbook. Firstly the biogas technologies were presented in general and subsequently in relation to the current situation in Bulgaria. Furthermore, the participants were informed about the barriers for biogas production in Bulgaria and the existing legislative framework and support mechanisms. Also a lecture how to start planning a biogas plant was given.

The interest of farmers in biogas during the courses was very large. They asked especially many questions in relation to the co-fermentation of waste feedstock with other material. Another topic of interest was the financing of biogas plants.

As highlight of the third training course, the participants decided to launch a Bulgarian Biogas Association connected to the Agricultural Academy. The objective of this association is to promote biogas to the Ministry of Agriculture.

In general, it seems that it is still a little bit early for training courses for the farmers in Bulgaria. This is due to the still lacking suitable since legislative framework. Currently, the main target group of the training shall be investors and the government. Still there is a big gap between the theory and the practice, since farmers are very interested in biogas plants, but

they do not have the needed investment costs. Furthermore, future training courses shall include both theoretical and practical training.

The strategic approach of the Bulgarian BiG>East partners to continue the biogas training activities, will focus on training of professional associations and bodies, like the unions of milk, poultry and cattle producers, farmers and other interested entrepreneurs. Furthermore, the contend of the courses will be enhanced and widened. Few items will be included to the core material:

- The policy of the European Union and the procedures of getting subsidies for farmers
- Financing the project – preparing the pre-feasibility study in a bankable way
- Preparation of application documents for bank loans
- Costs-profit analysis of different biogas project sizes
- Environmental aspects including the trade of green certificates
- Opportunities for the use of the heat from CHP plants
- Grid-injection of biomethane into the natural gas grid
- Regulatory problems such as e.g. permitting procedures

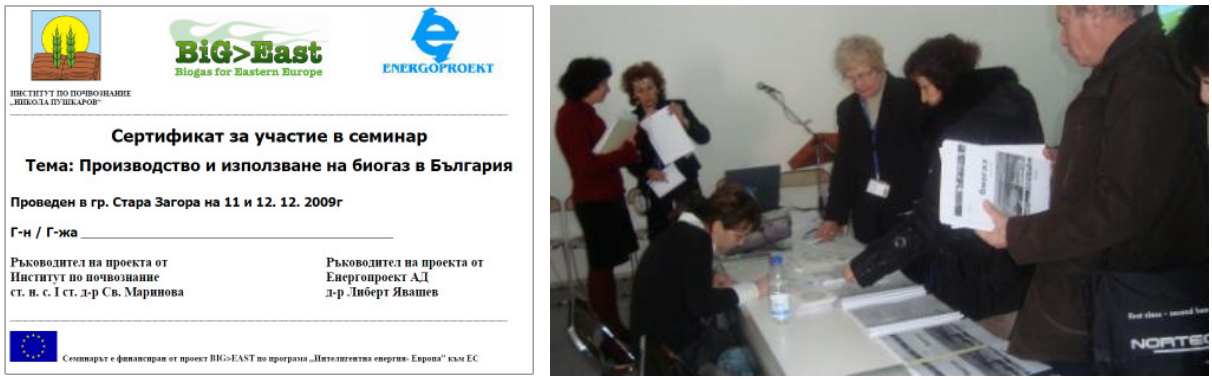

Figure 15: Certificate of the Bulgarian training course (left) and registration at the course (right)

8.2 Training courses in Croatia

In Croatia, three biogas training courses for farmers were successfully implemented. The trainings were implemented on 21-22 November 2009 at MESAP in Nedelisce, and on 23-24 November 2009 and 15-16 January 2010 in Zagreb. In total, more than 65 farmers, representatives from the Ministry of Agriculture, future biogas plant operators were participating. The course topics covered the chapters of the BiG>East Biogas Handbook.

At the time of implementation of the training courses, there was only one agricultural biogas plant operating in Croatia. Unfortunately, the operator/manager was unavailable for the trainings. The knowledge on biogas plants specific issues – anaerobic digestion, biology, working parameters, engineering etc. had to be transferred from the knowledge bearing project partners. In order to provide space for national experts, two professors from the Faculties of Agriculture from two Croatian universities (University of Zagreb and University of Osijek) were invited to present current situation of biogas market in Croatia and manure management. Each of the training courses had presentation of financing options for biogas investments, either as Croatian Bank for Development and Reconstruction (HBOR) or pre-accession fund for agriculture (IPARD) or both.

The evaluation of the both lecturers and the content of the trainings were positively evaluated. The only comment was that permitting procedure should have been covered as well. Feedback from participants and post training period communication has demonstrated demand for more trainings of this kind. Some general recommendations for the training of farmers can be summarised as follows:

- Biogas production is a very complex issue. Covering all topics in a two-day training course is very challenging. Future training courses may focus on specific biogas related topics, only.

- For farmers in Croatia, internet is not the best choice for communication. Much more audience could be addressed by placing an advertisement in the specialised newspapers or agricultural newsletters.

- It is important to understand that farmers usually cannot afford to be absent from their farms for more than a day. In that sense, organising training for farmers should either last one day or be implemented as a series of training once per week, half day.

- Timing of the training course implementation is also important. It should be avoided e.g. to organise the trainings during the season of high agricultural activity (sawing, ploughing, harvesting…).

- The language barrier is especially present among farmers which mean that simultaneous translation should be ensured during the trainings if non native speakers are providing the expertise.

- Much more audience will be covered if the training is provided in the vicinity or at the farming area. In that case, farmers do not have to lose time for travel to and from the venue. An agricultural fair could be also an option for the training, but includes also some risks (e.g. more fluctuation of participants within one day).

Trainings on biogas special features should be extended both by topics, repetition and by targeted audience. Farmers do not necessarily need to be the biogas plant investors in Croatia. A biogas plant could be also an independent place where farmers could deliver excess manure and obtain organic fertiliser. Operation of this plant concept may include farmers only as biomass/ feedstock owners and suppliers. Extended audience of biogas training in Croatia should include the administrative sector, financing sector, biogas investors and biogas plant operators with tailored syllabus covering the topics under their responsibility or interest. Three training courses implemented during this project lifetime indicated large demand of specific education on biogas issues.

Technology for renewable energy utilisation is still somewhat novelty in Croatia where educational authorities (schools, universities, lifetime educational centres) are slowly introducing renewables into the official curriculum. Implementation of training courses that provide specific, expertise and practical knowledge on biogas issues are bridging the gap while new educated generations will mature in working force.

Learning from the experience on the implemented biogas training courses for farmers, an ideal strategy for future training course on biogas with similar syllabus should last 5 days. The same topics that were concentrated in two days should be presented in more detail and farmers should have more time for asking questions and discussions. It should also allow time to "comprehend" the huge amount of new information provided on each of the topics. The training should be promoted both at farmers' newspapers and agricultural fair (promotional training). The training should be implemented at certain days in the week; 4 weeks in the row, at the same time and place. Learning material must be provided in national language, printed with sufficient space to write comments. The training itself must be in Croatian language. The ideal venue for the series of training would be a centre of farming area – small town or County centre – where translation service and accommodation for the lecturers could be found. In Croatia, the best time for implementing training for farmers is January and February when most farmers (both cattle breeders and ploughmen) are available.

Figure 16: Biogas training course in Croatia

8.3 Training courses in Greece

The three training courses for farmers and biogas plant operators in Greece were successfully implemented in three different areas of Greece with agricultural interest namely Agrinio, Larissa and Thessaloniki. In total 89 participants attended the training courses.

CRES has planned the training courses with the actual support and cooperation of the Pan-hellenic Confederation of Unions of Agricultural Co-operatives (PASEGES) and the local Unions of Agricultural Cooperatives of Agrinio and Larissa-Tirnavos-Agia. This fact gave an added value to the events as, the farmers could be reached and be informed properly and more easily by local stakeholders. Furthermore, the valuable contribution from PASEGES and the local Unions to the syllabus and training implementation according to local needs was reflected also to the trainings evaluation.

Larissa and Agrinio are two agricultural and very promising areas for biogas exploitation in Greece and the presentation of the site assessment studies for Trikala (next to Larisa) and Agrinio could further motivate the participants to support the idea of new agricultural biogas plants in these areas.

A combination between Greek experts (like biogas plant operators, future biogas investors, University professors, and researchers) and BiG>East partners as speakers gave the European state of the art and the Greek situation in an attempt to show that agricultural biogas plants under certain circumstances and careful design can be a valuable and viable option.

The duration of the training courses ranges from 1day (Agrinio) to 2 days (Larissa and Thessaloniki). It was obvious for the very beginning that it would be hard for the farmers to stay in a 2 days training course as they have field works and they are not used to it. Thus, in order to overcome this barrier the first day was dedicated to theoretical aspects of biogas technology and plant design and the second day mostly for a study tour (only in Agrinio the training course was scheduled only for one day as there is no biogas plant in operation in the nearby area for study visit). This combination seemed to be successful as it links theoretical and practical aspects.

The initial number of the trainees was scheduled to be around 20-30 per training course in order to achieve the targets and scope of the educational process. This target was achieved. The content of the courses was based mainly on the Greek Biogas HANDBOOK and the presentations were given mainly by CRES staff, experts in biogas and biogas plant operators. It two cases (Agrinio and Larissa) Michel Köttner (GEBRIO) participated transferring the German know-how. Translation of the presentations and discussion were needed to overcome the language barrier.

Figure 17: Biogas training course and site visit in Greece

8.4 Training courses in Latvia

The BiG>East biogas training courses in Latvia were organized in January 2010 in three different locations – in Riga, Auce and Madona. In total 70 external participants took part in the trainings and majority of them gave a positive evaluation of the training itself and appreciated the work of lecturers involved. Two of the training courses were accompanied with on-site visits giving the participants practical examples on operating biogas plant in Auce and biogas plant under construction located near to Madona.

Initially all three training courses were intended to have the same syllabus based on the Biogas Handbook developed within the BiG>East project. However, taking into account the availability of lecturers, the proposed on-site visits and the profile of participants, finally the first training in Riga had a different format than the other two. Also the audience in Riga consisted mainly of potential investors and businessmen. Therefore the first training addressed more theoretical issues and presentations from German experts have been provided in English without translation in Latvian. Participants of the last two trainings were mainly farmers and therefore trainings focused on more practical issues, e.g. calculations, biogas plant operation, plant components, technical parameters, problems etc. All presentations in Auce and Madona trainings were provided or translated in Latvian language thus encouraging training participants to ask questions and to involve them in discussions.

All three biogas training courses were organized in cooperation with Latvian Biogas Association and Latvian Farmers Association "Zemnieku Saeima". Both associations disseminated the information on up-coming trainings among their members and the head of the Latvian Biogas Association Andis Kārkliņš also participated in all three training courses, giving a presentation on the state of the art of biogas market in Latvia. From BiG>East project expert group GERBIO (presented by Michael Koettner) has participated in the first training in Riga and FITEC (presented by Tobias Finsterwalder) has participated in last two trainings in Auce and Madona. Other invited lecturers represented different national level organizations – educational bodies Riga Technical University (professors Dagnija Blumberga and Ivars Veidenbergs) and Latvian Agricultural University (Dr.Valdis Auziņš) and Ministry of Environment (Einārs Ciliniskis and Raimonds Kašs). All three training courses were organized and moderated by Ilze Dzene from Ekodoma.

The biogas trainings organized by the BiG>East project were the first of this kind of training courses provided for farmers, investors and other biogas market actors in Latvia. Interest from participants was high and according to the feedback received from participants, biogas trainings significantly contributed for development of biogas market in Latvia.

The following lessons were learnt from the training courses in Latvia:

- Choosing the right way for dissemination of information is very important. From the first three training courses organized in Latvia we have learned that besides personal invitations sent by email and information available on Internet it is also important to cooperate with local farmers associations and biogas association.

- The experiences of organizers show that in order to reach farmers, the training should be provided outside the capital Riga in regions close to agricultural intensive areas. The best is to choose a location where farmers from at least 2-3 administrative regions can come, meaning not more than 100 km away from their place of residence.

- The training should not be organized in the season of high agricultural activities, i.e. spring, summer or autumn. The best time for farmer trainings is from December to the end of February.

- According to the feedback received from training participants, the majority finds the length of the two day training appropriate; however, the extension of training to three days would give more time for discussions and time for practical examples and calculations. The lack of time for considering all important questions and extending the discussions beyond the timeframe was one of the drawbacks mentioned by training participants.

- Regarding the lecturers, since the biogas sector in Latvia only starts to develop, the first trainings still needs to be supported by foreign experts sharing their experiences especially on biogas plant operation issues. However, in the long term better local know-how is essential and local experts must be involved to a larger extent. This concern the knowledge on properties of feedstock and energy crops cultivated in Latvia, operation of biogas plant under climate conditions typical for Latvia, requirements and procedures for setting-up the biogas plant, etc.

- In case of participation of foreign lecturers, all training materials should be provided and presentations translated in Latvian language.

- Following the suggestions of training participants, the format of the training can be changed from single training course to the series consisting of several training courses each of them addressing different aspects of biogas production and use and only the first training addressing general issues of biogas. In that way participants could choose either to participate in all trainings or to participate in selected trainings according to their topics of interest. A proposal for the topics of the series of training courses are as following:

1. **Introduction on biogas production and use** (general information, including legislation aspects and biogas policy aspects) – length 2 days, no specific knowledge on biogas production is required

2. **Feedstock for biogas production** (waste materials, energy crops, gas yields, quality requirements, storage requirements, related safety issues, focusing on waste materials and energy crops available in Latvia, etc.) – length 1-2 days, basic understanding on biogas production and use is required

3. **Anaerobic Digestion** (biological process, process stability, parameters, etc.) – length 1-2 days, basic understanding on biogas production and use is required

4. **Biogas treatment** (treatment methods and technologies, suitability for different kind of feedstock, requirements for gas quality, etc.) – length 1 day, basic understanding on biogas production and use is required

5. **Biogas use** (use for heat and electricity production, use in transport, utilization of heat and/or electricity, etc.) – length 1-2 days, basic understanding on biogas production and use is required

6. **Biogas project economy** (calculations of biogas project economy, introduction to calculation tools, risk analysis, calculation of heat and electricity tariffs, presentations from financing bodies, grid connection authorities, etc.) – length 1-2 days, basic understanding on biogas production and use is required

7. **Setting-up the biogas plant using agricultural feedstock** (analysis of biogas plant and risks according to the type of technology and kind of feedstock used) – length 1-2 days, basic understanding on biogas production and use is required

8. **Setting-up the biogas plant using municipal or industrial waste feedstock** (analysis of biogas plant and risks according to the type of technology and kind of feedstock used, sanitation, conditioning and waste removal requirements, etc.) – length 1-2 days, basic understanding on biogas production and use is required

9. **Operation of biogas plant** (problems and solutions during the operation, what should the operator do, precaution measures, required analysis, monitoring of the plant, etc.) – length 2-3 days, deeper understanding and knowledge on biogas production and use is required

10. **On-site technical visits and presentations of existing biogas plants in Latvia** (or biogas plants in construction, analysis of biogas plants in Latvia, their pros and cons) – 2-3 site visits, basic understanding on biogas production and use is required.

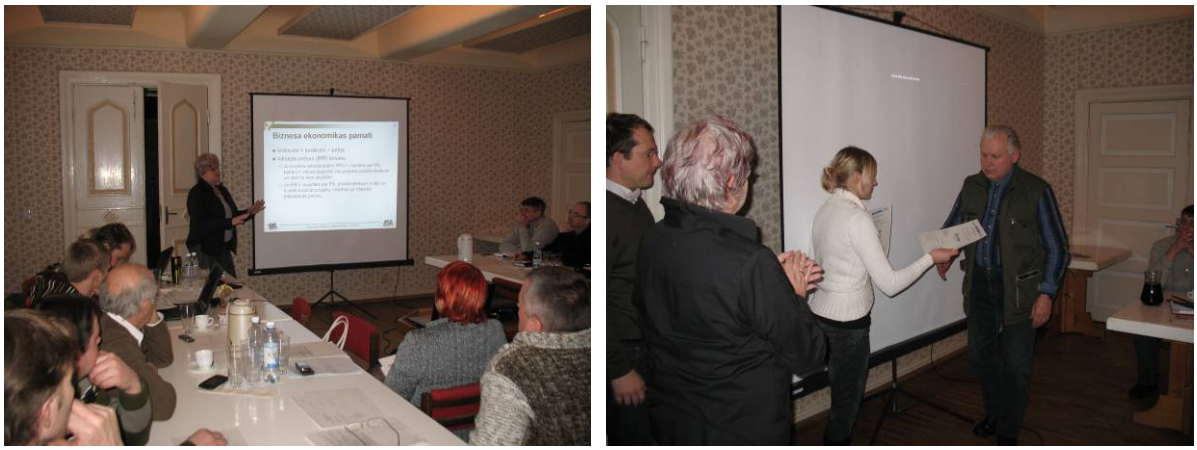

Figure 18: Biogas training course in Latvia (left) and distribution of certificates (right)

8.5 Training courses in Romania

In Romania, three courses were held on biogas at three locations which were identified as having a good potential for biogas production. Furthermore, these locations are also the areas of the Romanian BiG>East case studies. The villages targeted were: Bucharest, Buzau and Ploiesti. The first training course in Romania was organised on 13-14 April 2009 in Bucharest, the second one on 8-9 December 2009 in Buzau, and the third one on 10-11 February 2010 in Ploiesti. In total 65 participants attended the courses.

The results of the Big>East training courses will have a long-term impact on the Romanian biogas sector. Thus, the training efforts will still be performed after the end of the project. The Romanian BiG>East partner Mangus Sol will support training courses for the university curricula regarding biogas production in collaboration with the Petroleum – Gas University of Ploiesti.

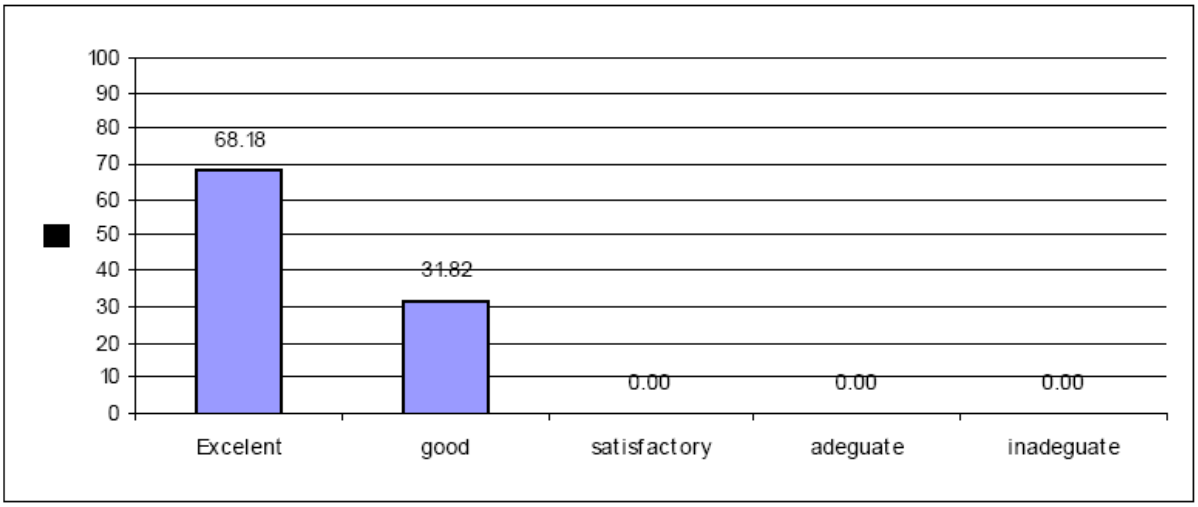

Figure 19: Example of the evaluation: Quality of the 3rd training course in Romania

8.6 Training courses in Slovenia

In Slovenia, two theoretical training courses were organised on 23 February and 2 March in Ljubljana and on 9 and 16 March in Hoče. The venues were the Agricultural Institute of Slovenia in Ljubljana and the Faculty of Agriculture and Biosystem Science in Hoče near Maribor. The third training course was a practical training on 20 March 2010 including a field trip to three biogas plants (the oldest in Slovenia - big pigs farm Ihan, the only farm level biogas plant in Letuš 150 kW and the newest in Turnišče 1MW on energy crops). In total more than 90 participants attended the courses.

In Slovenia Big>East did not come to an unpaved road, there were already seminars on biogas organised in the past and also during the time span of the BiG>East project. With this ongoing activities, synergies were created. Thus, ApE, the Slovenian BiG>East partner cooperated with the Agricultural Institute of Slovenia, the IEE BiogasRegions project and with other stakeholders.

Due to the experience of the previous biogas training activities in Slovenia it seemed that two days in a row is not suitable. Furthermore, since Slovenia is a small country, there is no need to make seminars in three different locations especially if the last course was organised not very long time ago. Therefore, two theoretical courses of two days duration and one practical course including a visit of three biogas plants were organised. After initial planning of organising two site visits, finally only one was organised. This was due to the limited interest of the participants in the site visit since similar field trips were organised in framework of other projects. Furthermore it was discovered that investors and/or local authorities many times organise field trips to similar biogas plants for the local population and potential investors. In the past they were organised mainly to biogas plants in Austria or Germany and now also to Slovenian locations.

Since the biogas sector in Slovenia is developing, several Slovenian biogas experts were identified. Therefore, only Slovenian lecturers were included in the training courses and no foreign speaker was invited. This reduced costs and avoided language/translation problems.

Figure 20: Visit of a biogas plant in Dobrovnik, Slovenia

9 Mobilization Campaigns for Decision Makers

In parallel to the training activities for farmers, the BiG>East also included activities targeting decision makers. This is due to fact that lack of knowledge of decision makers is one of the main barriers against biogas development in the BiG>East target countries.

Thus, an objective of BiG>East was to promote good practice sites for the implementation of new biogas plants to decision makers, such as municipalities, utilities, environmental NGO's, waste management authorities, financiers, project developers and SME's. Therefore, 13 Mobilization Campaigns for decision makers were organised in the target countries:

- 26 February 2008 in Zagreb, **Croatia** (EIHP); 40 participants in total
- 13 March 2008 in Markovci, **Slovenia** (ApE); 10 participants in total
- 11 September 2008 in Sofia, **Bulgaria** (IP/ENPRO); 26 participants in total

- 04 February 2009 in Auce, **Latvia** (EKODOMA); 76 participants in total
- 26 February 2009 in Vukovar, **Croatia** (EIHP); 60 participants in total
- 23 September 2009 in Zagreb, **Croatia** (EIHP); 25 participants in total
- 20 October 2009 in Athens, **Greece** (CRES); 114 participants in total
- 4 February 2010 in Thessaloniki, **Greece** (CRES); 68 participants in total
- 13 November 2009 in Bozurishte, **Bulgaria** (IP/ENPRO); 13 participants in total
- 7 December 2009 in Buzau, **Romania** (MANGUS); 34 participants in total
- 9 March 2010 in Ploiesti, **Romania** (MANGUS); 17 participants in total
- 16 March 2010 in Riga, **Latvia** (EKODOMA); 27 participants in total
- 30 March 2010 at the Biotechnical Centre in Naklo, **Slovenia** (ApE); 32 participants in total

The structure, duration and objectives of these mobilisation campaigns differed between the BiG>East target countries and also within one target country. Generally, the duration of one Mobilisation Campaign was between a half day and one day. In average 43 participants attended each mobilisation campaign. In total 560 participants attended the 13 mobilisation campaigns. Due to the large interest of stakeholders in biogas, even an additional third Mobilisation Campaign was organised in Croatia.

Most of the Mobilisation Campaigns were organised as small workshops where presentations from biogas experts were given according to a certain agenda, including the presentations of the BiG>East Show Cases. Furthermore, the events were also rather inter-active and allowed much discussion. At some mobilisation campaigns, also biogas plants were visited, in order to present practical applied biogas production to the decision makers.

In summary, all Mobilisation Campaigns were a large success, since it attracted many important stakeholders. Most of the Mobilisation Campaigns were the first events dedicated on biogas in the target countries. These events brought together several local stakeholders.

As one of the main long-term outcome of this activity, the Mobilisation Campaign in Croatia initiated the foundation of a national biogas interest group: A new interest group on biogas within the Association of RES at the Croatian Chamber of Economy was established on the occasion of the 2nd Mobilisation Campaign in Croatia.

Finally, the project partners of the target countries elaborated local implementation strategies for biogas projects in the target countries to underline the follow up activities for the decision makers about the utilization of biogas as renewable and sustainable energy source. The main issues that were addressed in these strategies are:

- Public acceptance of biogas projects and raising awareness of public sector.
- Quality and sustainability of new biogas installations.

- Collecting of local experiences and know-how, capacity building of administrative sector.
- Reducing the administrative barriers, especially on permitting procedures.
- Suitable frameworks for financing biogas projects.

Figure 21: 2nd Mobilisation Campaign in Croatia

10 Study Tours

Apart from the one-day site visits in the frame of the mobilisation campaigns and training courses, one study tour in Germany was organised for the BiG>East consortium and two three-days study tours were organised for farmers and decision makers from the target countries in Austria and Denmark.

In order to boost the transfer of knowledge to Eastern Europe and to motivate the project partners, a technical tour was organized on the occasion of the BiG>East Kick-off-meeting in Germany. 13 project partners, especially those from eastern Europe, participated in the tour. Two innovative biogas plants were visited in the vicinity of Munich:

- The first biogas plant in Pliening is one of the first German plants feeding biomethane into the national gas grid, namely 485 Nm³/h. The plant consists of 3 main digesters (1000 m³ each), 3 pre-treatment digesters (2.700 m³ each) and three storage tanks for digestate. The input material is 35.000 t/a maize silage.

- The second biogas plant is the BioPower biogas plant in Bernau. This plant is fed by food wastes and it is the first biogas plant which was planned by the project partner FITEC. The installed electric power is 250 kW_{el} and the input material are 6.000 t/a food wastes.

These two plants are very different since the first plant is an ago-industrial large-scale biogas plant and the second one is a small-scale plant for waste reduction. The tour gave the opportunity to gain experience, especially among those project partners who have only few possibilities to visit biogas plants in their home countries.

Figure 22: Study Tour in Germany: Pliening (left) and BioPower in Bernau (right)

The Ing. Gerhard Agrinz GmbH organised a study tour in Austria on 20- 22 April 2009. In total, 16 participants attended the tour. The three-day programme was divided into two parts, a theoretical presentation during one afternoon and two excursion days with visits of two biogas plants every day. The following biogas plants were visited:

- Biogas plant Margarethen am Moos (biogas upgrading facility; first public biomethane filling station of Austria)
- Biogas plant Bruck an der Leitha (biogas upgrading facility; biomethane grid injection; waste feedstock)
- Biogas plant Mureck (eco-energy park including a woodchip heating plant, a biodiesel plant and a biogas plant)
- Biogas plant St. Stefan im Rosental


Figure 23: Study Tour in Austria: Margarethen am Moos (left) and Bruck an der Leitha (right)


Figure 24: Study Tour in Austria: Mureck (left) and St. Stefan im Rosental (right)

The biogas study tour in Denmark took place on 7-9 September 2009. The study tour was arranged and organized by University of Southern Denmark (SDU). In total 11 participants attended the study tour. Similar to the Austrian study tour, the three-day program was divided into two parts, a theoretical presentation during the first afternoon and two days of visits to biogas plants. The following centralised co-digestion biogas plants were visited:

- Blaabjerg biogas plant
- Lemvig biogas plant
- Filskov biogas plant
- Lintrup biogas plant

Figure 25: Study Tour in Denmark: Blaabjerg (left) and Lemvig (right)

Figure 26: Study Tour in Denmark: Filskov (left) and Lintrup (right)

11 BiG>East Dissemination activities

Besides the dissemination through the implementation of training courses and mobilisation campaigns, a dedicated task in the BiG>East project aimed to inform and involve stakeholders in project activities.

The project was presented at more than 20 events (presentations and flyers) and more than 30 articles were published in magazines, newspapers, and journals.

One of the most important dissemination tools of BiG>East was the creation of a project website (www.big-east.eu) which was translated into the 6 languages of the target countries. Until May 2010 137,136 visitors visited the BiG>East website as shown in the graph below.

Two joint biogas workshops were organised together with other IEE biogas projects in Brussels, Belgium, on 12 February 2009 and on 24 March 2010. The workshops were organised in the framework of the European Sustainable Energy Week 2009 and 2010. More than 100 participants attended the two workshops.

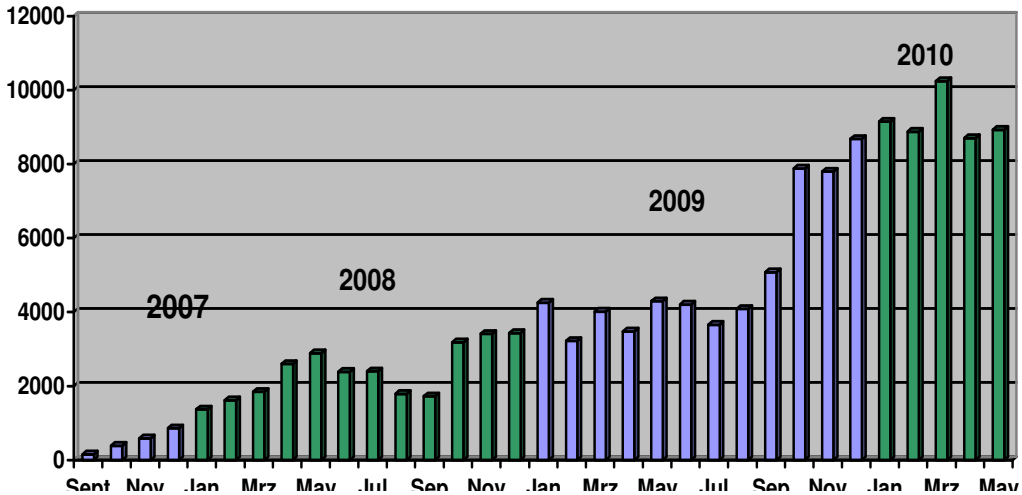

Figure 27: Visits of the BiG>East website (September 2007 to May 2010)

Figure 28: Biogas workshop on the occasion of the EUSW on 24 March 2010 in Brussels, Belgium

12 Impacts of the BiG>East Project

The outcome of the BiG>East project shows large impacts beyond the BiG>East project lifetime. The main long-term impact is the basic preparation of biogas development in Bulgaria, Croatia, Greece, Latvia, Romania, and Slovenia. More specifically, the following short/medium/long term impacts of the action were achieved:

Previous to the implementation of the BiG>East project, there was only very little human capacity on biogas in the target countries. BiG>East built human capacity on technical and non-technical aspects of biogas production in the target countries. This includes capacity of the consortium members as well as of the targeted stakeholders (farmers, decision makers and other stakeholders). This was achieved by the implementation of minimum two mobilisation campaigns, three training courses, the presentation of the national biogas handbooks, and by many local dissemination efforts. The human capacity will remain in the country for long-term.

Most of the national handbooks are first national standard references on biogas in local language. The handbooks will remain for long time in several libraries. They are furthermore available for free at the BiG>East website, as well as on the partner websites.

The direct involvement of stakeholders in the development of the BiG>East show cases and the presentation of the show cases to decision makers sowed the seed to real biogas project implementations. Once, the biogas plants were built in the medium-term, this will affect the long-term development of biogas in the target countries.

Most of the mobilisation campaigns were the first events dedicated on biogas in the target countries. These events brought together several local stakeholders and will have a long-term impact on the awareness of decision makers on biogas.

In some cases (Bulgaria, Croatia), the training course and the mobilisation campaign initiated the foundation of national biogas associations/groups. These will have long-term impacts on the promotion of biogas, lobby work, and on improving framework conditions.

In cooperation with several national organisations, the BiG>East partners of the target countries will continue with the organisation of biogas training courses. These courses will be further developed and extended. This will have a short- to long term impact on the overall biogas development in the target countries. As example, in Croatia, the BiG>East stimulated the inclusion of biogas training in the vocational education in which future biogas plant operators get certificates which are needed for financing support.

As direct outcome of BiG>East, a follow-up project was accepted for funding under the Intelligent Energy for Europe Programme. The BiogasIN project focuses on improving the framework conditions for biogas (financing, policies, and administrative issues) in Eastern Europe. This is the first IEE project coordinated by EIHP, Croatia. This will guarantee in the short-term the continuation of the BiG>East achievements.

13 Main Achievements of the BiG>East Project

The proposed actions of BiG>East will create various direct benefits for the target countries of Eastern Europe, as well as for the countries from Western Europe. Important direct benefits are described below.

Generally, the BiG>East project was a great success. The timing of the project start coincided with the start of the first developments on biogas activities most of the target countries, except in Romania which has already a long history of more than six decades in biogas, and except in Greece, where already several biogas plants were set-up. Thus, BiG>East supported the efforts in the creation of these new markets.

One of the outstanding and long lasting impacts of BiG>East was the development of the biogas handbook in English and in national languages. In most of the target countries, the translated handbook represented the first biogas handbook in local language. Since the handbook is available for free also in electronic version on the website, it will even have a long-term impact beyond the project lifetime.

Generally, large translation efforts were needed, not only for the handbooks, but also for the implementation of the other BiG>East activities in the target countries. This included the development of national biogas terminologies, the translation of training material, and (simultaneous) translation during the presentations of foreign biogas experts for the training courses and mobilisation campaigns.

In the framework of the biogas training courses, farmers, but also other stakeholders, were trained. However, while implementing the BiG>East project, also the project participants themselves were trained about biogas concepts, technologies, frameworks, and markets. This contributed to national capacity building on biogas production and utilisation in Eastern Europe.

18 training courses were successfully implemented in the target countries. In many cases, the duration of the training courses largely exceeded the schedules due to the high interest and motivation of the participants. In total, more than 340 participants attended the training courses.

The BiG>East Show Cases were elaborated in order to detect potentially suitable sites for biogas production, and to promote these examples among decision makers in so-called mobilisation campaigns. The Show Cases prepared the way for the implementation of several biogas plants. Especially in Greece Bulgaria, and Romania the Show Cases contributed to project realisations.

13 mobilisation campaigns were successfully implemented informing more than 560 decision makers about biogas. Local authorities, as well as potential plant operators and investors were the main groups of participants. At the Mobilisation Campaign in Bulgaria, the participants expressed the need to establish a Bulgarian Biogas Association and initiated first preparatory steps. At the 2nd mobilisation campaign in Croatia, the idea of establishing a biogas lobbying group have been introduced. Several months later, in November 2009, the Biogas Group at the Association of RES at the Croatian Chamber of Economy have been formally established.

BiG>East activities showed that there is very high general interest in biogas production in the target countries. Stakeholders made large efforts to gain information about biogas (some farmers travelled more than 1,200 km by car to attend the study tour). More then 1,000

stakeholders participated at various BiG>East events and provided feedback on opportunities and barriers on biogas development in Eastern Europe.

Since BiG>East was one of the first projects in some of the target countries supported by public funds and since it initiated great interest among the involved partners and participants, there is urgent need to continue the biogas activities in the target countries in order to positively improve the framework conditions for biogas development.

14 Conclusions

Feedstock material and biogas potential in the target countries is very high. The biomass availability and the applied technologies will determine the biogas exploitation. However, biogas production is currently very limited in the target countries, mainly since legal, administrative and financial frameworks are not suitable. Thus, there is large need to continuously support this technology and to mobilize politicians and decision makers. Knowledge and awareness (e.g. among farmers) are two main keys for the successful implementation of biogas plants in Eastern Europe.

In the framework of the biogas training courses, farmers, but also other stakeholders, were trained. However, while implementing the BiG>East project, also the project participants themselves were trained about biogas concepts, technologies, frameworks, and markets. This contributed to national capacity building on biogas production and utilisation in Eastern Europe. 18 training courses were successfully implemented in the target countries. In total, more than 340 participants attended the training courses. At the training course in Bulgaria, the participants expressed the need to establish a Bulgarian Biogas Association and initiated first preparatory steps.

In the BiG>East project more than 560 decision makers and stakeholders were informed about biogas production in 13 so-called Mobilisation Campaigns. The participants included local authorities, as well as potential plant operators and investors. At the 2nd Mobilisation Campaign in Croatia, the idea of establishing a biogas lobbying group have been introduced. Several months later, in November 2009, the Biogas Group at the Association of RES at the Croatian Chamber of Economy have been formally established.

Although BiG>East was very successful, one of the main outcomes was that the main barrier against biogas development in the target countries are, on the one hand still the unsuitable frameworks (administrative burdens of permitting procedures, lack of financing, lack of policies, feed-in tariffs, etc.), but on the other hand also the lack of capacity about biogas production and use (lack of pilot plants, lack of knowledge and awareness, lack of skilled personnel). These issues have to be tackled in more detail in future projects.

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15 Summary and Recommendations

The main barrier for further biogas development in the BiG>East target countries is the lack of suitable framework conditions, including legislation, permission procedures and incentives.

⇒ The national legislation has to support biogas technologies in order to develop a market. This includes e.g. feed in tariffs and clear and efficient permitting procedures. Target countries shall include biogas in the Renewable Energy Action Plans (NREAPs) which are mandated by the European Renewable Energy Directive (RED). Support mechanisms shall carefully consider advantages and disadvantages of different biogas concepts including the size, efficiency, heat use and feedstock.

⇒ On European level, the European Union should actively promote and support biogas, specifically from waste materials, in order to achieve the European renewable energy targets of the RED and of the waste directive.

⇒ Further awareness campaigns and information of key stakeholders and decision makers need to inform about the benefits of biogas production.

The biogas training courses were among the first training activities in the target countries. The BiG>East provides experiences from biogas training courses which were in general two-day training courses for farmers.

⇒ In future, it may be recommended to establish in the target countries series of biogas training modules with dedicated topics. The duration of an individual module depends on the national situation but may range between 8 and 50 hours.

⇒ The training shall be focused on specific target groups (farmers, investors, public bodies). However, in some cases a training course for any interested stakeholder may be needed in order to attract participants. The advantage of homogeneous participant groups is that it is easier to streamline the course content and to satisfy all participants. The advantage of inhomogeneous participant groups is that the stakeholders from different background support each other in different topics and thus broaden the general view on biogas.

⇒ Future training concepts should consider accreditation of the courses by public entities and certification of participants.

⇒ Biogas training shall be also included in the overall national education program, such as in vocational education (e.g. for agriculture) and university education.

⇒ More training is needed especially for planning and financing biogas projects.

⇒ There is still a serious lack of biogas capacity and skilled trainers in the target countries. Thus, a train-the-trainers concept is urgently needed.