Project: BiG>East

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Biogas Potential in Latvia. Summary Report

Deliverable 2.8

Based on Deliverables from WP2

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1 Introduction

Latvia is comparatively small country located in north-eastern Europe. The area of Latvia is 64 559 km^2, including 24 431 km^2 of agricultural land and 29 382 km^2 of forest area. Latvia is situated near the Baltic Sea with a 498 km length of sea border, it has border with Estonia (to the north) with Russia (to the east), with Belarus (to the southeast) and with Lithuania (to the south).[1]

Renewable energy sources (RES) play an important role in Latvia's primary energy balance. The main renewable energy sources used in Latvia are biomass (mainly wood fuel) and hydro energy. Wind energy, biogas, and straw are less used and Latvia still has significant potential for exploitation of those renewable energy sources.

According to the information obtained from the Central Statistical Bureau of Latvia[2], the proportion of renewable energy sources in primary energy balance was 29.1% in 2006 (see Figure 1.1).

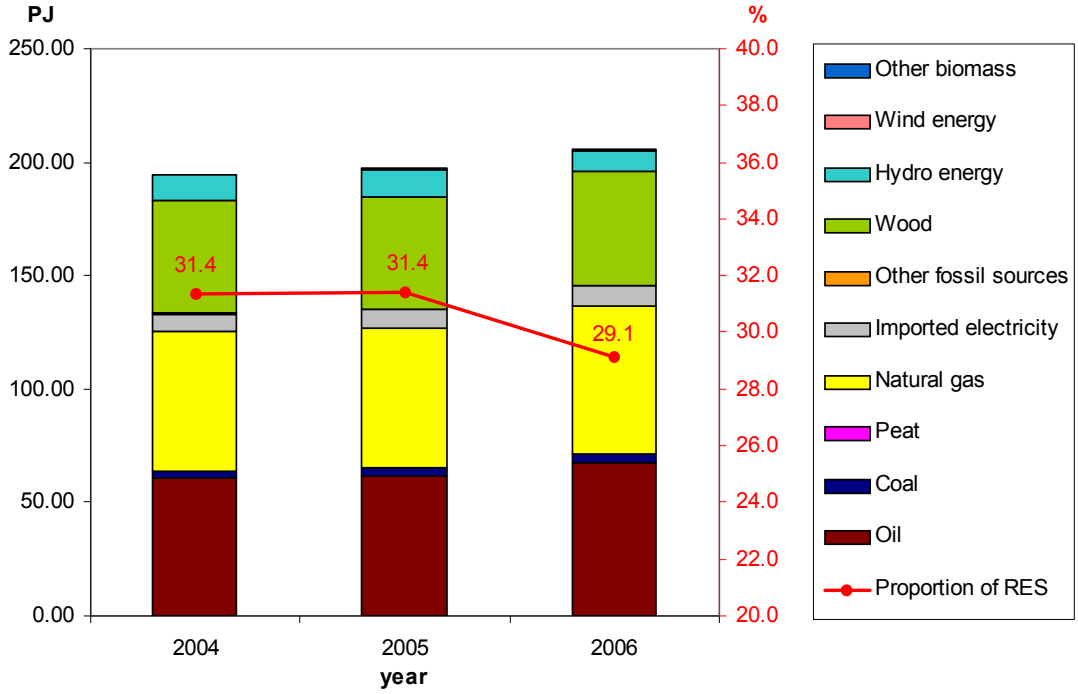

Figure 1.1.Structure of primary energy sources and proportion of renewables in primary energy balance

Approximately 80% of RES is wood fuel. Considering that available amount of hydro resources depends on meteorological conditions and water flow in rivers, the proportion of RES in primary energy balance is fluctuating according to those factors. The share of wind and other biomass energy sources is less than 1% from all energy produced from renewable energy sources.

This report gives an overview on evaluation of biogas potential in Latvia, including, investigations on available biomass amounts for biogas production, description of waste management schemes,

[1] *Source: Central Statistical Bureau of Latvia:* www.csb.gov.lv
[2] *Source: Central Statistical Bureau of Latvia, Energy Balance 2006*

agricultural structures, investigating possibilities for biomethane injection in natural gas grid and giving an overview on potential impacts from biogas production and use in Latvia.

This report has been developed in the scope of the BiG>East project, supported by the European Commission in the framework of the Intelligent Energy for Europe (IEE) Program.

2 Existing and planned biogas installations in Latvia

First investigations were done and first experimental biogas installation in Latvia were developed in 1983 when Latvia was a part of Soviet Union. On this time there was built biogas plant with two bioreactors in swine-breeding complex "Ogre" where biogas were used for heating and preparation of fodder. This biogas installation worked for several years and swine manure as feedstock was used. Installation was operated in thermophilic conditions (at temperature 54^{o}C) and has short feedstock retention time (~ 5 days).

2.1. Existing biogas installations

There were three biogas cogeneration plants in Latvia operating by the end of 2007. Their total installed electricity production capacity was 7.5 MW_{el}. The cogeneration plant owned by company "Rīga Water" for biogas production uses sludge from wastewater treatment. The other two biogas cogeneration plants are installed in landfills in Rīga and Liepāja regions and use landfill gas for electricity and heat production. However, the electricity generation capacity installed in landfills is not fully used. The main reason is the shortage in biogas production amount coming from existing composition of municipal waste. Map of Latvia with location of tree existing biogas plants is given in Figure 2.1.

Figure 2.1.Location of existing (2007) biogas plants in Latvia

1 – Company "Rīga Water" wastewater treatment plant "Daugavgrīva"
2 – Municipal waste landfill "Getliņi"
3 – Municipal waste landfill "Ķīvītes"

The overview on existing (2007) biogas installations with basic characteristics for each installation is given in Table 2.1:

Table 2.1

The overview on existing biogas installations in Latvia in 2007

Owner and name	Location	In operation since	Feedstock		Biogas production, Nm^3/day	Biogas utilization		Utilization of digestate
			Type	Input (t/day; % TS)		Type	Output, MW_{el}	
JSC "Rīgas ūdens", wastewater treatment plant "Daugavgrīva"	Rīga region	2004	Sludge from wastewater treatment	70 TS=25%	11 000	CHP-plant	2.096	Fertilizer
Getliņi Eko, Ltd., Landfill "Getliņi"	Rīga region	2002	Unsorted municipal waste	1370	50 000	CHP-plant	5.24	-
Liepājas RAS Ltd., Landfill "Ķīvītes"	Liepāja region	2003/ 2004	Unsorted municipal waste	80	8 800	CHP-plant	0.45	-

2.2. Planned biogas installations in Latvia

It is forecasted that available biogas amount in Latvia will increase by improving the logistics and waste separation practice. Starting from beginning of 2008 a number of new biogas projects are being developed and most of them are agricultural biogas projects. Map of Latvia with location of planned biogas plants (marked in light blue) is given in Figure 2.2.

Figure 2.2.Location of planned biogas plants in Latvia

1 – Scholastic research farm "Vecauce" of Agricultural University of Latvia (in operation since 2008)
2 – Municipal waste landfill "Daibe"
3 – Kalsnava distillery
4 – Farm "Nogales"

Biogas plants in construction

In the beginning of 2008 only one biogas plant in Latvia was in construction phase. This was the first agricultural biogas plant in Latvia. Plant is located at scholastic research farm "Vecauce" owned by Agricultural University of Latvia. Some basic characteristics of constructed biogas plant are summarized in Table 2.2 below:

Table 2.2

Basic characteristics of "Vecauce" biogas plant

Biogas plant in farm "Vecauce"	
Farm size	~ 1000 cattle (incl. 400 dairy cows)
Land area	1804 ha
Feedstock	Manure + crops (grass and maize silage)
Planned biogas production amount	1.3 million m^3/year
Use of biogas	CHP-plant
Heat consumers	Settlement located nearby
Heat for self-consumption	~30%

"Vecauce" biogas plant is intended to be a demonstration project for future agricultural biogas plant developers. The plant started the operation in October 2008.

Biogas plants in preparation

There are a number of Biogas projects in preparation phase:

- Biogas in Landfill "Daibe", owner "ZAAO Enerģija", Ltd
- Kalsnava distillery, owner "Lako", Ltd
- Different Farms, e.g., Farm "Nogales"

Landfill gas collection in Landfill "Daibe":

- Feedstock – unsorted municipal waste,
- Planned biogas production amount – 1.2 million m^3/year,
- Use of landfill gas – CHP-plant,
- Electrical capacity – 160 kW_{el}.

Biogas production on Kalsnava distillery:

- Feedstock – distillery solubles,
- Use of landfill gas – CHP-plant,
- Electrical capacity – 4-4.5 MW_{el},

Biogas plant in farm "Nogales":

- Farm size – 300 cattle,
- Land area – 10 ha,
- Land area available for crop growing – 30-50 ha,
- Feedstock – manure and crops (grass and maize silage),
- Planned biogas production amount – 2 million m^3/year,
- Use of biogas – CHP-plant,
- Electrical capacity – 4 MW_{el}.

Example of projects in a level of conception:

- Biogas plant in farm "Vidzemes putniņi" (farm size ~600 cattle, manure as feedstock could be used. Evaluated biogas production amount 600 000 m3/year);
- Biogas plant in swine-breeding farm "Miķelāni" (manure as feedstock could be used. Evaluated biogas production is 2.5 million m^3/year);

- Biogas plant in "Alejas Group", Ltd. wood drying utility;
- Biogas plant in farm "Jaundzelves" (feedstock – manure and residues from food processing companies);
- Biogas plant in Daugavpils region (different kind of feedstock is available, resulting in biogas production amount of 3.2 millions m3/year)
- etc.

3 Utilization of waste material for biogas production in Latvia

3.1. Waste collection system in Latvia

Legislative framework on waste management in Latvia states that tenants are responsible for organising waste management in their property. Usually they are signing the agreement on waste management directly with a managing company. However, there are also some municipalities that have undertaken the responsibility on waste management in their territory. In this case tenants for waste management are co-operating directly with a municipality. Waste management agreements usually include:

- Time schedule for waste collection.
- Description of waste bins and used equipment.
- Waste collection and transportation to respective recycling or disposal place.

Typical household waste collection and utilisation system is illustrated in Figure 3.1.

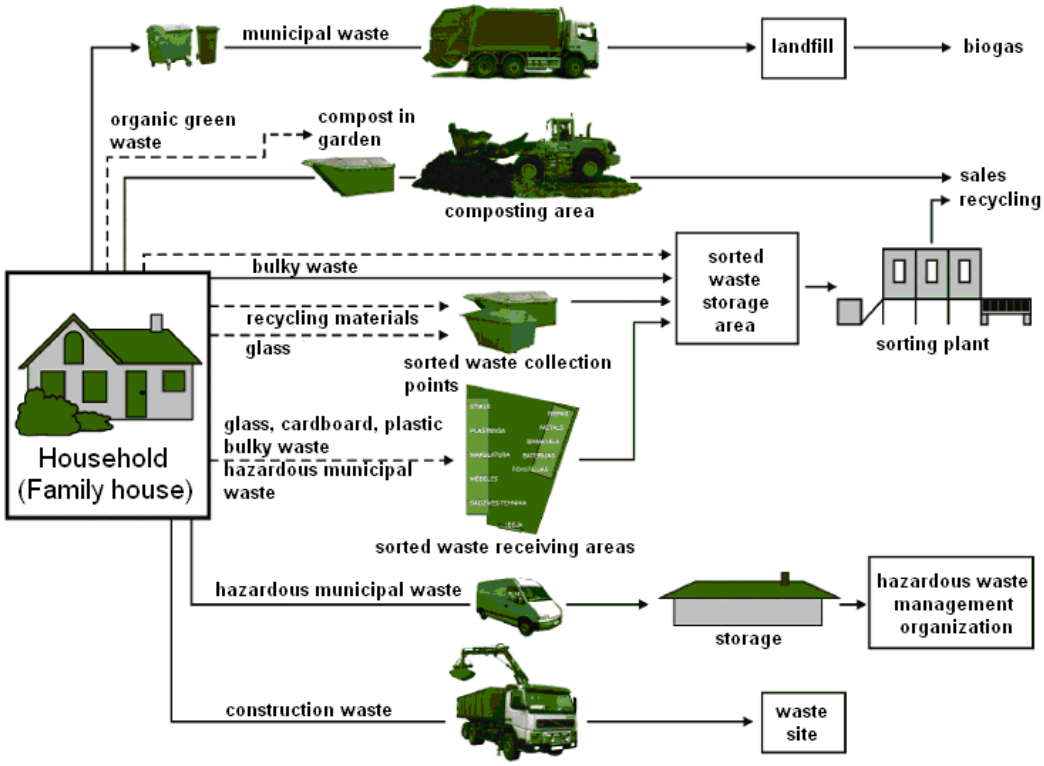

Figure 3.1.Typical household waste collection and utilisation system in Latvia[3]

In urban areas the household waste collecting system is organised unitarily where waste producers are in contract relations with waste collecting organisations and those relations generally are co-ordinated and supervised by the municipality. Usually waste bins are used for waste collection, however in the historical centre of Riga and in some other places, where it is not possible to place bins, waste is collected directly from inhabitants who have to wait on the street until the dump truck

[3] *Source: Latvijas Zaļais Punkts* www.zalais.lv

is passing by. This kind of collecting system is very inconvenient and is not profitable for waste management companies. Besides the problems mentioned before, this situation is also limiting further development of waste management and waste sorting practices.
In rural areas each household has a separate waste bin and waste collecting is done based on an agreement between the house owner and the waste collecting company. The frequency of waste collection is between once per week up to twice per month. Waste collecting frequency is affected by different factors:

- Contract conditions set between particular municipality and waste management organisation.
- Contract conditions set between particular house owner and waste management organisation.
- Volume of used waste bins.

Waste collection from enterprises and companies is done in three different ways:

- Companies with their offices located or registered in apartment houses don't have separate waste collection agreements and their waste is included in household waste bins.
- Considerable part of enterprises has directly contracted waste management company for waste collection and transportation services.
- Limited part of enterprises does the waste collection by themselves. However, this is not easy to define exact amount of self-collected waste due to the widely distributed co-operation practice between those companies.

Households are producing more than a half (around 54%) of municipal waste amount in Latvia[4]. The rest is produced by companies and enterprises. According to the information[5] obtained from State agency „Latvian Environment, geology and meteorology agency" in 2006 the total amount of produced municipal waste in Latvia was more than 900 000 t. About 40% of all municipal waste was delivered to Riga regional landfill „Getliņi". Overview on collected sorted biological waste and unsorted municipal waste is summarised in Table 3.1.

Table 3.1

Amount of collected biological and municipal waste in Latvia in 2006[6]

Waste material	**Collected waste amount, t**
Paper and cardboard	14.601
Biological kitchen waste	50
Food oil and fat	240
Waste from marketplaces	546
Other biological waste	17.608
Total	33.045
Unsorted municipal waste	*884.691*

Latest available information on content of unsorted municipal waste was obtained from investigations prepared in 2004. Results form those investigations shows that the percentage of organics in unsorted municipal waste is about 57%.

[4] *Source: Ministry of Environment of Latvia (www.vidm.gov.lv)*
[5] *Overview on waste in 2006*
[6] *Overview on biological waste and materials in 2006*

3.2. Availability of appropriate organic wastes

Kitchen wastes

There is no separate kitchen waste collecting system established. Basically kitchen wastes are treated together with unsorted municipal waste. Only in particular cases organic kitchen wastes are collected separately. Restaurants and hotels are paying for the waste removal according to the normal waste management practice established by waste management agreements.

Wastes from supermarkets

Only few supermarkets have contracts with some of the by-product processing companies. Thermally processed food waste and food residues according to agreement with waste collecting company are delivered to landfill or in very few cases food waste from supermarkets are feed for fur-bearing animals (non-productive animals). On emergency situations (like storm or electricity outage) all food is delivered to specialised by-product processing company for disposal.

Use of over dated food in Latvia is regulated by EC regulation 1774/2002. This regulation allows thermally processed waste food delivering to landfill, feeding it to fur-bearing animals or disposing in specialised by-product processing company. Over dated raw food is allowed to feed for non-productive animals or to dispose in specialised by-product processing company. Delivery of raw food waste on landfill is prohibited.

Food wastes are not allowed as feed for productive animals (e.g. for pigs). Over dated dairy products, in case if they fulfil microbiological standards, are allowed as feed for animals if they are fattened or breed for food production.

Wastes from industrial production

To describe food industry development in Latvia, the number of companies and number of employees in each productive industry is given in Table 3.2.

Table 3.2

Food production industry profile in Latvia[7]

Productive industry	Number of companies	Average number of employees
Meat production and processing	123	6.154
Fish production and processing	112	7.509
Fruit and vegetable processing	32	842
Vegetable and animal oil and grease production	6	200
Dairy production	52	4.242
Flour and starch production	25	728
Animal feeding stuff production	12	490
Bakeries	253	8.161
Confectionery production	19	781
Distilleries	9	1.014

[7] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*

Productive industry	Number of companies	Average number of employees
Breweries	19	1.629
Mineral water and soft drink production	23	1.104
Other food production	20	1.262

Description and amount of available organic waste from food industry in 2006 is summarised in Table 3.3.

Table 3.3

Organic waste from food production in Latvia in 2006[8]

Waste material	Waste in t
Animal tissue waste	18.256
Agricultural, horticultural, forestry and fishery waste	66
Meat, fish and other animal origin food production and processing waste	11.792
Washing, cleaning, peeling and separation residues	1.916
Materials that could not be used for consumption or processing	115
Fruit, vegetable, cereal, food oil production and processing waste	1.713
Dairy production waste	42.586
Bakery waste	28
Distillery waste	3.078
Total	79.550

Currently, every particular food production company is responsible for their organic waste management. More than half of available organic waste material (see Table 3.3) is coming from dairy production. Whey is mainly used for cattle and swine breeding. The rest is mixed with manure and applied as fertiliser. Animal tissue waste and other meet and fish production waste are given to certified waste management companies for further processing.

Waste from fruit and vegetable processing based on agreements are sold to farms for animal breeding. Waste food oil is used for animal feed production.

Wastes from breweries and distilleries are used for animal breeding or as fertiliser. Based on conditions of particular agreements those waste are sold either given for free.

Agricultural wastes

Agricultural waste market in Latvia currently is saturated and at the same time limited. In most cases farmers with additional expenses apply manure directly on fields without any preliminary processing. At the same time many farmers have problems with lack of appropriate storage facilities to follow the regulations on manure storage. At the worst – farmers do not have enough land space for manure spreading. Furthermore, farmers have to pay taxes on emissions generated from manure storage and spreading operations.

[8] *Overview on biological waste and materials in 2006*

From the other hand manure availability is limited by the fact that farmers realise the value of manure as fertiliser. The value is rapidly growing together with price of chemical fertilisers. Thus farmers are not interested to give the manure for other companies for free.

Overview on cattle and pig farm size in Latvia is summarised in Table 3.4.

Table 3.4

Farms structured by size in Latvia in 2007[9]

Farm size, cattle	Number of cattle farms	Farm size, pigs	Number of pig farms
1	12.311	1	6.155
2	9.775	2	10.470
3-5	10.702	3-4	4.496
6-9	3.868	5-9	1.595
10-19	3.952	10-19	959
20-29	1.435	20-49	591
30-49	1.318	50-99	225
50-99	808	100-199	116
100-199	307	200-399	57
200-299	75	400-999	28
300-499	45	1,000-1,999	11
>= 500	48	2,000-4,999	11
-	-	>= 5,000	22

Regarding horse farms, there are only 34 farms with size more than 20 animals. Thus horse dung is not considered as significant feedstock for biogas production.

The market situation of agricultural by-products is different from case to case. Depending on agreements and particular conditions, waste suppliers get some payment whether pay by themselves for waste and by-product processing. Only small part of agricultural by-products and agricultural waste is collected separately from total waste stream.

Bio-wastes from local authorities

So far there is not information on local authorities that would be interested in biogas projects. The best way to identify such projects could be to look on authorities with necessity to solve heat supply problems in their region. At the same time there have to be an availability of appropriate bio gas feedstock material.

Potential plant sites

Some previous investigations on identification of potential agricultural biogas plants show that almost all larger pig and poultry farms in Latvia have potential for co-fermentation. The list of big size farms is given in Table 3.5.

[9] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*

Table 3.5

Potential farms for co-fermentation in Latvia

Farm	Location	Farm type
Vistako, Ltd	Alūksne region	poultry farm
Uzvara – Strauti, Ltd	Bauska region	pig farm
JS company „Balticovo“	Bauska region	poultry farm
Lielzeltiņi, Ltd	Bauska region	poultry farm
Gaižēni, Ltd, farm „Smurģi“	Cēsis region	pig farm
JS company Latgales bekons	Daugavpils region	pig farm
Daugavpils putni, Ltd	Daugavpils region	poultry farm
Baltic Agro Contractor, Ltd, farm „Avoti"	Dobele region	pig farm
LatviDanAgro, Ltd, farm “Ošlejas”	Dobele region	pig farm
PF Vecauce, Ltd	Dobele region	pig farm
Rīgas kombinētās lopbarības rūpnīca, Ltd., farm "Kroņauce"	Jelgava region	pig farm
Sēļi, Ltd, farm “Stiebriņi”	Jēkabpils region	pig farm
JS company “Jēkabpils labība”, farm “Miķelāni”	Jēkabpils region	pig farm
JS company “Šķaunes bekons”	Krāslava region	pig farm
Korkalns, Ltd	Kuldīga region	pig farm
Nīcas rukši, Ltd	Liepāja region	pig farm
Vaiņodes Bekons, Ltd	Liepāja region	pig farm
Ozolāji cūkaudzētava, Ltd	Liepāja region	pig farm
GDG Holding, Ltd	Liepāja region	pig farm
Nygaard International, Ltd, farm „Apriķi Bacon”	Liepāja region	pig farm
Nīca - 1, Ltd	Liepāja region	pig farm
Nīckrasti, Ltd	Liepāja region	poultry farm
Cirmas Bekons, Ltd	Ludza region	pig farm
JS company „Madona”	Madona region	poultry farm
Daugavieši, Ltd	Rēzekne region	pig farm
Kantinieku bekons, Ltd	Rēzekne region	pig farm
Ulbroka, Ltd	Rīga region	pig farm
Baltic Pork, Ltd	Rīga region	pig farm
JS company „Putnu fabrika Ķekava“	Rīga region	poultry farm
Druvas Unguri, Ltd, farm “Krasti”	Saldus region	pig farm
Druvas Unguri, Ltd, farm “Jaunstraumēni”	Saldus region	pig farm
Druvas Unguri, Ltd, farm „Unguri“	Saldus region	pig farm

Farm	Location	Farm type
Starteris, Ltd, farm „Brīvkalni“	Talsi region	pig farm
Mārupes lauksaimniecības centrs, Ltd	Tukums region	poultry farm
Sprīdītis, Ltd, farm “Kalna Eķītes“	Valka region	pig farm

There have been some more discussions and investigations on a potential biogas project in farm “Miķelāni” located in Jēkabpils region. However, currently farm owners are working on other farm modernisation projects and they are ready to start biogas project only after completion of ongoing tasks.

According to the Waste Management Plan[10], 10 to12 regional landfill sites will be developed and existing dumping grounds will be closed and recovered in following steps:

- Until 2009 – construction of regional landfills according to requirements of Directive 1993/31/EK.
- Until 2009 – closing of existing dumping grounds and their total recovering until 2012.
- Inclusion of waste collecting, sorting and processing equipment in new landfill projects.

Latvia is divided in 11 waste management regions. For each region separate waste management plan has to be developed and approved by the Cabinet of Ministers of Latvia. Currently 7 regional landfills are in operation and in two of them (landfill “Getliņi” and landfill “Ķīvītes”) landfill gas is collected and used for heat and electricity production. In landfill “Daibe” gas collection project is on the stage of development.

However, organic fraction is not separated from total waste stream on landfill sites. Theoretically all regional landfills are potential sites for this kind of biogas production. The list of regional landfills and their current development status is described in Table 3.6.

Table 3.6

List of regional landfills in Latvia

Landfill	Location	Status
Landfill “Getliņi”	Rīga region	In operation
Landfill “Ķīvītes”	Liepāja region	In operation
Landfill “Daibe”	Cēsis region	In operation
Landfill “Pentuļi”	Ventspils region	In operation
Landfill “Auziņas”	Dobele region	In operation
Landfill “Kaudzītes”	Gulbene region	In finalization
South Latgale regional landfill	Daugavpils region	In construction
East Latgale regional landfill	Rēzekne region	In construction
Coastal regional landfill “Janvāri”	Talsi region	In development
Vidusdaugava regional landfill	Jēkabpils region	In development

[10] *Waste Management Plan for Latvia 2006-2012*

4 Feedstock availability in Latvia

4.1. Energy crops potential

Since in Latvia there are only a few biomass plants using specially grown energy crops like cereal straw, maize silage, grass silage and rape, in calculation of energy crop potential all kind of crops that could be used as energy crops are included (as well as those currently used for human food and animal feeding). Crops included in calculation of energy crops potential are different kind of cereals, potatoes, pulses, rape, flax, sugar beets and other traditionally grown in Latvia.

Data on sown area for each kind of crop and yield of agricultural crops were obtained from Central Statistical Bureau of Latvia[11] as well as from online statistical databases to evaluate the spatial distribution of crops by NUTS 3 regions in Latvia. The average figures from data collected in 2001-2006 were used. Spatial distribution of energy crop potential in the territory of Latvia is given in Figure 4.1.

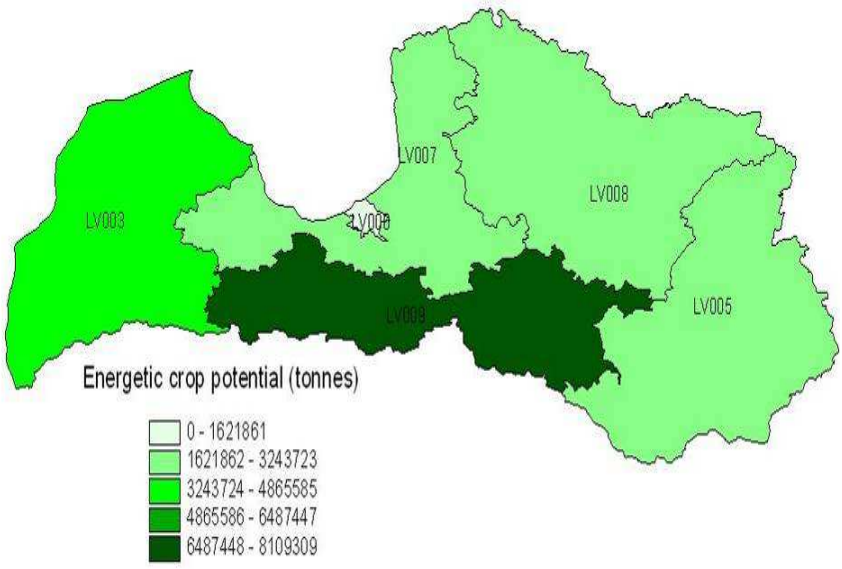

Figure 4.1.Energy crop potential in Latvia

An important potential for energetic crop is found in one region in Latvia (LV009). This region traditionally is characterized with the high agricultural intensity and productivity.

4.2. Agricultural waste

The amount of agricultural waste products from primary production (incl. cereal straw, waste from grain drying and processing, potatoes stalks, beet leafs, rape seed processing residues etc.) was calculated based on Statistical data[12] average figures in 2000 - 2006. The set of assumptions were maid to define the percentage of waste that could be collected and used for biogas production.

[11] *Source: Central Statistical Bureau of Latvia, Collection of Statistical data "Agriculture in Latvia in 2006"*
[12] *Source: Central Statistical Bureau of Latvia, Supply balance sheets for crop products*

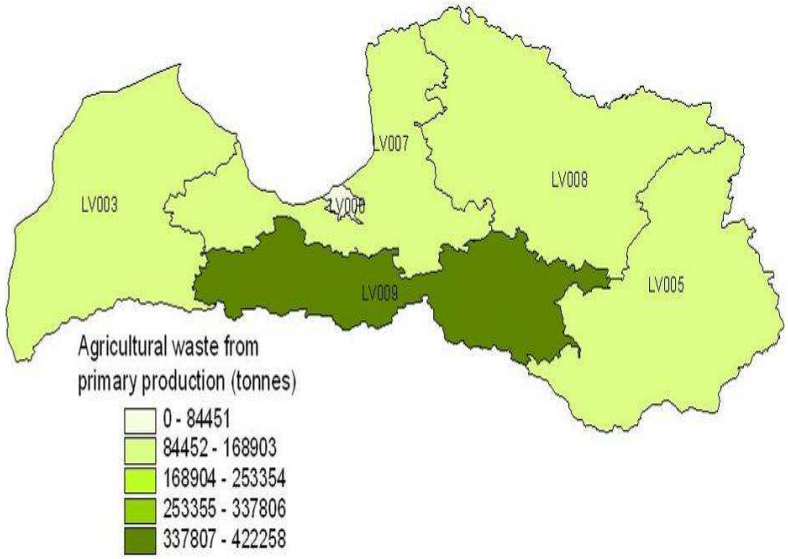

Figure 4.2.Agricultural waste from primary production in Latvia

Wastes from primary production are also to be found in the same area (LV009) as this is also the main primary production area for the country. Quantities of over 400 thousand tones of wastes in the last years are usual to this area (Figure 4.2).

Secondary agricultural wastes in Latvia include manure and organic waste from animal slaughtering. Secondary agricultural waste amounts were calculated based on annual number of livestock (including cattle, pigs, sheep, goats, horses and poultry). The number of livestock in each NUTS 3 region was obtained from State agency Agricultural Data Center[13]. Amount of by-products from each type of animal was calculated based on waste factors obtained from Latvian Meet Producers Association and according to information collected from different animal breeding associations and farmers.

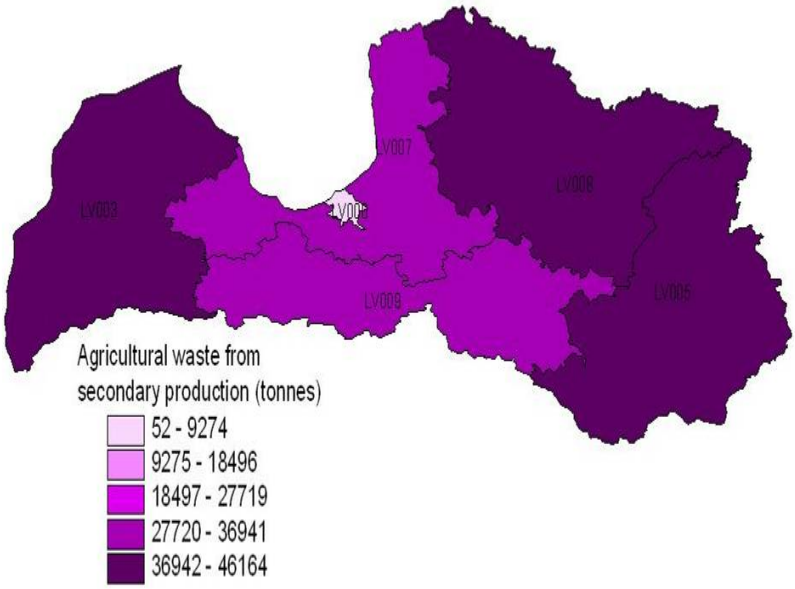

Figure 4.3.Agricultural waste from secondary production in Latvia

[13] *Source: State agency Agricultural Data Center, National Livestock register*

The secondary agricultural wastes are based in 3 different areas (LV003, LV005 and LV008). Wastes up to 46164 tones (an average over several years) are to be found in all of these regions, making these regions potential attractive for the development of biogas facilities (Figure 4.3).

4.3. Municipal waste

The municipal waste in Latvia was of about 600 000 tones in 2000. The highest amount could be found in Riga (LV006) were actually is located the biggest landfill (Getliņi).The region around Riga is also an important provider of municipal solid waste (Figure 4.4).

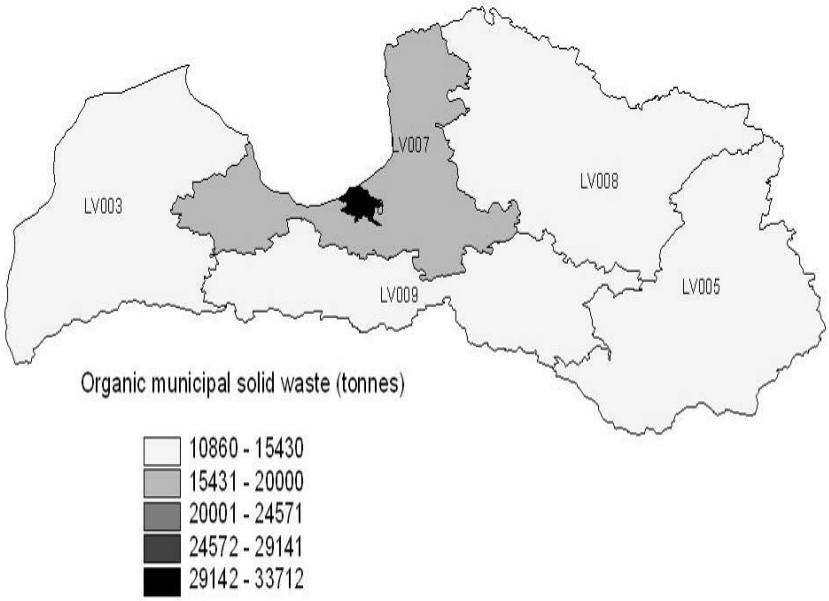

Figure 4.4.Organic municipal solid waste in Latvia

In order to calculate the amount of municipal solid waste in each region the information from regional waste management plans were used. The difficulty in using those data was in fact that division of waste management regions in Latvia is different from statistical levels of NUTS 3. Thus different assumptions were made to divide the total organic municipal solid waste amount by regions. Moreover since waste separation practice in Latvia is still on very low level of implementation, exact amount of organics in municipal waste is not known and it could differ from region to region.

4.4. Sewage sludge

Available sewage sludge amounts were calculated based on information obtained from Latvian Environment, geology and meteorological agency[14]. Data on sewage sludge amounts was taken as average from 2004-2007.

[14] *Source: Latvian Environment, geology and meteorological agency, database "Nr.2-Ūdens"*

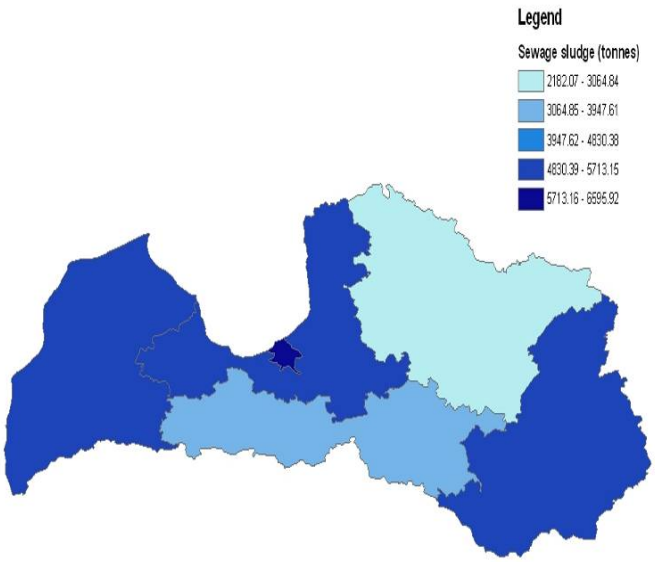

Figure 4.5.Sewage sludge in Latvia

The region providing the most of the sewage sludge in Latvia is Riga region (LV006) – see Figure 4.5. Since the most of population is located in the region, the highest amounts of sewage sludge are generated here. In average there are 6.6 thousand tones of sludge generated in Riga region each year.

4.5. Food industry waste

The food industry waste is also having a great impact upon the production potential of biogas in Latvia. The amount of food waste was obtained from Latvian Environment, geology and meteorological agency (national waste database). Waste amounts from database were extracted based on number of particular waste in classifier. However, in some cases there is only one company giving a majority in waste amount in region and often their waste amounts are significantly changing from year to year. Thus changes in operation of waste producer can significantly influence the distribution of overall food industry waste potential. Based on available data from 2004-2006, the highest potential is related to region LV009 with more than 60 thousand tons of food industry waste.

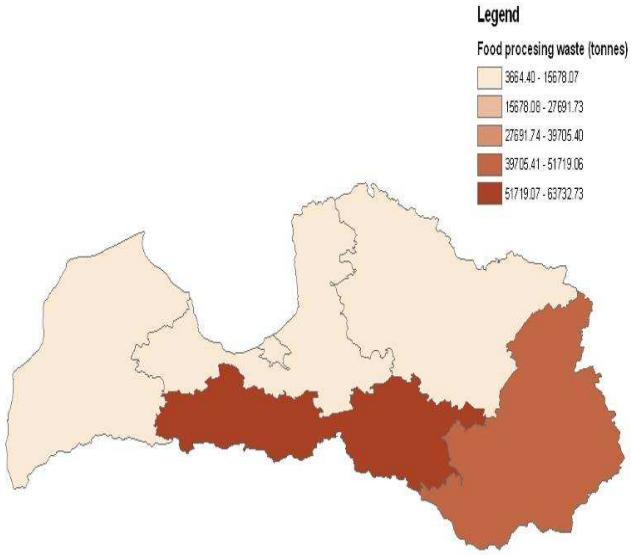

Figure 4.6.Food processing waste in Latvia

5 Agricultural structures in Latvia

Data for assessing agricultural structures in Latvia are based on the former agricultural census (from 2001)[15] as well as new data from *Eurostat*[16] and from Central Statistical Bureau of Latvia[17]. Spatially distributed land cover structure of Latvia is given in figure 5.1. The dominant colour is green followed by yellow areas that according to the European Topic Centre on Land Use and Spatial Information[18] are representing forests (including woodlands) and agricultural areas. Based on the agricultural census more then 180 000 farms could be found with a surface of about 3.586 million ha. On the average one farm had 19.8 ha of land.

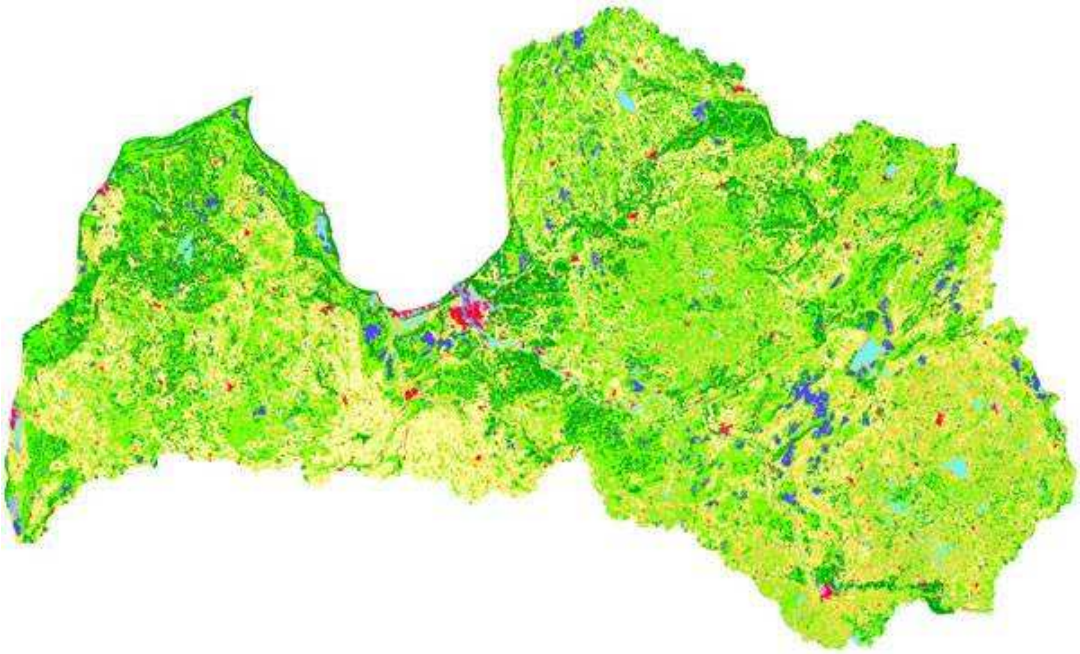

Figure 5.1.Corine Land Cover 2000 of Latvia (European Topic Centre on Land Use and Spatial Information)

An overview of land distribution by use in Latvia (in 2000-2007) is given in Table 5.1 and shown in Figure 5.3 (% in 2007).

In 2007 28% of total land area of Latvia (i.e. 1839.2 thousand hectares) were utilized as agricultural land. The main part of agricultural land consists of arable land following by meadows and pastures (see Figure 5.3.). There is still a significant part of land in Latvia that could be used for agricultural production – 23% (i.e. 1456.8 thousand hectares in 2007) of land in Latvia is referred as unused for agriculture available land.

[15] *Agricultural census in Latvia, 2001*
[16] *Eurostat*
[17] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*
[18] *European Topic Centre on Land Use and Spatial Information, Corine Land cover 2000 classification*

Table 5.1

Total land area and its distribution by use (10^3 hectares)[19]

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Total land area	*6458.90*	*6458.90*	*6458.90*	*6458.90*	*6458.90*	*6458.90*	*6458.90*	*6458.90*
Land area (excl. inland waters)	6229.00	6229.00	6229.00	6229.00	6229.00	6229.00	6224.30	6225.00
Utilized agricultural area	1587.20	1581.80	1595.50	1581.80	1642.10	1733.70	1855.30	1839.20
..arable land	969.90	958.20	972.80	956.40	1008.60	1091.80	1205.10	1188.10
..permanent crops	11.50	12.10	12.20	12.00	12.40	12.80	13.20	10.00
..meadows and pastures	605.70	611.30	610.30	613.00	620.90	628.90	636.80	641.00
Forests and woodland	2851.70	2868.20	2861.50	2877.20	2885.50	2904.40	2918.20	2929.00
Other land	1790.10	1779.00	1772.00	1770.00	1701.40	1590.90	1450.80	1456.80

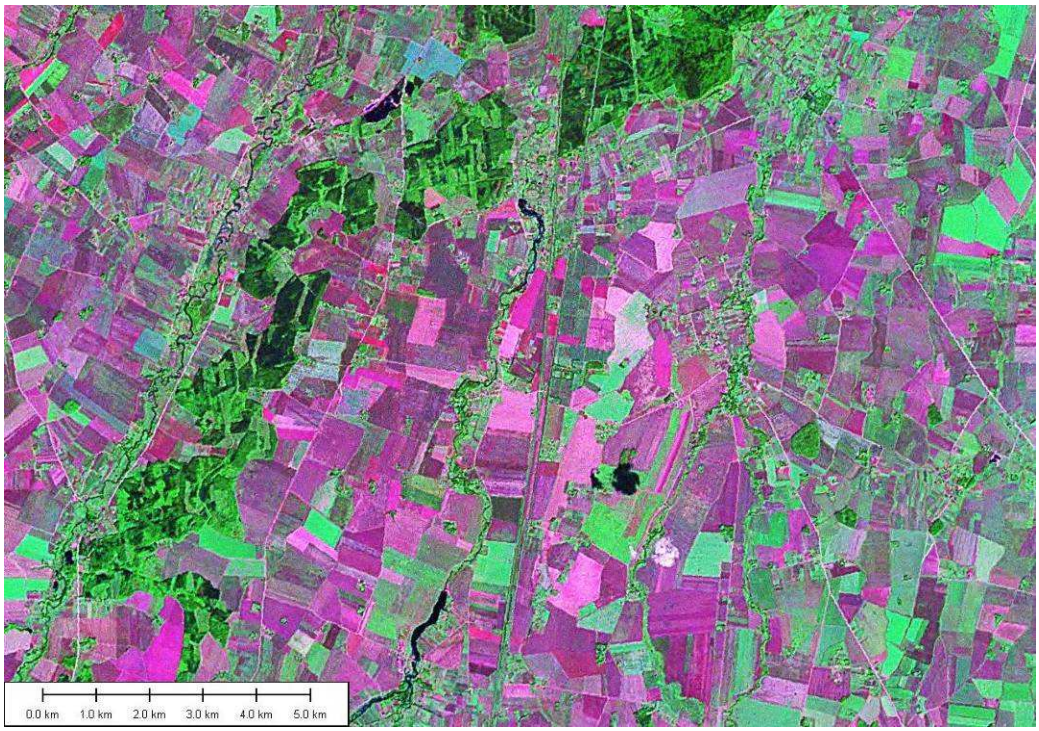

Figure 5.2.Typical agricultural spatial structure at the local scale in Latvia

Based on the agricultural census more then 180 000 farms could be found with a surface of about 3.586 million ha. On the average one farm had 19.9 ha of land or 12.4 ha of agricultural land.

By area of agricultural land the farm interval between 5 to 10 hectares are dominating in the agricultural land structure with 331 600 hectares (in total). The distribution of number of farms and agricultural land area by previously defined farm size is given in Table 5.2.

[19] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*

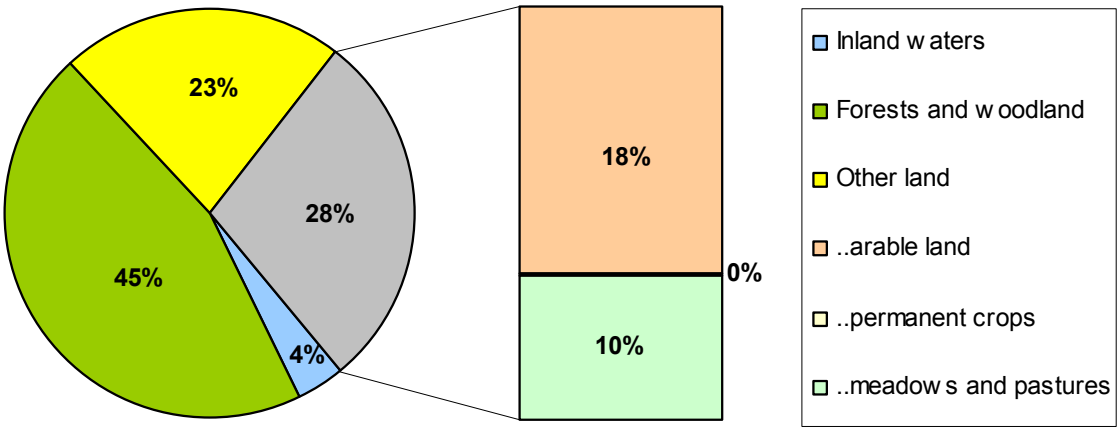

Figure 5.3.Land area distribution by use (% of total land area) in 2007 in Latvia[20]

Table 5.2

Grouping of farms according to agricultural land area[21]

Size	Number of Farms	% of total farms	Agricultural land area, 10^3 ha	% of total agricultural land area
TOTAL	*180263*	*100*	*2228.7*	*100*
< 5 ha	76013	42	209.5	9
5 < 20 ha	81884	45	821.5	37
20 < 50 ha	17307	10	507.8	23
> 50 ha	5059	3	689.9	31

As shown in Table 5.2, the highest number of farms (45% of total number of farms) has 5 to 20 hectares of agricultural land and is covering the biggest share in total agricultural land area (37% or 821 500 ha in total).

The use of agricultural land in Latvia is quite balanced with more emphases on specialization of field crop growing and mixed crop and livestock growing. Typical agricultural spatial structure in Latvia is given in Figure 5.2. Traditionally agricultural land in Latvia is alternating with forest lands with higher representation of agricultural lands in Zemgale region (NUTS LV009). The main part of agricultural land in Latvia is in farm ownership. The rest is rented agricultural land with a highest share of rented land in Zemgale region (NUTS LV009).

The temporary crops are dominated by wheat and barley with almost 300 000 hectare. The livestock is dominated by cattle with over 360 000 units and pigs with the same number.[22] Significant part of agricultural land is used for growing forage plants and occupied by permanent pasture and meadows. The temporary crops are dominated by cereals (mainly wheat and barley) with starting from 415 000 ha to more than 520 000 ha of sown area (see Table 5.3).

[20] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv), 2007*
[21] *Source: Central Statistical Bureau of Latvia, Agricultural Census, 2001*
[22] *FAO, 2000*

Table 5.3

Sown area under principal agricultural crops (10^3 hectares)[23]

	Sown area, total	**Cereals**	**Rape**	**Sugar beets**	**Potatoes**	**Vegetables**	**Long-fibre flax**
2000	881.1	420	6.9	12.7	51.3	9.7	1.6
2001	869.8	443.7	8.4	14.1	55.1	13.3	1.4
2002	877.7	415	18.4	15.9	53.6	12.5	2.1
2003	851.1	428.5	25.9	14.4	54.6	14.3	2.1
2004	899.2	436.7	54.3	13.8	48.9	13.5	2.7
2005	999.6	468.9	71.4	13.5	45.1	12.9	2.2
2006	1 122.7	511.8	83.2	12.7	45.1	13.4	1.5
2007	1 126.2	521.9	99.2	0.3	40.3	11	1.4

The livestock is dominated by pigs with over 410 000 units in 2007 and cattle with almost 400 000 units in 2007 (see Table 5.4). During the last few years also the number of poultry units has increased significantly reaching more than 4.7 million units in 2007.

Table 5.4

Number of livestock and poultry at the end of the year 2007 (10^3 heads)

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Cattle	367	385	388	379	371	385	377	399
..of which dairy cows	204	209	205	186	186	185	182	180
Pigs	393	429	453	444	436	428	417	414
Sheep	29	29	32	39	39	42	41	54
Goats	10	12	13	15	15	15	14	13
Horses	20	20	19	15	16	14	14	13
Poultry	3 105	3 621	3 882	4 003	4 050	4 092	4 488	4 757

[23] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*

6 Opportunities for biomethane injection into the Latvian national gas grid

6.1. Natural gas grids in Latvia

Natural gas supply in Latvia is provided by JSC "Latvijas Gāze". This company is the only gas transmission operator in Latvia. The shareholders structure of "Latvijas Gāze" by the end of 2006:

- E.ON. Ruhrgas International AG – 47,23 %
- AAS Gazprom – 34%
- SIA Itera-Latvija – 16%
- Other shareholders – 2.77%

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. The gas transportation system (existing and planned) is shown in the Figure 6.1 below.

Figure 6.1.Latvian gas transportation system[24]

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.

Existing Law on Energy of Latvia makes no provision for third party access to natural gas transmission, distribution and storage infrastructure. According to Law on Energy Law implementing provisions, Natural Gas Market in Latvia will be open in 1 January 2010.

[24] *Source: JSC Latvijas Gāze Annual Report 2006*

6.2. Characteristics of natural gas grids

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 per day, where approximately half is provided to Latvia supply and the left – for foreign countries.

Latvian gas transportation system initially was constructed to ensure the gas consumption of 3 billion m^3 per year. In 2006, natural gas consumption in Latvia was about 1.75 billion m^3. The total length of the natural gas pipelines on January 1, 2007 reached 5872.3 km, including the gas transmission pipelines – 1281.06 km and the gas distribution pipelines – 4591.25 km.[25]

According to the agreement, supplied gas should meet following criteria:

- Net calorific value should not be less than 7900 kcal/m^3 (in reality it is higher).
- Methane content is between 97-98%.

Gas coming from Inčukalns UGS is with moisture content of 0.15 g/m^3 and with pressure of 50-55 bar.

6.3. Technical requirements for biomethane injection into the natural gas grid

There are not 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 Table 6.1) were defined in 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 gas supplier and gas user.

Table 6.1

Biogas characteristics in Latvia[26]

Characteristic	Unit	Limit value
Net calorific value*	MJ/m^3	31.8
Highest limit of Wobb index	MJ/m^3	41.2 - 54.5
Hydrogen Sulphide	g/m^3	≤ 0.02
Mercaptan Sulphur	g/m^3	≤ 0.036
Oxygen	%	≤ 1.0
Particles	g/m^3	≤ 0.001

* At temperature of +20°C and pressure of 1.01325x10^5 Pa

[25] *Source: JSC Latvijas Gāze Annual Report 2006*
[26] *Cabinet of Ministers Regulation No.23 "Regulation on Gas Supply and Use" (not in force since 17.03.2005)*

6.4. Opportunities for biomethane injection

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 are no legal bases for biomethane injection in Latvia. In order to inject biomethane in natural gas grid, it is necessary to amend a 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.

7 Impacts of biogas production in Latvia

7.1. Environmental Impacts

There are 12 581 km^2 of protected areas in Latvia.[27] Regarding nature protection areas, the responsible organization for implementation of unified nature protection policy in Latvia is Nature Protection Board. According to the information found from this organization altogether in Latvia there are 633 specially protected natural areas, including: 1 biosphere reserve, 3 national parks, 4 strict nature reserves, 9 areas of protected landscapes, 43 nature parks, 278 nature reserves, 206 geological and geomorphological formations with protectable qualities, 89 dendrological planted areas, that makes 12% of the area of Latvia in total. The most of these protected areas are established as Natura 2000 protection areas. Indication of nature protection areas in Latvia is given in Figure 7.1.[28]

Figure 7.1.Nature protection areas (in green) in Latvia

Before any potential expenditure it must be considered if there could be any impact on protection areas from intended activity.

Air and emissions

According to the Latvia's National GHG Inventory Report 1990-2006[29], the most significant sources of anthropogenic greenhouse gas (GHG) emissions in Latvia are energy (including transport) and agriculture sectors. In 2006 energy sector has more than 73.5% share of the total GHG emissions, following the agriculture sector with approximately 17% of Latvia's total GHG emissions. An overview of GHG emissions by sectors is given in Figure 7.2.

[27] *Source: Central Statistical Bureau of Latvia (www.csb.gov.lv)*
[28] *Nature Protection Board of Latvia: www.dap.gov.lv*
[29] *Latvia's National Inventory Report 1990-2006: Submitted under United Nations Convention on Climate Change and the Kyoto Protocol, 2008*

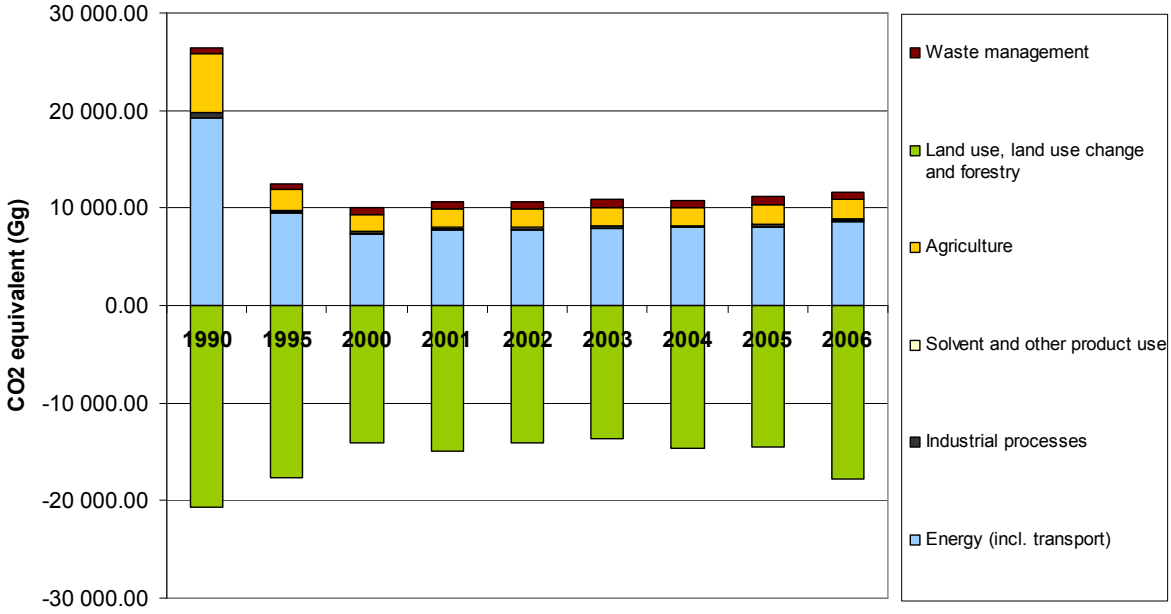

Fig.7.2. GHG emissions in Latvia 1990-2006, Gg CO_2 equivalent

As shown in Figure 7.2., between 1990 and 2000 GHG emissions decreased significantly. The reason for that was recession in Latvian national economy in the beginning of 1990-ties. In 2006, Latvia's total GHG emissions showed a decrease of 56% from the base (1990). However, compared to the total GHG emissions in 2005, emissions have risen by about 4.5 % in 2006. So far the land use, land use change and forestry (LULUCF) is a net sink in Latvia and the main sink is forestland.

Biogas in Latvia has a large potential for substitution of fossil fuels and to reduce the GHG emission form energy sector, e.g., using biogas for energy (heat, electricity, CHP) generation and as transport fuel.

GHG emissions from the agriculture in Latvia include emissions of CH_4 from enteric fermentation, manure management and emissions of N_2O from manure management and agricultural soils. Yet, the annual GHG emissions form agriculture have reduced approximately by 66% since 1990 (due to decreases in the number of livestock and in nitrogen fertilisation), the total GHG emissions from agricultural activities in Latvia is slightly increasing every year. Biogas could give a significant contribution for reduction of CH_4 and N_2O emissions from animal husbandry and animal manure storage and application. In particular this is a case for Latvia where in 2006, methane emissions from enteric fermentation of domestic livestock comprised 87 % of total agricultural emission.

Water and soil

Society in Latvia, even between professionals in agriculture has wrong opinion about minor impact of agriculture on environment. Agriculture like other human activities has substantial impact on environment, especially water quality. Run-off from agricultural land seems to have good water quality, but, in principle, it is leakage from soil matrix with considerable concentration of nutrients (N; P; K and microelements).

Results of run-off monitoring implemented in Latvia in 2005[30] indicated that in several sites (Bērze, Vecauce) nitrate concentrations where higher than the limiting values of EU Nitrate Directive. Highest losses were measured in Zemgale region, part of which has been designated as vulnerable zone (see Figure 6.3).

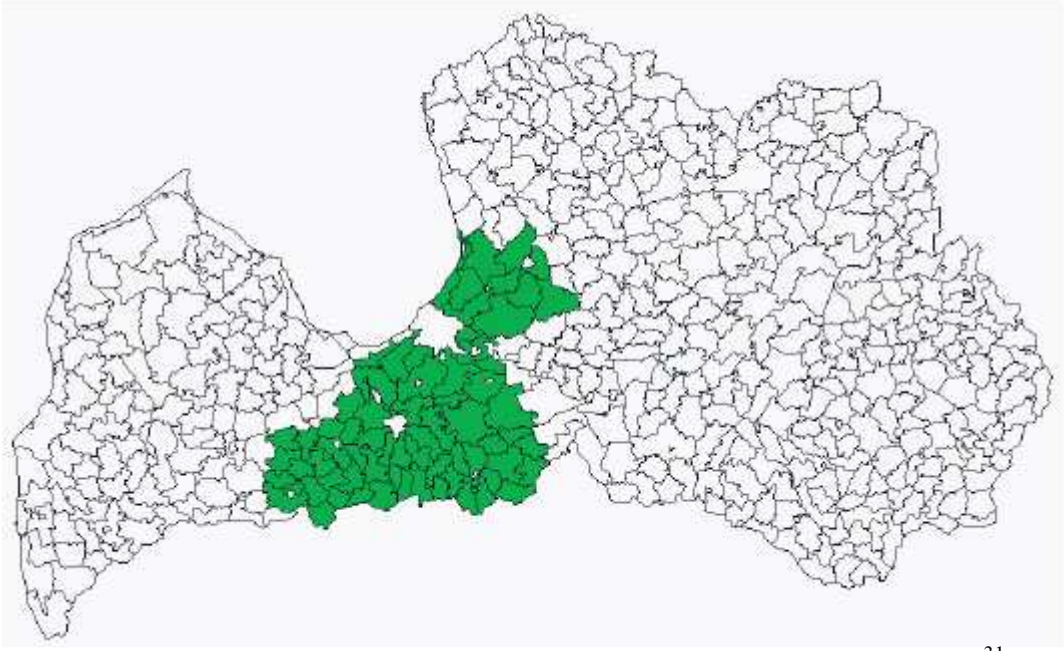

Fig.6.3. Location of vulnerable zones (in green) in the territory of Latvia[31]

According to the run-off monitoring results, the highest leaching and run-off losses were observed in areas characterized by high animal density and intensive application of the manure. To avoid the release of leakage fluids in to the watercourses, ground waters and soil, particularly concerning nitrogen vulnerable zones, practices of proper manure management and application have to be considered.

Land use

One of the most significant environmental impacts resulting from growing of energy crops for biogas production is land use change. After 1990 there was a rapid decline in agriculture in Latvia resulting to a lot of unused agricultural areas. According to the national statistical data[32,] during the last 8 years the area of utilized agricultural land tends to increase, however, almost 40% of available agricultural land in Latvia is still not used for agricultural production. Biogas production could contribute to more intense use of available agricultural land allowing increasing the standard of living for farmers.

According to the recent investigations[33] prepared by University of Agriculture of Latvia, the huge amounts of unused land ensures that growing energy crops for biogas production will not stand the competition with agricultural crops and in long term increase of competition would promote more

[30] *Lauksaimniecības noteču monitorings (Monitoring of Agricultural Run-offs), University of Agriculture of Latvia, 2006*

[31] *Regulation of Cabinet of Ministers of Latvia Nr.1002 „Kārtība, kādā ieviešams programmdokuments „Latvijas Lauku attīstības plāns Lauku attīstības programmas īstenošanai 2004.-2006.gadam", 30.11.2004*

[32] *Source: Central Statistical Bureau of Latvia:* www.csb.gov.lv

[33] *Biomasas izmantošanas ilgtspējības kritēriju pielietošana un pasākumu izstrāde (Development of actions and implementation of sustainability criteria for biomass use), University of Agriculture of Latvia, 2009*

intensive development of agriculture in Latvia and giving agricultural products with higher additional value.

Waste

According to the Latvia's National GHG Inventory Report 1990-2006[34], GHG emissions from waste sector have been increased since 1990. In 2006, emissions were ~12% higher than in 1990, contributing to about 6.57 % of total GHG emissions (excluding LULUCF).

The main directions in the waste management are the development of the construction of polygons and collecting system for non–hazardous municipal waste. According to Latvian Waste management plan for 2006-2012[35] there will be 11 waste polygons in Latvia. Biogas collection and use for energy production from biodegradable wastes and sludge is set as one of priorities in Latvia.

7.2. Social and Economic Impacts

Concerning the level of development, there is a big difference among urban and rural territories of Latvia. To evaluate the level of development, every year State Regional Development Agency[36] calculates development index for each administrative territorial unit of Latvia. The development index is calculated based on different indicators like unemployment rate, income-tax per capita, demographical load, population density, change in number of population, etc. Comparison of development indexes for rural territories shows that from the total 449 rural parishes only 147 (33%) has positive development index in 2006. Exploitation of locally produced renewable energy resource like biogas could positively affect all those indicators and increase the level of development of rural territories of Latvia.

Job creation, new income opportunities and facilitation of rural development

Biogas sector development creates new jobs and new markets for manufacture of technical equipment, construction and operation of biogas plants. This is very important for Latvia since due to the economical crisis unemployment rate recently has increased in all sectors and in all regions of Latvia.

Biogas gives new income opportunities for farmers that could gain additional income from biogas production by producing energy and reducing their organic waste amounts. Biogas production could be one of the solutions for farmers suffering from low milk prices having in Latvia one of the lowest prices among all European countries[37].

In case of Latvia when a lot of agricultural land is unused each activity that promotes the use of agricultural land including biogas production will give a positive impact on income of farmers and overall rural development.

Substitute for fossil energy and energy imports

Latvia has a relatively high dependency on fossil fuels end imported energy. According to the National Energy Development Plan for 2007-2016[38], only 36% of energy consumption is covered by locally available energy resources. About 29% of primary energy resources are covered by

[34] *Latvia's National Inventory Report 1990-2006: Submitted under United Nations Convention on Climate Change and the Kyoto Protocol, 2008*
[35] *Latvian Waste management plan for 2006-2012, Ministry of Environment, 2005*
[36] *State Regional Development Agency: http://vasab.org/en/about/ , Development Index in 2006*
[37] *EU Farmgate Milk Prices Report, 24/02/2009: http://www.mdcdatum.org.uk/MilkPrices/eumilkprices.html*
[38] *National Energy Development Plan 2007-2016, Ministry of Economy of Latvia, 2006*

natural gas that is imported from one supplier – from Russia, ~30% are imported oil products from CIS and other countries, coal and imported electricity are counting for the rest of ~5%.

Biogas production would allow reducing dependency from imported fossil fuels and to strengthen national and regional economy in Latvia. In order to achieve that and to be able to compete with fossil fuels, a strong incentives or subsidies for biogas are required. Yet, the new feed-in tariff system for biogas electricity is introduced in Latvia; still the efficiency of the new system is not proved on real projects.

Social acceptance

Generally public attitude regarding renewable energy and biogas is positive. However, time by time as well some negative experiences regarding odours from industrial and agricultural processes, particularly from pig farms are circulating in regional media. Therefore building a biogas plant could be a very sensitive issue regarding the social acceptance. To improve the social acceptance of particular biogas project public involvement is crucial and it must be considered during the planning process.

8 Conclusion and Outlook

Due to the available biomass resources, the biogas potential of Latvia is very promising, but at the moment, there are only four biogas plants with cogeneration units in operation. The current situation for agricultural biogas projects in Latvia is very promising and in 2008 the first agricultural biogas project (intended as demonstration project) started the operation and some more projects are under construction and in a preparation. Biogas sector development in Latvia is facilitated by latest improvements in biogas related legislative framework and in availability of financial resources.

Latvia have good infrastructure and framework for waste collection, however, the waste is not separated, and largely ends up in landfill sites. EU standards for waste collection and handling have been largely adopted; however, there are only some pilot programs for waste separating and recycling. 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.

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.

The estimations on biogas potential in this study were provided only in terms of available biomass. To evaluate the biogas potential in terms of produced biogas, a series of limitations and constrains must be taken into consideration. These limitations are especially linked with the available (not theoretical) raw material from agriculture, with technical availability and also with socio and economic constrains. The political background could play the main role in lifting this constrains and limitations. Specific support mechanisms could help promoting and further developing the use of biogas.

In the growing context of legitimate debates regarding competition between food resources and bio-energy production, assessment of biogas potential in Latvia were based on two biomass categories – organic wastes from agriculture (both primary and secondary production) and other organic residues (urban waste, food industry and sewage sludge). Organic wastes from agriculture, food industry and sewage sludge could be used for energy production not only through anaerobic digestion, but also through gasification or simple combustion. Other transformation patterns could also redirect this potential to bio-ethanol or other bio-products.

Two regions could play an important role in establishing new biogas facilities in Latvia (regions that have an important potential): Zemgale region (LV009) and Latgale region (LV005).

Important areas for biogas production, based on biomass potential, as well as the main types of resources that could be used for biogas generation, could be completed with details related to land fragmentation and crop diversity, ownership structure and livestock peculiarities.

The number of comparatively small farms is large in Latvia and this could have a negative impact on the development of effective potential sites. From one side small size biogas production units could be the solution for the high fragmentation of the farming. From the other side more diverse

farms (including farm types, size, production capacity and crop heterogeneity) means better diversity in opportunities for different anaerobic digestion patterns.

Investigations on possibilities for biomethane injection showed that there are no legal bases for biomethane injection in Latvia. 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.

Biogas in Latvia has a large potential for substitution of fossil fuels and to reduce the GHG emission form energy sector, e.g., using biogas for energy (heat, electricity, CHP) generation and as transport fuel. Biogas could give as well a significant contribution for reduction of CH_4 and N_2O emissions from animal husbandry and animal manure storage and applications. However, before building a biogas plant it must be considered if there could be any impact on protection areas from intended activity.

One of the most significant environmental impacts resulting from growing of energy crops for biogas production is land use change. Since almost 40 % of available agricultural land in Latvia is still not used for agricultural production, each activity that promotes the use of agricultural land including biogas production will give a positive impact on income of farmers and overall rural development. Biogas production could contribute to more intense use of available agricultural land allowing increasing the standard of living for farmers.

Exploitation of locally produced renewable energy resource like biogas would allow reducing dependency from imported fossil fuels and to strengthen national and regional economy in Latvia. In order to achieve that and to be able to compete with fossil fuels, a strong incentives or subsidies for biogas are required. Yet, the new feed-in tariff system for biogas electricity is introduced in Latvia; still the efficiency of the new system is not proved on real projects.

To improve the social acceptance of particular biogas project public involvement is crucial and it must be considered during the project planning process.