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Did you Know that Biogas...?

INTELLIGENT ENERGY EUROPE

Biogas basics

Biogas is a mixture of methane, carbon dioxide, nitrogen, hydrogen and hydrogen sulphide. The desired compound is methane, but the exact composition of biogas varies depending upon the feedstock material used for its production. Biogas is produced anaerobic, meaning, that it can only be generated under absence of oxygen (Anaerobic Digestion, AD).

AD is common to many natural environments, such as marine water sediments, or the stomach of ruminants. AD is a biochemical process during which organic matter is decomposed by various microorganisms. These microorganisms are only able to survive under anaerobic and dark conditions. Therefore, AD normally takes place in digesters, which are specially designed for this purpose. Biogas digesters are hermetically sealed from oxygen and light.

After the feedstock has been filled into the digester processed two principal outputs from AD are produced: biogas and digestate:

- The **biogas** produced during AD is removed from the digester and further processed. Energy can only be produced from the methane fraction in the biogas. It can be burnt directly in order to produce heat or electricity or purified in order to use it as fuel for vehicles or as substitute for natural gas.

- **Digestate** is the biodegraded feedstock, which is left after AD. Depending on the feedstock, it has either more liquid or more solid components. Digestate is an excellent fertiliser and has a considerable advantage compared to the original feedstock. Due to the treatment during AD, its odour is significantly reduced while nutrients are not addressed by AD and remain in the digestate.

Generally, digesters can use many biodegradable materials. The most common biomass categories used in European biogas plants are (Al Seadi et al., 2008)[1]: Animal manure and slurry, Agricultural residues and by-products, Digestible organic wastes from food and agro industries, Organic fraction of municipal waste and from catering, Sewage sludge, Dedicated energy crops (e.g. maize, miscanthus, sorghum, clover), Wastewater sludge.

DID YOU KNOW THAT BIOGAS IS...

- **...a GHG savings tool?**
- **...a tool for implementing best agricultural practice?**
- **...a renewable energy carrier?**
- **...a source for regional development and socio-economic benefits?**

[1] Al Saedi T., Rutz D., Prassl H., Köttner M., Finsterwalder T., Volk S., Janssen R., Biogas Handbook, October 2008

Biogas benefits

Environmental friendly solution

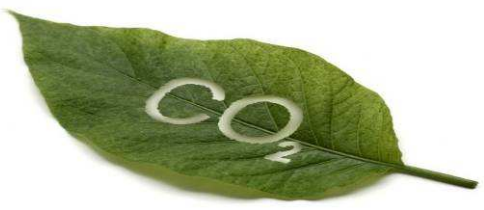
In contrast to fossil fuels, burning biogas only releases the amount of atmospheric CO_2 that was stored in the plant during its growth. Thus, the carbon cycle of biogas is closed. For that reason, utilisation of biogas reduces CO_2 emissions and helps to avoid an increase of the CO_2 concentration in the atmosphere, which helps fighting global warming. Furthermore other GHG emissions, such as methane and nitrous oxide from untreated manure, are reduced.

In general GHG saving due to biogas utilization can be arisen by:

- **Manure management:** potential emissions saved due to CH_4 utilisation of animal manure and slurry
- **Substitution effect:** Emission saved due to electricity and heat (cogeneration) produced from biogas
- **Replacement of fossil fertilisers**: Emission saved due to replacement of mineral fertilisers with digestate

Livestock production can result in methane (CH4) emissions from enteric fermentation and both CH4 and nitrous oxide (N2O) emissions from livestock manure management. In many countries large livestock populations play an important source of GHG emissions.

Biogas production by AD results with forming of digestate, which replaces utilisation of raw manure as fertiliser. Due to the fact that digestate has better fertiliser efficiency than raw animal manure, additional substitution of mineral fertilisers occurs. This results in GHG savings due to reduced production of mineral fertilizers.



Best agricultural practice

One of the main advantages of biogas production is the ability to use waste as a feedstock for AD. A large fraction of municipal and industrial waste contains organic compounds, which can be utilised for biogas production in anaerobic digesters. This reduces the volume of waste, saves money and contributes to meeting national and European waste recycling regulations. Besides, excess of manure in intensive livestock breeding areas can be effectively used for biogas production. This is considered as one of the good agricultural practices in manure management. Furthermore, the produced digestate contributes to compliance of a closed nutrient cycle.

Digestate has improved fertiliser efficiency due to homogeneity and higher nutrient availability. It is rich in nitrogen, phosphorus, potassium and micronutrients and can be applied on soils just like liquid manure. Further advantages of digestate compared to manure are the reduction of odours and flies due to the biodegradation and improved veterinarian safety, because the digestate is either submitted to a controlled sanitation process previous to the appliance to soil, or sanitation is provided by the AD process itself.

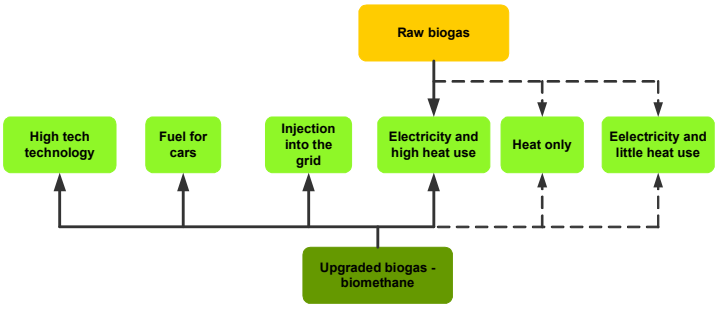
Digestate can be used as a substitute for synthetic fertilisers. Thus, additional nutrient deployment is constrained. This contributes to meeting EU directives, such as the EU Nitrate Directive.

Biogas benefits

Renewable energy production

Biogas covers a variety of markets, including electricity, heat and vehicle fuels. Biogas is versatile energy carrier and most commonly is used for production of electricity and/or heat, upgraded for injection into the gas grid or used as fuel for cars.

As biogas is a high value energy carrier that can be easily converted into other energy forms it should not be used as source of heat or electricity alone but mainly for electricity production in combination with the use of the heat or as transportation fuel. Efficient biogas pathways (bold arrows) are illustrated in Figure[1] below:



Socio economic issues

Biogas production has many social benefits and most of these are related to job creation and rural development. Especially in agricultural rural regions and small to medium size decentralised biogas systems, may have considerable advantages, such as:

- The development of a biogas sector stimulates the establishment of new enterprises, which will increase the income and give more job opportunities, but also will increase the economic growth of the area. Biogas can contribute to revitalise rural areas by making them attractive for facility manufacturers, investors and entrepreneurs.
- As biogas can generate electricity and heat and work as a substitute for vehicle fuel, its utilisation contributes to reducing the dependency on fossil fuels, but also to energy diversification, security, competitiveness and sustainable supply.
- Biogas production and utilisation influences the socio-economic structure in rural areas. Improves the social cohesion of the local population.

[1] Source: AEBIOM, European Biomass Association, A Biogas Roadmap for Europe, October 2009

Case studies

Twenty eight (28) regions were examined within the BiogasIN target countries (Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Slovenia) and the next paragraphs highlight the potential benefits from biogas utilisation in these regions.

Bulgaria

Map of Bulgaria with BiogasIN target regions

The use of biogas is underdeveloped despite the available resources. Biogas produced in Bulgaria, mainly by urban waste water treatment plants, is used for own and local needs and is not integrated into the existing natural gas networks.

Bulgarian biogas market is still developing. There are still no biogas plants installed, even though there is huge interest from some farmers and investors. It is hard to define the quantities of the resources for producing biogas in Bulgaria. When making the assessments of the resources, have in mind the quantity material, generated from organic waste and from agricultural waste. All the crops are potential energy sources.

In Bulgaria the biggest potential for producing biogas can be found in the regions North-east and South-central. In these same regions are located the four target areas. Bulgaria has a large potential for producing biogas from crops.

Veliko Tarnovo covers a surface of 4,662 km^2. 275,000 people are populated in the municipality, of which 24% are living in the city of Veliko Turnovo.

Haskovo is the largest of the four target regions, covering an area of 5,543 km^2 and is populated by 279,000 inhabitants. Around 34% of them are living in the city of Haskovo.

Stara Zagora covers an area of 5,151 km^2 and is populated by 389,000 people, of which 42% are living in the capital.

Jambol covers a surface of 3,336 km^2. It is populated by 141,000 inhabitants, 65% of them living in the city of Jambol.

Biogas benefits in Bulgaria

According to the National Energy Action Plan, under Directive 2009/28/EC, Bulgaria's mandatory national target for 2020 is a 16% share of energy from renewable sources in the gross final consumption of energy, including a 10% share of energy from renewable sources in the consumption of energy in the transport sector. The contribution (installed capacity, gross electricity generation) expected from biogas in Bulgaria to meet the binding 2020 targets has been estimated to 65MW or 357GWh (31ktoe). Additionally, 20ktoe is the estimated contribution (final energy consumption) of biogas for heating-cooling in 2020.

Bulgaria ratified the Kyoto protocol to the UNFCCC on August 15th, 2002. The target adopted by Bulgaria is an 8% reduction compared to the base year (1988). GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 73.5 million tones, which means a 44.6% reduction between the base year and 2008. Agriculture share of GHG emissions in 2008 was 6.7% and energy supply 49.9%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Bulgaria can give the following results:

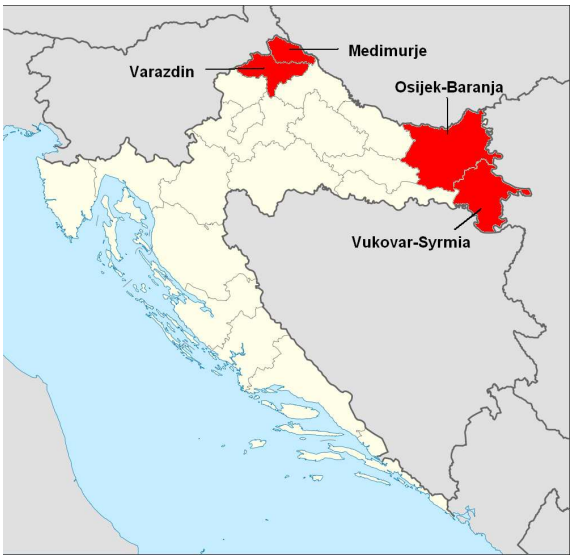
Target region / Biogas advantages	Veliko Turnovo	Haskovo	Stara Zagora	Jambol
Potential emission savings ($ktCO_2$-eq per year)	199.49	197.76	203.58	174.61
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	2,957	2,882	2,900	2,918
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	855,313	833,833	838,941	844,213
Electricity production potential (in cogeneration), (GWh)	91	93	97	79
Biogas energy share in national renewable targets in 2020, %	2.9	3.0	3.1	2.5
Biogas energy share in national biogas target in 2020, %	4.7	4.7	5.0	4.0
Installed capacity, (MW)	12.2	12.5	13	10.6
Number of biogas plants (installed capacity of 0.5MW)	24	25	26	21
Local job creation	38-232	39-237	41-248	33-202
Number of households supplied with electricity (generated in co-generation)	26 293	26 648	27 923	22 716
Investment costs (M€)	38.4	39.2	40.9	33.3

Which means:

- saving of about 775.44 $ktCO_2$-eq or 1.06% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2eq in 2008 amounted to 73,431 $ktCO_2$-eq).
- contribution with 11.1% to the national renewable energy target in 2020 and with 18.4% to the national biogas target.
- Total installed capacity of about 48.35MW with investment costs of M€151.8
- About 100 new small biogas plants (0.5MW each) creating a range of 151-919 new jobs.
- saving of about 11,657 t/yr artificial fertilizers worth of 3,372,399€/yr
- 103,580 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Croatia



Map of Croatia with BiogasIN target regions

Medimurje County is located in the very northern part of Croatia. Despite being the smallest sized county in Croatia, it is the most densely populated one. 118,000 inhabitants are living in an area of 730 km^2. The economy of Međimurje is dynamic and fast-growing, based on a long tradition in entrepreneurship and craft. 14% of the population of this export orientated region are living in rural areas. Total agricultural land covers a surface of 55,000 ha. The share of crop production on arable land is 60%, while 40% are used for cattle breeding (mostly pigs and poultry). Dominant crops are cereals, potatoes and vegetables, industrial crops and fodder.

Varazdin County is a county in northern Croatia and covers an area of 1,261 km^2. The population is about 184,000 people. 67,000 ha of the county are occupied by agricultural land out of which 67% are currently utilised.

Another important economical factor in Varazdin County is food processing industry. Agriculture and food processing industry generate employment for 12% of the active population. The advantages of biogas utilisation are considerably important for this county, as it is an environmentally friendly way of waste management and energy recovery from organic waste originated from well food processing industry.

Vukovar-Syrmia County is predominantly a plain region, which covers a surface of 2,448 km^2 and is populated by 204,000 inhabitants. Most of the area is utilised for agriculture (150,000 ha) due to the fertile, black soil. The main agricultural outcomes are wheat, maize, sugar beet and tobacco. It is the first Croatian county to have an agricultural biogas plant operating since mid 2009. Some 20% of national biogas potential has been attributed to this county. Available base feedstock for biogas production are dairy cow and cattle manure, pig slurry and, to a lesser extend, poultry manure and slaughterhouse waste plus feedstock from food-processing industry and energy crops.

Osijek-Baranja County is predominantly a plain region suitable for agricultural development covering an area of 4,155 km^2 and populated by 330,500 inhabitants. About 258,000 ha of agricultural land are provided in the county. Cereals, industrial crops and fodder are the dominant crops produced in the arable land. The county has one agricultural biogas plant operating since early 2010 and about one third of Croatian future biogas locations have been identified here.

Biogas benefits

Biogas benefits in Croatia

Croatia in the pre-accession period for full membership in the EU also respects the obligations of cutting greenhouse gas emissions by 20%, produce 20% of its energy from renewable sources and increase energy efficiency by 20%, by 2020. The contribution (gross electricity generation) expected from biogas in Croatia to meet the binding 2020 targets has been estimated to 722 GWh.

Croatia ratified the Kyoto protocol to the UNFCCC on May 30, 2007 (entered into force on 28 August 2007). The target for Croatia is 5% reduction compared to the base year (1990). GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 31.1 million tones, which means 0.9% reduction between the base year and 2008. Agriculture share of GHG emissions in 2008 was 10.8% and energy supply 28.6%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Croatia can give the following results:

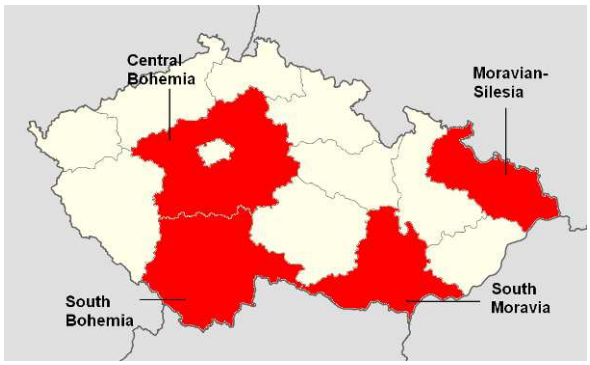
Target region / Biogas advantages	Međimurje	Varaždin	Vukovar-Srijem	Osijek-Baranja
Potential emission savings ($ktCO_2$-eq per year)	23.72	29.53	49.42	92.08
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	75	126	244	418
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	21 786	36 377	70 622	120 857
Electricity production potential (in cogeneration), (GWh)	15	19	34	55
Biogas energy share in national renewable targets in 2020, %	0.2	0.3	0.5	0.9
Biogas energy share in national biogas target in 2020, %	5.9	7.5	13.4	21.7
Installed capacity, (MW)	2.0	2.6	4.6	7.4
Number of biogas plants (installed capacity of 0.5MW)	4	5	9	15
Local job creation	6-38	8-48	14-87	23-140
Number of households supplied with electricity (generated in co-generation)	3 590	4 554	8 145	13 245
Investment costs (M€)	6.3	8.0	14.3	23.2

Which means:

- saving of about 194.75 $ktCO_2$.eq or 0.6% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2.eq in 2008 amounted to 31,132 $ktCO_2$-eq).
- contribution with 2% to the national renewable energy target in 2020 and with 48.4% to the national biogas target.
- Total installed capacity of about 16.52MW with investment costs of M€51.9
- About 33 new small biogas plants (0.5MW each) creating a range of 52-314 new jobs.
- saving of about 863 t/yr artificial fertilizers worth of 249,641€/yr
- 29,533 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Czech Republic



Map of the Czech Republic with BiogasIN target regions

The Czech Republic is within the top 10 biogas producers in the European Union. 2009 the Czech Republic produced a primary energy output from biogas of 129.9 ktoe (kilo t oil equivalent), which equates 441.3 GWh_{el}. This represents the electric power consumption of about 100,000 four-person households during one year*. The Czech Republic shows a rising tendency in energy production from biogas plants. From 2008 to 2009, the electricity output from biogas utilisation rose by 65%.

South Bohemian Region is located in the south-western part of the Czech Republic. It covers an area of 10,057 km^2 and has 636,000 inhabitants, of which 35% are living in rural areas. The area is active in agriculture and fish farming.

South Moravian Region is located in the south eastern part of the Czech Republic, covering an area of 7,195 km^2. 1,147,000 people are living in South Moravia. Agricultural land comprises more than 60% of the Region's total area, of which 83% is arable land.

Central Bohemia Region is located in the western part of the Czech Republic, occupying a surface of 11,015 km^2. It is populated by 1,230,700 inhabitants. Close ties with the capital city in the geographic centre of the region characterise its socio-economic structure. The majority of employees are working in manufacturing sectors and agriculture.

Moravian-Silesian Region lies in the northeast of the Czech Republic. It covers an area of 5,427 km^2, of which more than 50% is agriculturally utilised land. Moravia-Silesia is the most populated region in the Czech Republic with more than 1,250,000 inhabitants.

* The calculation grounds on an assumed electric power consumption of 4,500 kWh/a.

Biogas benefits in Czech Republic

The National Renewable Energy Action Plan for the Czech Republic suggests a target of a 13.5% share of energy from renewable sources in gross final energy consumption and the fulfilment of a target of a 10.8% share of energy from renewable sources in transport in gross final energy consumption. The contribution (installed capacity, gross electricity generation) expected from biogas in Czech Republic to meet the binding 2020 targets has been estimated to 417MW or 2,871GWh (247ktoe). Additionally, 167ktoe is the estimated contribution (final energy consumption) of biogas for heating-cooling in 2020.

Czech Republic ratified the Kyoto protocol to the UNFCCC on November 15, 2001 (entered into force on 16 February 2005). The target for Czech Republic is 8% reduction compared to the base year. GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 141.4 million tones, which means 27.2% reduction between the base year and 2008. Agriculture share of GHG emissions in 2008 was 5.9% and energy supply 47.7%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Czech Republic can give the following results:

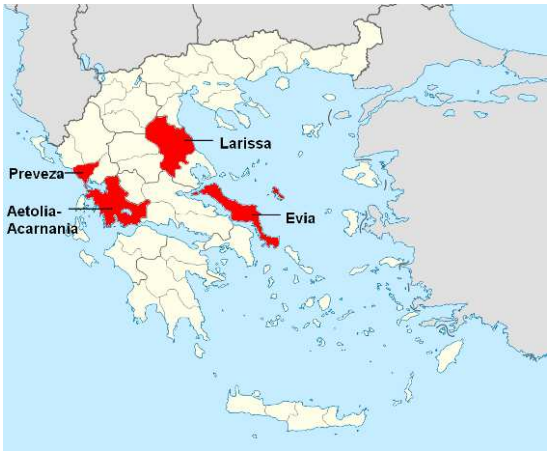
Target region / Biogas advantages	The Region of South Bohemia	South Moravian Region	Central Bohemia Region	Moravian-Silesian Region
Potential emission savings ($ktCO_2$-eq per year)	476.18	231.66	406.19	186.52
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	13,069	7,516	12,209	5,183
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	3 780 622	2 174 092	3 531 745	1 499 337
Electricity production potential (in cogeneration), (GWh)	255	118	213	100
Biogas energy share in national renewable targets in 2020, %	2.3	1.1	2.0	0.9
Biogas energy share in national biogas target in 2020, %	25.4	11.7	21.2	9.9
Installed capacity, (MW)	34.2	15.8	28.6	13.4
Number of biogas plants (installed capacity of 0.5MW)	68	32	57	27
Local job creation	107-651	50-301	89-544	42-255
Number of households supplied with electricity (generated in co-generation)	74 959	34 583	62 558	29 364
Investment costs (M€)	107.5	49.8	89.8	42.2

Which means:

- saving of about 1,300,55 $ktCO_2$-eq or 0.92% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2-eq in 2008 amounted to 141,400 $ktCO_2$-eq).
- contribution with 6.3% to the national renewable energy target in 2020 and with 68.2% to the national biogas target.
- Total installed capacity of about 92.13MW with investment costs of M€289.3
- About 184 new small biogas plants (0.5MW each) creating a range of 288-1,750 new jobs.
- saving of about 37,976 t/yr artificial fertilizers worth of 10,985,796 €/yr
- 201,464 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Greece



Map of Greece with BiogasIN target regions

Greece is located to the south-eastern edge of Europe, occupies an area of 132,000 km^2 and has a population of 10.96 million according to the 2001 census (66% of which live in urban areas).

Greece has a fast developing biogas market. The theoretical biogas potential is very high especially of organic wastes and animal manure. The utilisation of biogas in most of the existing biogas plants, cover mainly heat demands of the plants For the year 2008 the installed capacity of electricity generation from biogas was 39.4 MW (40.8 MW in December 2010) and the gross electricity generation reached to 176.7 GWh [Hellenic Transmission System Operator].

Larissa covers a surface of 5,381 km^2 and is populated by 279,300 people. The area is the most important agricultural region in Greece with 3,472 km^2 agriculturally used land. Livestock-farming plays an important role in Larissa, too.

Aetolia-Acarnania occupies an area 5,461 km^2. The population of the Prefecture is 223,000 inhabitants. Aetolia-Acanarnia is a mountainous area, as only 20% of its surface is in a plain. However, 2,121 km^2 are used agriculturally, producing both, crops as well as livestock products.

Preveza is the smallest of the four Greece target regions, covering a surface of 1,036 km^2. It is populated by 19,000 inhabitants. Only 33% of its total area is in a plain. 306 km^2 of the total area of Preveza are used agriculturally. Additionally livestock farming is an important economical factor in this region.

Evia is the second largest island and has a total extend of 4,167 km^2. The population of the section is 215,000 people, of which 41% are living in rural areas. Evia provides 1,707 km^2 agricultural areas. The main form of farming represents the extensive sheep breeding in the mountainous regions.

Biogas benefits in Greece

The National targets for RES until the end of 2020, based on Directive 2009/28/EC, are set as follows:

a) contribution of the energy produced from RES to the gross final energy consumption by 20%,
b) contribution of the electricity produced from RES to the gross electricity consumption to a share of at least 40%. According to the Ministry of Environment decision (Α.Υ/Φ1/οικ.19598, October 2010) the desired installed capacity of biomass was set to 350MW.
c) Contribution of the energy produced by RES to the final energy consumption for heating and cooling to a share of at least 20%.

According to the provisions of the National Renewable Energy Action Plan the estimation of total contribution in electricity (installed capacity, gross electricity generation) expected from biogas to meet the binding 2020 targets is 210MW and 895GWh.

Creece ratified the Kyoto protocol to the UNFCCC on May 31, 2002 (entered into force on 16 February 2005). The target for Greece is 25% increase compared to the base year. GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 126.9 million tones, which means 20.34% increase between the base year and 2008. Agriculture share of GHG emissions in 2008 was 7% and energy supply 46.7%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Greece can give the following results:

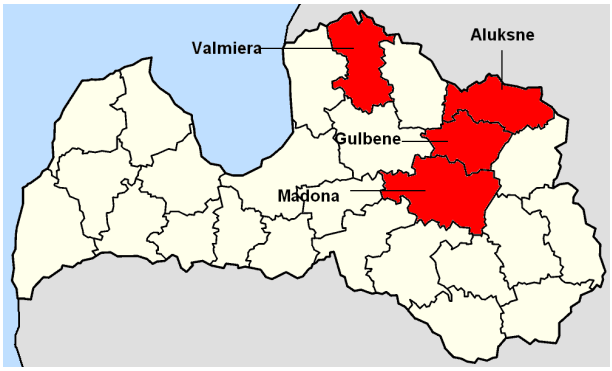
Target region / Biogas advantages	Larissa	Aitoloakarnania	Preveza	Evia
Potential emission savings ($ktCO_2$-eq per year)	190.77	237.81	99.08	60.12
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	13 963	18 346	4 501	7 220
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	4 039 165	5 307 186	1 302 169	2 088 714
Electricity production potential (in cogeneration), (GWh)	70	84	35	17
Biogas energy share in national renewable targets in 2020, %	0.3	0.3	0.1	0.1
Biogas energy share in national biogas target in 2020, %	1.0	1.2	0.5	0.3
Installed capacity, (MW)	9.4	11.3	4.7	2.3
Number of biogas plants (installed capacity of 0.5MW)	19	23	9	5
Local job creation	29-179	35-214	15-89	7-43
Number of households supplied with electricity (generated in co-generation)	16 340	19 638	8 122	3 961
Investment costs (M€)	29.5	35.4	14.9	7.2

Which means:

- saving of about 587.78 ktCO2-eq or 0.92% of the country emissions for the year 2008 (according to the NIR 2010 the CO2-eq in 2008 amounted to 126,900 ktCO2-eq).
- contribution with 0.8% to the national renewable energy target in 2020 and with 3% to the national biomass/biogas target. The theoretical electricity generation in the selected areas can cover more than 70% of the biogas target for 2020 (895GWh).
- Total installed capacity of about 27.67MW with investment costs of M€86.9
- About 55 new small biogas plants (0.5MW each) creating a range of 87-526 new jobs.
- saving of about 44,031 t/yr artificial fertilizers worth of 12,737,233 €/yr
- 48,061 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Latvia



Map of Latvia with BiogasIN target regions

The Latvian biogas sector only provides little energy per inhabitant compared to other European countries. The primary biogas energy production in 2009 was 4.3 toe (t oil equivalent)/1000 inhabitants (compared to 51.5 toe/1,000 inhabitants in Germany). Thus, the overall energy output from biogas in Latvia is 9.7 ktoe, or 45.0 GWh_{el}. However, this is an increase of 16.6% compared to 2008. 45.0 GWh electricity equates the annual consumption of 10,000 four-person households*.

Valmiera Region covers a surface of 2,373 km^2 and it is populated by 57,583 inhabitants. About 37% of the territory is covered by agricultural land. The main economical activity in the region is agricultural production, while industrial and service activities are more concentrated in Valmiera city.

Madona Region is the second biggest region in Latvia and covers an area of 3,349 km^2, populated by 41,662 inhabitants. 37% of the territory is used agriculturally. The main economical activities in the region are forestry, wood processing, agriculture, tourism and trading.

Gulbene Region is one of the smallest regions in Latvia, providing an area of 1,873 km^2. It is populated by 25,496 inhabitants and agricultural areas cover 35% of the surface. The main economical activities in Gulbene region are related to agriculture, forestry and wood processing.

Aluksne Region occupies a surface of 2,243 km^2 and it is populated by 23,926 inhabitants. 29% of the region is covered by agricultural areas. The main economical activities in Aluksne region are related to agriculture, trade and wood processing.

* The calculation grounds on an assumed electric power consumption of 4,500 kWh/a.

Biogas benefits in Latvia

According to the National Energy Action Plan, under Directive 2009/28/EC, Latvia's RES targets up to 2020 is: 1) by 2020, the share of renewable energy in total gross final energy consumption to be increased to at least 40% and to increase it gradually thereafter; 2) by 2020, the share of renewable energy in the transport sector must reach at least 10% of gross final energy consumption for transport and to increase it gradually thereafter. The contribution (installed capacity, gross electricity generation) expected from biogas in Latvia to meet the binding 2020 targets has been estimated to 92MW or 584GWh (50ktoe). Additionally, 49ktoe is the estimated contribution (final energy consumption) of biogas for heating-cooling in 2020.

Latvia ratified the Kyoto protocol to the UNFCCC on July 5, 2002 (entered into force on 16 February 2005). The target for Latvia is 8% reduction compared to the base year. GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 11.9 million tones, which means 54.1% reduction between the base year and 2008. Agriculture share of GHG emissions in 2008 was 17.5% and energy supply 17.9%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Latvia can give the following results:

Target region / Biogas advantages	Valmiera	Madona	Gulbene	Alūksne
Potential emission savings ($ktCO_2$-eq per year)	15.55	15.38	8.71	7.05
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	764	774	445	368
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	220,948	223,962	128,739	106,588
Electricity production potential (in cogeneration), (GWh)	24	25	14	12
Biogas energy share in national renewable targets in 2020, %	0.3	0.4	0.2	0.2
Biogas energy share in national biogas target in 2020, %	13.3	13.6	7.7	6.5
Installed capacity, (MW)	3.2	3.4	1.9	1.6
Number of biogas plants (installed capacity of 0.5MW)	6	7	4	3
Local job creation	10-61	11-64	6-36	5-31
Number of households supplied with electricity (generated in co-generation)	10,272	10,509	5,970	5,000
Investment costs (M€)	10.1	10.5	5.9	5.1

Which means:

- saving of about 46.69 $ktCO_2$.eq or 0.4% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2.eq in 2008 amounted to 11,900 $ktCO_2$-eq).
- contribution with 1.1% to the national renewable energy target in 2020 and with 41.1% to the national biogas target.
- Total installed capacity of about 10.07MW with investment costs of M€31.6
- About 20 new small biogas plants (0.5MW each) creating a range of 32-191 new jobs.
- saving of about 2,351 t/yr artificial fertilizers worth of 680,237 €/yr
- 31,751 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Romania

Map of Romania with BiogasIN target regions

Romania represents one of the weakest biogas markets in the European Union. However, it shows a rising tendency. The amount of primary energy produced by Romanian biogas plants more than doubled between 2008 and 2009. In 2009, the energy produced by biogas plants equated 1.3 ktoe (kilo t oil equivalent), which stands for an electric energy output of 1.0 GWh_{el}.

Buzau County is located in the western part of South Romania. It occupies a surface of 6,103 km^2 and is populated by 488,763 inhabitants, of which 59% are living in the rural areas (most of the employed population is working in agriculture). The county is characterised by isolated complex industrial centres and vast cropping and vine areas.

Vrancea County is located north from Buzau County and occupies a surface of 4,857 km^2. It is populated by 392,619 inhabitants, of which 62% are living in the rural areas (about 49% of the employed population working in agriculture). The county provides vast cropping and vine areas.

Giurgiu County is located in the southern part of Romania, occupying an area of 3,526 km^2. It is populated by 283,408 inhabitants, 69% of which in the rural areas (about 58% of the employed population working in agriculture). The surface consists entirely of plain. The southern part of Giurgiu County has access to the Danube.

Teleorman County covers a surface of 5,790 km^2 and a population of 413,064 inhabitants. 66% of the people in this county are living in the rural areas (about 59% of the employed population working in agriculture). The surface of Teleorman County consists entirely of plain. To the south it is bordered by the Danube.

Biogas benefits

Biogas benefits in Romania

According to the National Energy Action Plan, under Directive 2009/28/EC, Romania's target by 2020 is the share of renewable energy in total gross final energy consumption to be increased to 24%. The contribution (installed capacity, gross electricity generation) expected from biogas in Romania to meet the binding 2020 targets has been estimated to 195MW or 950GWh (82ktoe).

Romania ratified the Kyoto protocol to the UNFCCC on March 19, 2001 (entered into force on 16 February 2005). The target for Romania is 8% reduction compared to the base year. GHG emissions inventory for 2008 showed that the overall GHG emissions in CO2–eq. amounted to 145.9 million tones, which means 47.6% reduction between the base year and 2008. Agriculture share of GHG emissions in 2008 was 13.9% and energy supply 38.6%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Romania can give the following results:

Target region / Biogas advantages	Buzau	Vrancea	Giurgiu	Teleorman
Potential emission savings ($ktCO_2$-eq per year)	330.27	217.40	194.65	316.71
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	8,540	5,782	4,716	8,027
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	2,470,560	1,672,750	1,364,176	2,322,030
Electricity production potential (in cogeneration), (GWh)	212	140	124	202
Biogas energy share in national renewable targets in 2020, %	0.3	0.2	0.2	0.3
Biogas energy share in national biogas target in 2020, %	4.4	2.9	2.5	4.2
Installed capacity, (MW)	28.5	18.8	16.7	27.1
Number of biogas plants (installed capacity of 0.5MW)	57	38	33	54
Local job creation	89-541	59-357	52-316	85-515
Number of households supplied with electricity (generated in co-generation)	150,595	99,640	87,989	143,347
Investment costs (M€)	89.4	59.0	52.3	85.2

Which means:

- saving of about 1,059.03 $ktCO_2$-eq or 0.73% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2-eq in 2008 amounted to 145,900 $ktCO_2$-eq).
- contribution with 1.1% to the national renewable energy target in 2020 and with 14.0% to the national biogas target.
- Total installed capacity of about 91,06MW with investment costs of M€285.9.
- About 182 new small biogas plants (0.5MW each) creating a range of 285-1,730 new jobs.
- saving of about 27,066 t/yr artificial fertilizers worth of 7,829,517 €/yr
- 481,572 households can be supplied with electricity produced from biogas in CHP plants

Case studies

Slovenia

Map of Slovenia with BiogasIN target regions

The primary energy output from biogas in Slovenia rose by 59% between 2008 and 2009. This is a considerable strong increase, which lead to an electric power generation from biogas utilisation of 68.8 GWh_{el} in 2009. This amount of electric energy covers the annual consumption of more than 15,000 four-person households*.

Pomurska region in the north eastern part of Slovenia covers a surface of 1,337 km^2 and residues 123,500 inhabitants. It is predominately an agricultural region with field crops representing over ¾ of the total utilized agricultural area, twice as much as the Slovene average. However, its geographical position and inferior infrastructure influence the region's economic power negatively.

Savinjska region, named after the Savinja River, stretches along the valley that lies to the east of central Slovenia. 260,000 inhabitants live in this region, covering an area of 2,384 km^2. Forests cover almost 57% of the region's surface, while 40% or 70,000 ha are used agriculturally. The main agricultural product is cereals for the production of grains and forage. Farming is dominated by mixed livestock and pasture livestock farming.

Gorenjska region, which is almost entirely alpine, measures 2,137 km^2 and is populated by 203,000 inhabitants. 26% of the surface of the region consists of agricultural land, which is characterized both by its developed livestock and forests exploitation. Furthermore, Gorenjska region is one of the most economically developed regions of Slovenia with a strong and diversified industry, handicrafts and tourism.

Spodnjeposavska region is the smallest of the four target regions with an area of 1,031 km^2 and 78,400 people living in it. Thanks to the favorable natural conditions for agricultural activity this region still characterizes as rural. The primary agricultural sector is livestock farming. Spodnjeposavska provides the largest share of electricity production of all Slovenian regions. This is in the first place due to the only Slovenian nuclear power plant, located here.

* The calculation grounds on an assumed electric power consumption of 4,500 kWh/a.

Biogas benefits

Biogas benefits in Slovenia

According to the National Energy Action Plan, under Directive 2009/28/EC, Slovenia's target by 2020 is the share of renewable energy in total gross final energy consumption to be increased to 25%. The contribution (installed capacity, gross electricity generation) expected from biogas in Slovenia to meet the binding 2020 targets has been estimated to 61MW or 367GWh (32ktoe).

Slovenia ratified the Kyoto protocol to the UNFCCC on August 2, 2002 (entered into force on 16 February 2005). The target for Slovenia is 8% reduction compared to the base year. GHG emissions inventory for 2008 showed that the overall GHG emissions in $CO_{2-eq.}$ amounted to 21.3 million tones, which means 4.6% increase between the base year and 2008. Agriculture share of GHG emissions in 2008 was 9.3% and energy supply 31.7%.

Biogas exploitation using 100% livestock manure available in the four (4) target areas in Slovenia can give the following results:

Target region / Biogas advantages	Pomurska	Savinjska	Gorenjska	Spodnjeposavska
Potential emission savings ($ktCO_2$-eq per year)	174.97	251.54	98.66	53.73
Artificial fertilizers saving (Urea-Ammonium Nitrate), (t/yr)	5,569	3,444	1,521	1,242
Artificial fertilizers saving (Urea-Ammonium Nitrate), (€/yr)	1,610,905	996,350	440,048	359,324
Electricity production potential (in cogeneration), (GWh)	58	114	62	27
Biogas energy share in national renewable targets in 2020, %	1.2	2.3	1.2	0.5
Biogas energy share in national biogas target in 2020, %	12.2	23.9	13.0	5.7
Installed capacity, (MW)	7.8	15.3	8.3	3.6
Number of biogas plants (installed capacity of 0.5MW)	16	31	17	7
Local job creation	24-148	48-291	26-158	11-69
Number of households supplied with electricity (generated in co-generation)	13,445	26,285	14,279	6,269
Investment costs (M€)	24.5	48.1	26.1	11.4

Which means:

- saving of about 578.9 $ktCO_2$.eq or 2.72% of the country emissions for the year 2008 (according to the NIR 2010 the CO_2.eq in 2008 amounted to 21,300 $ktCO_2$-eq).
- contribution with 1.3% to the national renewable energy target in 2020 and with 5.2% to the national biogas target.
- Total installed capacity of about 35.05MW with investment costs of M€110
- About 70 new small biogas plants (0.5MW each) creating a range of 110-666 new jobs.
- saving of about 11,776 t/yr artificial fertilizers worth of 3,406,627 €/yr
- 60,277 households can be supplied with electricity produced from biogas in CHP plants

Conclusions

The EU has set a series of demanding climate and energy targets to be met by 2020, known as the "20-20-20" targets. These are:

- a reduction in EU greenhouse gas emissions of at least 20% below 1990 levels
- 20% of EU energy consumption to come from renewable resources
- a 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency.

According to the latest Summary EU GHG inventory report of 2010, total GHG emissions, without LULUCF, in the EU-27 decreased by 11.3 % between 1990 and 2008 (627 million tonnes CO_2-eq). Emissions decreased by 2.0 % (– 99 million tonnes CO_2-eq) between 2007 and 2008. Emissions in 2008 for the EU-27 were 12.3% lower than emissions in the base year. The overall greenhouse gas emissions in CO_2-eq (excl. LULUCF) in 2008 amounted 4,939.7 million tones.

Renewables will play a crucial role to meet the EU binding 2020 targets and biogas is one of them. All target countries and regions have a significant GHG emission savings. According to BiogasIN assessment about 4,543.14 kt CO_2-eq can be saved, which represents the 0.8% of the total GHG emissions of the BiogasIN target countries for the year 2008.

In 2009, 8.3 Mtoe of primary energy produced in the EU from biogas and 25.2 TWh of electricity (Eurobserv'er, 2010). In the 28 target regions 0.883 Mtoe of primary energy can be produced by biogas and the electricity generation from the biogas theoretical potential (using 100% livestock manure in a CHP plant) amounted to 2,389GWh or 9.5% of the electricity generation in 2008 in the EU.

Biogas projects still need high investment costs and the revenue comes mainly from the pricing tariff system for electricity production for RES. The theoretical total installed capacity was assessed to 320.85 MW and the necessary investment cost is about M€1.007.

Digestate has improved fertiliser efficiency due to homogeneity and higher nutrient availability. Utilization of digestate as fertilizer can replace the use of mineral fertilizes and has at least economic and environmental dimension. In the 28 selected regions of BiogasIN establishing the best agricultural practice for manure management (Nitrate Directive) result in artificial fertilizers savings of 135,721 t/yr (Urea-Ammonium Nitrate) worth of about 39.3 M€/yr.

In the case of small farm scale plants the part time employment of the farmer can give benefits and parallel new income opportunities. The implementation of biogas plants can increase direct or indirect the jobs during the all project phases and lifetime and for the needs of BiogasIN projects it was assessed that about 640 new small biogas plants (0.5MW each) can be established in the selected areas creating a range of about 1,000-6,100 new jobs. In Germany the employment in biogas sector in 2008 reached to 7,300 jobs (4,000 jobs in the O&M sector and 3,400 to the biogas plants development, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety). Today, there are established around 6,000 biogas facilities in the German countryside. Central and Eastern European countries, with still substantial agriculture sectors, can benefit from biogas development as it contributes direct to rural income generation.

www.biogasIn.org

Welcome to BiogasIN project

Imagine what European countryside would gain if we could exploit agro-industrial wastes via biogas exploitation: a) production of renewable energy with local resources, b) reduced consumption of resources and increased recycling, c) reduced water environment pollution from leaching of nutrients, d) environmental friendly solution to the waste disposal problem as digestate can be used as fertilizer, e) job creation and rural development.

BiogasIN aims to create a sustainable biogas market in Central and Eastern Europe (CEE): Bulgaria, Croatia, Czech Republic, Greece, Latvia, Romania, and Slovenia, by:

- Highlighting biogas benefits for local communities
- Streamlining permitting procedures for biogas investments
- Adjusting and creating new financing schemes for biogas investments

Expected results from the project will be increased biogas investment activity in target countries and beyond.

Project Partners

- WIP Renewable Energies (WIP), Germany
- European Biogas Association (EBA), Belgium
- Fraunhofer (IWES), Germany
- Centre for Renewable Energy Sources and Savings (CRES), Greece
- Czech Biogas Association (CzBA), Czech Republic
- EKODOMA, Latvia
- Energoproekt, JSC (ENPRO), Bulgaria

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INTELLIGENT ENERGY EUROPE