SEBE – Sustainable and Innovative European Biogas Environment

Work package 3: Economic and Logistical Environment

"Final Report"

Country: Slovenia

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February 2011

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LIST OF ABBREVIATIONS

%	percent
a	year(s)
AD	Anaerobic digestion
CH_4	methane
DEX	Decision Expert (Software)
EC	Expert choice (Software)
GDP	Gross domestic product
GWh	Gigawatt hour
ha	hectare
Kilo (K)	1000
Km	Kilometre
ktoe	Kilo Tonnes of Oil Equivalent
kV	kilovolt
kWe	Kilowatt of electrical energy
mio.	million
MW	Megawatt
MWh	Megawatt hour
R&D	research and development
RES	Renewable energy source
Sm^3	Standard cubic meter
t	tonne

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EXECUTIVE SUMMARY

Biogas production started in Slovenia at the end of 1980th. First two biogas plants were for the anaerobic digestion on municipal plants – central wastewater treatment and big pig farm. Energy utilization of biogas from the anaerobic digestion sewage, manure or agricultural wastes and landfill gas is present in Slovenia, but it has at this moment a negligible impact on energy balance, while the important impact is the reduction of emission of greenhouse gases. Use of biogas from central wastewater treatment (CWWT) is necessary, especially from the aspect of reducing methane emission. Energy of biogas covers partly the energy need of the wastewater treatment. The energy produced is used in the plant for heating the fermentors (digesters) and partly covers the electricity needs. In Slovenia exist eight central wastewater treatments (CWWT) installed systems for biogas production, but only four of them use biogas for production of heat and electricity (CHP). In others, the biogas is burned on torches. Total installed electricity power on sewage gas is less than 1 MW estimated at about 9,000 GWh per year.

In year 2010 were in Slovenia 12 biogas plants with total power of 14,7 MW, that above all from animal manure and of energy plants produce biogas.

One of the main potentials for the generation of biogas lies in agriculture. Agricultural substrates are animal manure and energy crops. The potential of agricultural raw material (substrates, plant biomass and animal manure) to be used for biogas production was evaluated based on the analysis of 1707 animal farms and 24 companies and of 375 farms and 18 field crop production companies, cultivating together 15.701 ha.

Biogas potentials are also from the following sources:

- Organic wastes at municipal waste dumps,
- Bio-degradable wastes at central waste water treatment plants (sewage),
- Bio-degradable industrial wastes,
- Wastes from households, restaurants and grocery shops,

The estimated potential or quantity of substrates and expected yields of biogas and electricity production from agricultural sector are shown in Table below.

Table 1: Potential of biogas production from stockbreeding and agricultural small farms.

Type of substrate	Total quantities of substrates (ton/year)	Total biogas production (m3/year)	Electricity production (MWh/year)	Electricity power (MW)
Animal manure	110,414	38,953,904	80,674	10,1
Energy plants	107,372	60,344,926	124,974	15,6
TOTAL	217,786	99,298,830	205,748	25,7

Strategy development of biogas production

The main objective of the development strategy for biogas production in Slovenia is to increase production and energy utilization of biogas from the agricultural sector. Big agricultural biogas plants are in operation or under construction on almost all big farms in the country. The main unutilized potential for biogas production in Slovenia lies in the small stockbreeding and agricultural farms and companies.

The main types of non-technical barriers and recommendation measures to overcome them are the following:

- legal (authorisation procedures),
- education and information,
- economic and financial,
- technical and organisation and,
- public acceptability.

Action plan

Ministry of the Economy prepared in cooperation with Institute »Jožef Štefan« National action plan for renewable energy for period 2010 – 2020. The actions proposed in the Action plan take into consideration the set of proposed measures to achieve the objectives in terms of biogas production in Slovenia. The proposed actions are:

- influencing policy makers,
- establishment of professional association(s) for biogas operators and/or owners,
- increasing information in agricultural sector,
- programme promotion of biogas technologies,
- dissemination of information,
- identification of location of biogas plants in agriculture for more farmers,
- training programme for the operators of biogas plants, energy and agricultural advisors,
- creation of special training programmes.

1. INTRODUCTION

Slovenia is highly dependent on energy imports. Coal and RES are representing the most important part of the domestic energy sources. Like in the EU (European Union) member countries the RES and efficient use of energy are representing the only available instr ments for stagnation or decrease in energy imports. The increase of the share of RES (small and large hydro, wood biomass and solar energy) must represent Slovenia's strategic direction.

Taking into account the existing tradition Slovenia has a good start-point and possibility for further development and could join the group of the leading European countries. Together with the programs for efficient use of energy the requirement for the 8% decrease of the CO2 emissions according the Kyoto protocol will be possible to achieve. Besides the rehabilitation and enlargement of the existing power plants, the construction of the hydro chain on the Sava River the biggest potential lies in the development of modern use of wood biomass and wind energy. A substantial potential exists also for other renewables, but without a serious governmental program of support for RES the potential will remain only theoretical.

Biogas market is one of the most interesting renewable energy sectors for the farmers in Slovenia. Although there was some interest among farmers for building biogas plants also in the past decades – Austrian example was near enough - there was however a major barrier to it, namely financing. The investment risk was simply too high. After feed-in tariff system was introduced in 2002 things started to evolve. But it was mainly after 2006 when the feed-in tariffs become interesting enough and later on when subsidies for investment into RES installations for farmers were prepared by Ministry of Agriculture that biogas begun its real take-off. However, due to the price categories within the feed-in support system which were in favour of bigger plants (around 1MW).

Anaerobic digestion is a biochemical process during which complex organic matter is decomposed in absence of oxygen, by various types of anaerobic microorganisms. The process of AD is common to many natural environments such as the marine water sediments, the stomach of ruminants or the peat bogs. In a biogas installation, the result of the AD process is the *biogas* and the *digestate.* If the substrate for AD is a homogenous mixture of two or more feedstock types (e.g. animal slurries and organic wastes from food industries), the process is called "co–digestion" and is common to most biogas applications in Slovenia today.

2. COUNTRY ECONOMY

With stronger foreign demand, economic growth is projected to be 0.9% in 2010, somewhat higher than the spring forecast (0.6%). Incentives for stronger economic activity in Slovenia this year mainly come from the international environment, with economic growth in Slovenia's trading partners being even higher in the second quarter than expected in the spring. At the same time, the phasing-out of anti-crisis stimulus packages and the fiscal austerity measures announced in a number of countries in the EU lowered the values of indicators of expectations in recent months, which suggest that this high growth will not continue in the second half of the year. While export demand picked up, impulses from the domestic environment are weaker, which is linked to the situation in the construction sector and related activities as well as labour market movements, where signs of recovery have yet to be seen. (UMAR, 2010). The inflation rate in the period from January 2009 to November 2010 was 3.6 %. Real growth in 3rd quarter was 1.7 %.

Table 2-1: Economic situation from 2004 to 2009. (SORS, 2010)

	2004	2005	2006	2007	2008	2009
GDP-Current prices (mio EUR)	27,073	28,749	31,050	34,568	37,304	35,384
GDP - Annual volume change (%)	4.3	4.5	5.9	6.9	3.7	-8.1
GDP – per ca pita (EUR, at current prices and current exchange rate)	13,599	14,369	15,467	17,122	18,449	17,331
Inflation rate (%)	3.2	2.3	2.8	5.6	2.1	1.8
Exports of goods and services - annual volume change (%)	12.4	10.6	12.5	13.7	3.3	-17.7
Imports of goods and services - annual volume change (%)	13.3	6.7	12.2	16.7	3.8	-19.7

Agricultural output in 2009

The total volume of agricultural output, which had been on a declining trend in the last five-year period, also decreased in 2009. After a 1.3% fall in 2008, the volume of agricultural output declined to similar extent in 2009 (-1.2%), according to the economic accounts for agriculture, being already as much as 7.7% lower than in the weatherwise favourable year 2004. After both of them declined in 2008, crop production increased by 3.5% in 2009, while animal production declined by as much as 6.2%. Crop production was thus somewhat higher than in 2007, while animal production dropped to the lowest level in the last few years. The share of crop production in total agricultural production thus rose from 50.7% to 52.0%, while the share of animal production declined from 47.6% to 46.0%. The volume of agricultural services also decreased but their share is relatively modest. Crop production decreased in the cereal sector only, while in animal production, pig and cattle breeding recorded a significant decline. The yield of cereals diminished due to fewer areas sown and a lower yield of produce per unit area. Rainy weather conditions during ripening had a deteriorating effect on both the quantity and quality of grain. A particularly positive sign is a high yield of vegetables, even if it was not due to an increase in the area sown but to a better harvest. Namely, Slovenia's self-sufficiency in vegetables is very low and is even deteriorating (amounting to a mere 36% in 2008), despite increasing demand and consequently higher prices. Within animal production, pig meat production continued to decline and recorded an exceptionally large drop last year (-20.2%). The decline was attributable to the persistent crisis in this sector, with purchase prices being relatively low while production costs increased. Amid lower domestic production, there was a significant increase in pig imports and a concurrent decline in pig exports. Last year, production volume also declined in cattle breeding, in the production of both meat and milk. Poultry meat production continued to increase, as did the production of sheep and goat meat. More information in Annex; Table 2. (IMAD, 2010)

Table 2-2: Electricity consumption/GDP 2005 to 2009. (SORS, 2010)

	2005	2006	2007	2008	2009
Electricity consumption/GDP (MWh/mio. EUR)	581	567	533	500	478
Electricity consumption per capita (KWh)	6,425	6,615	6,584	6,369	5,580

Industrial activities are concentrated in urban centres, also representing important employment centres. In the cooperation area, this sector employs the majority of active population and represents the most important economic activity. In general, problems can be summarised as: weak level of entrepreneurship, high labour - low technology industries, low labour productivity, restructuring of traditional industries, lack of investment capital, low level of export orientation and - with a few exceptions – lack of competitiveness, low level of innovation and cooperation with R&D institutions, lack of communication between the industries, concentration of the industrial potential in urban areas, peripheral areas are declining, a low level of business and managerial know-how. Economic situation of regions - look in Annex; Table 1. Most important industries/ branches are described in Annex; Table 6.

Export/ import (volume in EUR/ year).

Table 2-3: Export/Import, Slovenia from 2006 to 2010 (in 1000 EUR). (SORS, 2010)

2006		2007		2008		2009		2010*	
export	import	export	import	export	import	export	import	export	import
16757167	18340809	19405894	21507583	19808198	23045703	16017671	17115280	13438894	14187518

*first 9 months

Table 2-4: Export and import for standard international trade classification, Slovenia, cumulative data from 2008 to 2010 (in 1000 EUR). (SORS, 2010)

	2008		2009		2010*	
	export	import	export	import	export	import
0-Foodstuffs and living animals	626934	1337974	596574	133657	433517	923317
1-Drinks and tobacco	72107	162426	72700	163520	53170	127661
2-Raw substances, forby fuels	607629	1196426	485130	818676	549118	876163
3-Mineral fuels and lubricants	601943	2943718	518722	1933689	553658	1745170
4- Oils, masti and waxes animal. and of plants. origins	14421	60303	9801	46572	8243	43538
5-Chemical products	2859573	2717265	2629165	2312867	2206287	2018864
6- Products, arranged round material	4705718	4686238	3335905	3139288	2961239	2790010
7- Machines and transport devices	7887248	7716307	6449663	5479812	5243975	4177959
8-Different products	2423358	2173449	1910024	1890477	1412712	1426714
9-Products and transactions	9268	51598	9985	26722	16976	58122

*first 9 months

Slovenia´s 15 main trading partners are Germany, Italy, France, Austria, Croatia, the United Kingdom, the Czech Republic, Hungary, Poland, Slovakia, Spain, Belgium, the Netherlands, Russia and the US (trade volume in EUR/year for this countries - please look Annex; Table 3). (IMAD, 2010)

3. BIOGAS UTILISATION AND POTENTIAL (COUNTRY LEVEL)

3.1. Natural Resources and Potentials

The estimated potential or quantity of substrates and expected yields of biogas and electricity production from agricultural sector are shown in Table 3-1.

Table 3-1: Potential of biogas production from stockbreeding and agricultural small farms.

Type of substrate	Total quantities of substrates (ton/year)	Total biogas production (m3/year)	Electricity production (MWh/year)	Electricity power (MW)
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In 2009 agriculture land covers the area of 468,496 ha, of which arable land represent 175,189 ha, permanent grassland 267,304 ha and land under permanent crops 26,003 ha. Forest land covers 1,186,104 ha. Share of agriculture land in the total area of the country was about 23.1% and the share of forest and woods 58.5%. In Table 3-2 Structure of utilised agricultural area by land use categories from 2007 to 2009 are presented.

Table 3-2: Structure of utilised agricultural area by land use categories (ha). (SORS, 2010)

	2007	2008	2009
Arable land	175,035	180,303	175,189
Permanent grassland	297,284	285,973	267,304
Land under permanent crops	26,147	26,148	26,003
Total	498,466	492,424	468,496

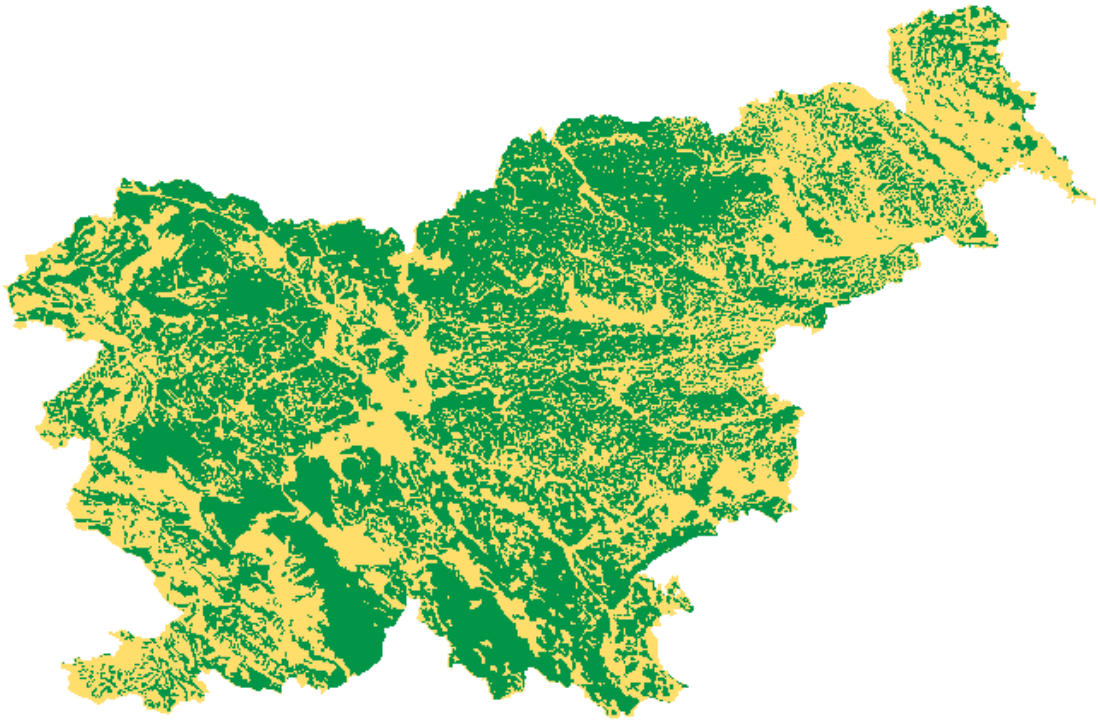

Fig 3-1. Forest areas of Slovenia (green is forest). (AMGI)

The most important arable crop in Slovenia are cereals, over the last five years was about 56% of arable land sown with the cereals. In recent years the total harvested area of cereals does not significantly vary, about 100 thousand hectares. In the sown structure is the most area intended for maize for grain (2005-2009 41%), wheat (31%) and barley (18%). For sown area, production and yield look Annex; Table 5.

Table 3-3: Arable crops (ha). (SURS, 2010)

	cereals	potatoes	vegetables	industrial crops	Fodder plants	Stubble Cereals*
2007	98,586	5,736	2,752	11,255	51,994	56,815
2008	105,016	4,427	3,421	9,816	54,963	60,484
2009	100,173	4,175	3,406	10,731	54,476	60,687

*Wheat, Spelt, Rye, Barley, Oats, Buck wheat (Stubbly fields).

The total harvest of cereals (533 thousand tonnes) was 8% lower than in 2008, to which most contributed poor harvest of wheat and other cereals and reduced volume of stubble cultivation of maize for grain. According to the market reports of the AKTRP (Agency for Agricultural Markets and rural Development) was at the time of harvest together received (pur-

chased) only 37 thousand tonnes of wheat harvest 2009, which is 40% less than in the year before, and only 27% of the total harvest of wheat in 2009 (2007: 39%, 2008: 57%). Domestic consumption of cereals exceed home production and range between 0,9 and 1 million tonnes annually, of which two thirds are for the fodder consumption (average 2005-2009 65%). In 2009, the domestic consumption of cereals amounted to 968 thousand tonnes, which is 6% more than in 2008. To increase the consumption of cereals is affected, in particular, the greater consumption of maize (+ 13%). For fodder was used 15% more cereals than in 2008, while the consumption for food decreased (-8%). The greater consumption of cereals for fodder is the result of significantly higher consumption of maize (+ 16%), which occupies two thirds of used cereals for fodder in Slovenia, as a result of poor quality also considerably greater consumption of wheat (+ 20%) and barley (+ 11%). Slovenia imported in the average of the last five years in the form of grain, flour and processed products 487 thousand tonnes cereals per year, of which between 70 and 85% in the form of grain. In 2009 422 thousand tonnes of cereals was imported, of which 173 thousand tonnes of wheat, 178 thousand tonnes of maize and 50 thousand tonnes of barley. Imports of cereals in 2009 decreased by 10% in comparison with the previous year and the volume was the lowest since 1992, imports of wheat was lower than 11%, of maize for 5% and barley as much as 23%. The export of cereals is small, but in recent years in the five-year period export amounted to 58 thousand tonnes on average. In recent years in the structure of exports the grain dominated, while before 2005 flour and processed products. In table 3-4 balance of production and consumption of cereals from 2007 to 2009 are presented. (KIS, 2010)

Table 3-4: Balance of production and consumption of cereals (in 1000 t). (SORS; KIS, 2010)

	2007	2008	2009
Produced	531,9	579,6	532,8
Initial stocks	701,5	756,3	831,2
Final stocks	756,3	831,2	713,1
Domestic consumption	992,8	912,3	968,4
-fodder	645,8	582,9	670,6
-seed	18,0	19,1	19,0
-industrial intentions	44,0	35,6	27,7
-losses	34,7	33,5	29,0
-consumption for diet	250,3	241,2	222,1
Self supply (%)	53,6	63,5	55,0

KGZ Celje (Agricultural forestry institution Celje) made three scenarios. First scenario suggests that we could devote 5.9 % of arable land, 26 % of stubbly fields and 3.6 % permanent grassland for energy crops. Second scenario suggests that we could devote 9.8 % of arable land, 28% of stubbly fields and 5.2 % permanent grassland for energy crops. Third scenario suggests that we could devote 13.9 % of arable land, 29.9 % of stubbly fields and 6.8 % permanent grassland for energy crops.

3.2. Installed and Potential Biogas Capacity

In Table 3-5 primary biogas energy output in Slovenia is presented.

Table 3-5: Primary biogas energy output in Slovenia in 2008 and 2009 (in ktoe). (Biogas barometer, 2010)*

2008				2009*			
Landfill Gas	Sewage Sludge Gas**	Other biogas***	Total	Landfill Gas	Sewage Sludge Gas**	Other biogas***	Total
8,2	3,1	2,7	14,1	8,3	3,0	11,0	22,4

*Estimation, **Urban and industrial, ***Decentralised agricultural plant, municipal solid waste methanisation plant, centralised co-digestion plant.

Table 3-6: Gross electricity output by gas deposit in Slovenia in 2008 and 2009 (in GWh). (Biogas barometer, 2010)

2008				2009*			
Landfill Gas	Sewage Sludge Gas**	Other biogas***	Total	Landfill Gas	Sewage Sludge Gas**	Other biogas***	Total
31,6	12,2	12,2	55,9	30,7	11,9	26,2	68,8

In Table 3-7 Biogas plants are mentioned also their Names, Power, Year of start and Substrates which are used.

Table 3-7: Agricultural biogas plants.

Name	Power (MW)	Year of start	Substrates
Bioterm d.o.o. (Flere)	0,27	2003	Beef slurry: 2200 m3/year Kitchen organic waste: 2000m3/year Waste from dairy: 180 m3/year
Bioplin, Marjan Kolar s.p.	1	2007	Pig slurry: 3200 m3/year Grass silage: 3000 t/year Maize silage: 7700 t/year Corn Cob Mix: 550 t/year
Bioplinarna Farma Ihan (FI-EKO d.o.o.)	1,05	1993	Pig slurry: 90000 m3/year Slaughter waste: 1200 t/year
Bioplinarna Nemščak (Panvita EKOTEH d.o.o.)	1,46	2006	Pig slurry: 69000 m3/year Maize silage: 12500 t/year Slaughter waste: 4500 t/year
Bioplinarna Motvarjevci (Panvita EKOTEH d.o.o.)	0,83	2007	Chicken manure Slurry Maize silage
Ljubljana KOTO	0,53	2007	Beef slurry: 1000 t/year Biowaste (sorted biological waste) Slaughter waste
BPE Keter Organica Kolar 2	1	2009	Beef slurry Maize silage
BPE Keter Organica Gjerkeš 1	1,2	2009	Chicken manure Slurry

			Maize silage Biowaste
BPE Keter organica Vargazon 1	1	2010	Silage from maize, sorghum, grass, cereals Beef slurry
BPE Keter organica Petrač 1	1	2010	Silage from maize, sorghum, grass, cereals Beef slurry
Bioplinska naprava Lendava (E-COS d.o.o.)	4,25	2008	Maize silage Grass silage
BIOFUTURA Ilirska Bistrica	1,1	*	Organic waste: 30000 t/year
BIOENERG d.o.o. Črnomelj	1,36	*	*
Bioferm Pivka	1,5	*	*
Bioplinarna papirnica Količevo	0,53	*	*
Bioplinarna Matevž Čokl	0,018	*	*

*no data

Table 3-8: Landfill gas.

Name	Power (MW)	Year of start
Deponija Pobrežje Maribor	0,625	2001
Deponija Ljubljana Barje	*	*
Deponija Bukovžlak Maribor	*	*
Deponija Nova Gorica	*	*

*no data

KGZ Celje (Agricultural forestry institution Celje) made three scenarios as mentioned previously. After first scenario, could be together with animal manures produced so much biogas, that we could install biogas plants with total power of 86 MW, after second scenario 116 MW and after third scenario 147 MW.

3.3. Biogas Market

Predicted development of anaerobic digestion from 2010 on until at least 2020.

Table 3-9: Predicted development of biogas (MW) for electricity production (GWh) from 2010 to 2020. (AN OVE, 2010)

2010		2011		2012		2013		2014		2015	
(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)
30	148	36	192	44	259	50	299	54	323	58	351

2016		2017		2018		2019		2020	
(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)	(MW)	(GWh)
59	355	60	360	60	363	61	366	61	367

Slovenia has within planning and construction of biogas plants her showpiece company Keter Organica, that already quickened penetrates on foreign markets. Keter Organica is subsidiary of group Keter Group. For period 2010-2011 are already decided 23 contracts for construction of new large biogas plants – mainly abroad (Croatia, Serbia, Macedonia, Romania, Hungaria). (Mladina, 2010)

3.4. Economic Viability

Access to economical information on biogas plant is limited.

Multi-criteria model for evaluation of energy crops for biogas production
For the purpose of planning and decision making in production and processing of energy crops into biogas the integrated computer based deterministic simulation model BIOGAS was developed. The simulation model BIOGAS consists of three main models: model calculations of energy crop production, simulation model of processing the energy crops into biogas and simulation model of production of electricity and heat from biogas. The developed system allows the assessment of the economic viability of processing the energy crops into biogas. The simulation results present the input parameter for multi-criteria decision analysis. Two methods were used: the method DEX-i and analytical hierarchy process (AHP). With multi-criteria decision models, depending on input data and criteria, the energy crops were assessed. The analysis showed that by using current model the most relevant alternative used for energy crop for biogas production is maize. The maize results in the best multi-criteria evaluation EC = 0,248 and DEX-i evaluation = appropriate. The best alternative for maize is sorghum with multi-criteria evaluation of EC = 0,201 and DEX-i evaluation = less appropriate, followed by sunflower with multi-criteria estimate EC = 0,151 and DEX-i estimate = less appropriate sugar beet EC = 0,150 and DEX-i estimate = less appropriate, amaranth EC = 0,127 and DEX-i estimate = inappropriate and, lastly, Jerusalem artichoke EC = 0,123 and DEX-i estimate = inappropriate. (P. Vindiš, 2010)

Price of energy
When talking about biogas from manure and organic waste, investment costs are relatively high and therefore already represent the first barrier to the potential investor. Average specific investment cost for standard biogas plants in Slovenia is: 4.500 €/kWe for plants up to 1 MW and 4.000 €/kWe for plants over 1 MW. For using biogas from landfill or sewage gas than the investment is much lower.

Operation & Maintenance costs are in existing biogas plants in the range of 40-55 €/MWh of produced electricity.

Project profitability
Profitability of the agricultural biogas plants at current price is just over zero due to the increase of the corn silage prices. Besides, for the new power plants farmers expect a payment for using their manure in case of manure collection in nearby farms. CHP plant on landfill sites or sewage gas in very good (return period from 6 years) Current electricity price for biogas plants using manure and other biomass is 12.09 c€/kWh and premium is 8.33. For CHP plants on landfill site or waste water treatment plants is for plants up to 1 MW 5.32 c€/kWh and for over 1 MW 4.95c€/kWh.

Fact is also, that Heat consumption is not covered in total. Normally, excess heat is partly used for heating own object and the rest is released into the air.

In spite of raising interest for biogas plant building in Slovenia there is still a considerable lack (or it is not widespread enough) of knowledge about factors that influence the process of biogas production. The same is true also for the economical part of biogas plants and with environmental-veterinary-sanitary regulation on treating of input and output substances of the biogas process. One needs to understand that it is extremely difficult to provide the kind of the general cost estimates for the investment or for the operating cost. Therefore, the detail

planning of the process, the costs and revenues estimation with all due respect to the local circumstances is a must before the final decision about the project realization is made. (ApE, 2008).

4. BIOGAS VALORISATION (COUNTRY LEVEL)

4.1. Overview on Current Status of Biogas Valorisation

Produced biogas from anaerobic fermentation is being used mostly in systems for combined heat and power production (CHP). Produced heat in boilers or in CHP plants is useful in first line to warm-up digester on desired temperature, excess of heat can be used for other purposes. Biogas is being used mostly for production of electrical energy in CHP plants. Used are mainly gas engines, which are adapted to characteristics of biogas.

Currently, in Slovenia biogas is namely produced on agricultural biogas plants, landfills and by entities related to agriculture sector, mostly pigs and cattle farms. Agricultural biogas and landfill gas are used mainly for combined heat and power production. There are no biomethane or any biogas upgrading plants under construction.

4.2. Electricity Production

Most electricity in Slovenia is produced in nuclear power, while the dual ownership (half of Slovenia, half of Croatia), half the power belongs to Croatia. If this is taken into account, it is considered that in 2008 more than electricity produced from solid fuels (lignite and brown coal) 32%, followed by renewable energy sources 26%, nuclear 19.5%, and gaseous fuels 3%.

Buildings on three voltage levels are making Slovenian high voltage transmission network: 400 kV, 220 kV and 110 kV. Length of high voltage transmission network is presented in Table 4-1.

Table 4-1: Length of high voltage transmission network in Slovenia. (ELES, 2010)

Voltage level (kV)	Length (Km)
110	1736
220	328
400	508

During in-country strategic tasks Elektro-Slovenia (of Eles), systemic operator of Slovene transmission system, a reinforcement of transmission network with intention is staying also within next year, that final clients of electrical energy will be never deprived at her delivery. At European integrations society supports construction of international power line connections from accepted 10-annual sketches of development of European energy networks, that they are allowing increased fluxes from east on west of continent. This goal pursue also prepared 10-annual plan of development of transmission electricity grid system of state like just completed investment to transverse transformer and activities over construction of important transmission power lines within state quickened. Figure 4-1 present Slovenian high voltage transmission network (ELES, 2010)

Fig 4-1. Slovenian high voltage transmission network. (ELES, 2010)

In Table 4-2 we can see that net production of electricity is increasing. Increasing of electricity has influence on Export of electricity – which also is increasing. Final consumption of electricity is decreasing. Slovenia export more electricity than import.

Table 4-2: Balance of production and consumption of electricity (GWh), Slovenia. (SORS, 2010)

	2007	2008	2009
Gross production-total	15,043	16,398	16,401
Net production-total	14,044	15,357	15,374
Import	6,140	6,218	6,156
Export	5,911	7,820	9,222
Losses in the network	867	809	886
Final consumption-total	13,405	12,945	11,422

Incorporation of producer of electric energy onto a distribution network is necessary to sell electric energy to network manager. Before incorporation of power plant onto the distribution network, the user of distribution network has to acquire the concordance for incorporation onto network from system operator of distribution network, which contains conditions for incorporation onto energy network. The procedure and conditions for acquiring concordance for incorporation onto distribution network are determined in Rule book on systematic operation of distribution network for electric energy and in General conditions for the supply and take away of electric energy from the electric energy distribution network. Producer of electric energy signs contract about 15 annual purchase from produced electrical energies at ensured purchase price with company Borzen.
Proportion of electrics generation from biogas in primary production in year 2007 was 11,9 ktoe. At most electric energy was produced from electric power plants on landfill gas (63 %),

5 % was from sewage plants and 32 % was produced from agriculture waste and corn silage (Figure 4-2) (EurObserv'ER 2008, Bioplin).

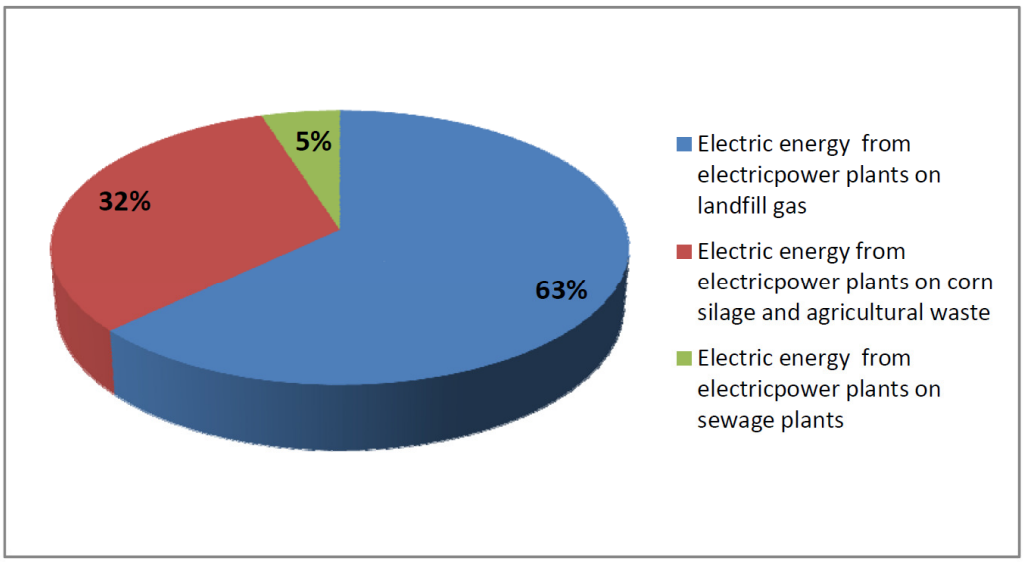

Fig. 4-2. Percentage of different power plants on biogas in Slovenia. (Biogas barometer 2008, EurObserver

4.3. Biogas to Biomethane

In Slovenia are no biomethane producing plants. There are no biomethane or any biogas upgrading plants under construction. Biomethane is also not used for transportation purposes.

Society Geoplin plinovodi d.o.o. is with provisions of European Gas guidelines and Slovenian Energy law systemic operator of transmission network of natural gas.

Data about gas pipeline network:

- Length 1014 Km,
- 197 Measuring-regulation station´s,
- 2 Compressor station´s (Kidričevo, Ajdovščina),
- Pressure within a gas pipeline 70 bar,
- Dispatcher centre with remote supervisions of network, uninterrupted supervision and administration of gas pipeline network.

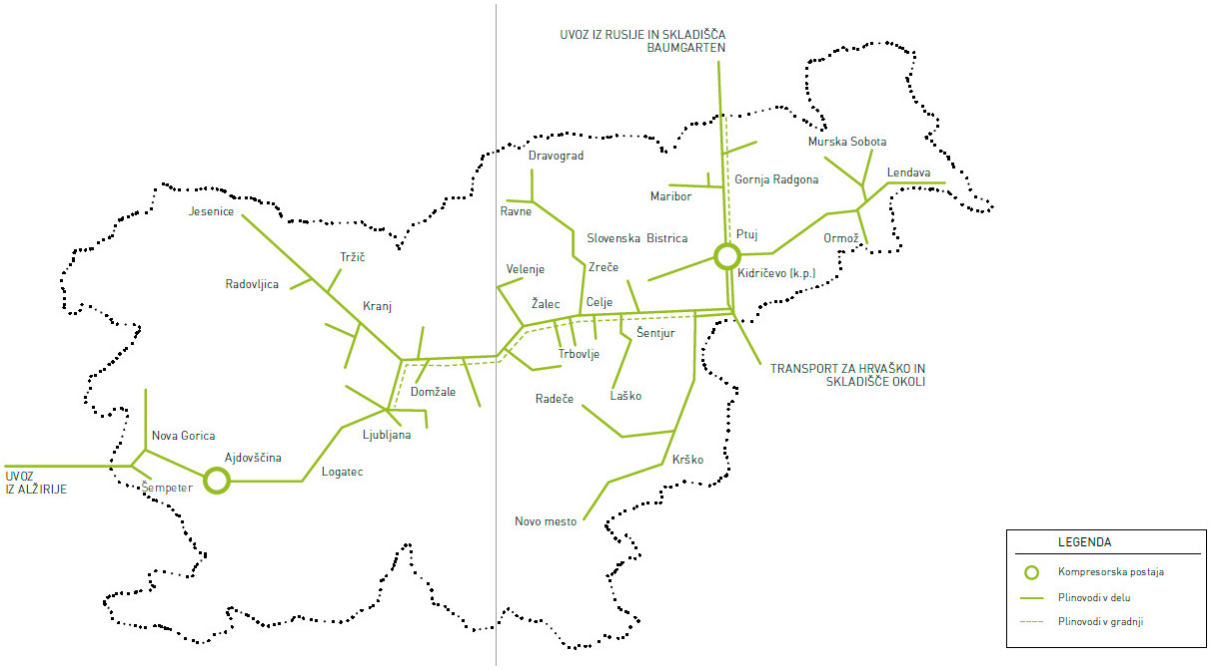

Fig 4-3. National gas pipeline system. (Geoplin, 2010)

National gas system is connected to the system in Austria (import of Russian gas), Italy (import of Algerian gas) and Croatia (transport to Croatia). Slovenia not export gas – look in Table 4-3.

Table 4-3: Balance of natural gas supply (mio. Sm^3), Slovenia. (SORS, 2010)

	2007	2008	2009
Production	3	3	3
Import	1,120	1,076	1,019
Consumption	1,123	1,079	1,022
Power plants	110	117	154
for electricity production	24	24	23
for heat production*	56	54	49

*Only fuel use for heat production for sale is included.

Standard for injection of biogas into the natural gas grid in Slovenia does not exist.

Quality of natural gas

The system operation instructions determine the quality of natural gas. The gas transmission operator transmits natural gas with the quality characteristics of the gas received at the entry point to the transmission network managed and operated by the system operator. The quality of the natural gas received at the entry points is monitored daily with the certificates of natural-gas quality. The natural-gas quality is established by the system operator of the neighbouring transmission network that provides, for the user of the transmission network, the transmission of natural gas to the entry point.

Each supplier supplying natural gas to the eligible customers connected to the transmission network is obliged to submit, on a daily basis, to the system operator, a specification of the composition of the gas delivered for transmission.

The transmission system operator is obliged to receive, for the purpose of transmission, only natural gas with the following characteristics:

a) Chemical composition (in mol percentage):

methane (C_1)	minimum	89.7 %
ethane (C_2)	maximum	6.3 %
propane, butane and heavier gases		
(C_3, C_4 +)	maximum	2.1 %
oxygen (O_2)	no	
nitrogen (N_2)	maximum	2.1 %
carbon dioxide (CO_2)	maximum	1.575 %

b) Sulphur composition:

hydrogen sulphide (H_2S)	maximum	6.3 mg/Sm^3
mercaptan	maximum	15.75 mg/Sm^3
total sulphur content	maximum	105.00 mg/Sm^3

c) Base calorific value:

minimum	33.650 kJ/Sm^3	(15°C)
maximum	36.630 kJ/ Sm^3	(15°C)

d) Dew point:

of water	not more than minus 7°C at a pressure of 39 bar
of hydrocarbons	not more than minus 5°C at a pressure of 39 to 69 bar

e) Temperature:

maximum	42°C

f) The gas should be without any mechanical matter, resin or compounds that can form resins.

Society Geoplin plinovodi d.o.o. as a systemic operator of transmission network of natural gas in Slovenia is obligatory accepted to transfer only natural gas with characteristics, that are listed in table and under conditions under which transmission pipeline system works. If characteristic of natural gas withdraw of listed, can in spite of demanding technological and preliminary treatment for covenant to replace natural gas with biogas only this causes problems like over execution of transfer, also at users of transmission network and final clients on their brass instruments.

Society Geoplin plinovodi d.o.o. thinks that possible use of biogas is above all on completed ranges for own use of a producer or for few direct clients of which dynamic and consumption is adapted to technology and dynamic of production.

4.4. Biogas as Vehicle Fuel

Biogas production in Slovenia is increasing. Beside landfill gas and sewage sludge gas production, recent trend is mainly upon central and farm scale biogas plants. However, biogas is used solely either for power production or, in last decade, combined heat and power production (CHP). Biogas is not used as vehicle fuel, there are no biogas upgrading plants, also due

to dispersed relatively small scale biogas production. Biogas is not predicted as a Vehicle Fuel in Slovenia – look table 4 in Annex.

Only few test vehicles to promote methane gas in Slovenia exist. None of those use biogas. Company Energetika Maribor d.o.o. has 1 CNG car Volkswagen Passat EcoFuel and Refuelling station VRA (Vehicle refuelling appliance) for filling of a vehicle on compressed natural gas (CNG), which stands before company. Refuelling station is assigned for own use, because filling lasts 4 to 5 hours. Filling of a car lasts 4 to 5 hours - too long. Filling should last max. 5 to 7 minutes – so long we need now to fill average tank with fuel.

5. BIOGAS IN REGIONS

5.1. Natural Resources and Potentials

More than 60 % of agricultural potential for production of biogas in Slovenia is in regions Pomurje and Podravje followed by regions Osrednjeslovenska, Savinjska, Gorenjska and Spodnjeposavska. Least potential is in regions Zasavje, Koroška, Karst. Highest potentials for biogas production have Pomurje and Podravje regions. On Relief of Slovenia we can see that most of arable land is in these two regions (Figure 5-1). For location of regions please take a look at Annex; Figure 1.

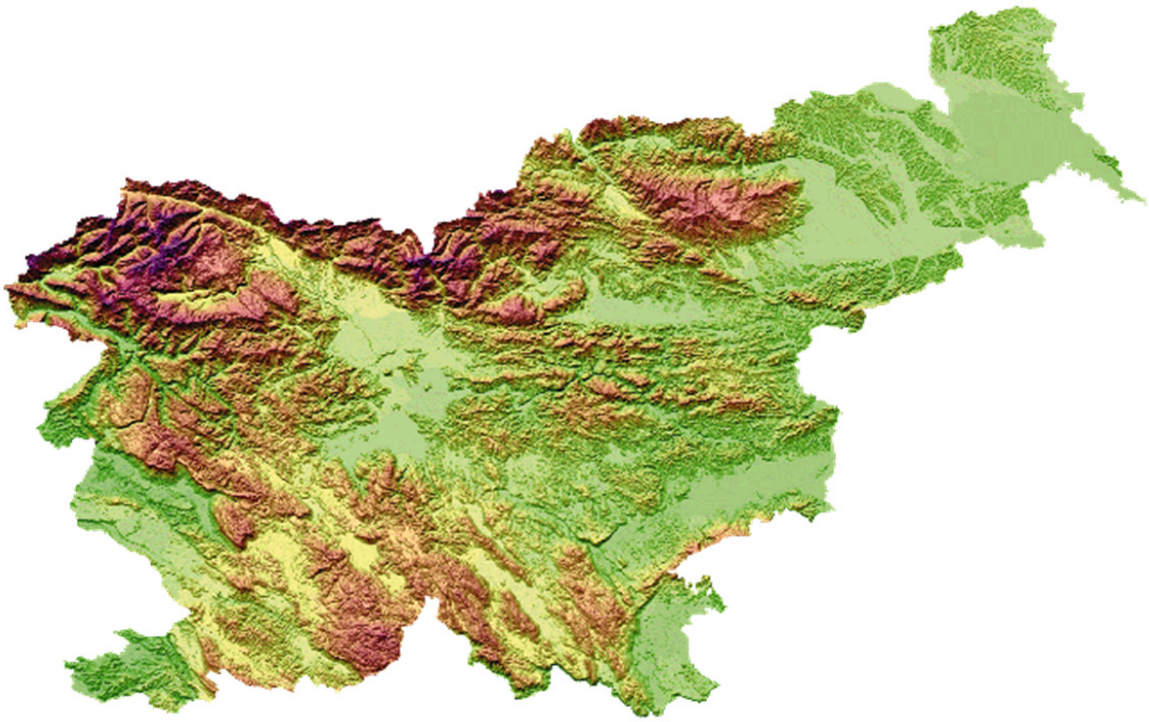

Figure 5-1: Relief of Slovenia. (AMGI)

Largest potential of animal manure in Slovenia presents cow slurry and stable manure followed by pig slurry, manure from hens layer, manure from chickens and turkeys. (Delo, 2010)

Organic kitchen waste

The management of such waste is determined in the Decree on the management of organic/biodegradable kitchen waste (Official Gazette of the Republic of Slovenia, No. 68/08).

Since the implementation of the regulation governing organic kitchen waste, collected quantities from both households and food service activities have been growing. In 2007, 11,405 tonnes were collected from households and 13,956 tonnes from food service activities. The collected quantities more than doubled in comparison to 2004, when the new system of collection was set up.

Prior to the implementation of the regulation, the majority of organic kitchen waste was deposited on landfills. However, the purpose of the regulation is not only to separate as much organic kitchen waste as possible from other municipal waste and to provide for their recovery, but also to prevent the entry of animal by-products into the food chain. The Decree therefore specifies the methods of further management and treatment of this waste in order to prevent spreading of possible infections and diseases.

Data on the relevant waste management fluctuate from year to year. According to official EARS data composting of organic kitchen waste was carried out on a very small scale in 2006. The EARS also has no information on any recovery of organic kitchen waste in a biogas facility carried out in 2006. Comparison of data on generated and/or collected organic kitchen waste and data on further management of such waste shows that regulations regarding annual reporting obligation have not been observed. Furthermore, there is a notable discrepancy between the quantity of landfilled organic kitchen waste reported by landfill operators and the quantity of deposited organic kitchen waste reported by municipal waste collection and removal services. In short, the indicator reveals inadequate/unsatisfactory reporting on recovery and other handling of organic kitchen waste in 2006.

In 2007, waste treatment was provided for 19,181 tonnes out of 25,361 tonnes of generated organic kitchen waste. Slightly less than half of it was exported, 2,912 tonnes of such waste were composted, and 2,799 tonnes recycled in biogas plant and for 4,609 tonnes other recovery methods were provided in 2007. Figure 5-1 presents organic kitchen waste management. (Waste Management Database, EARS, 2009)

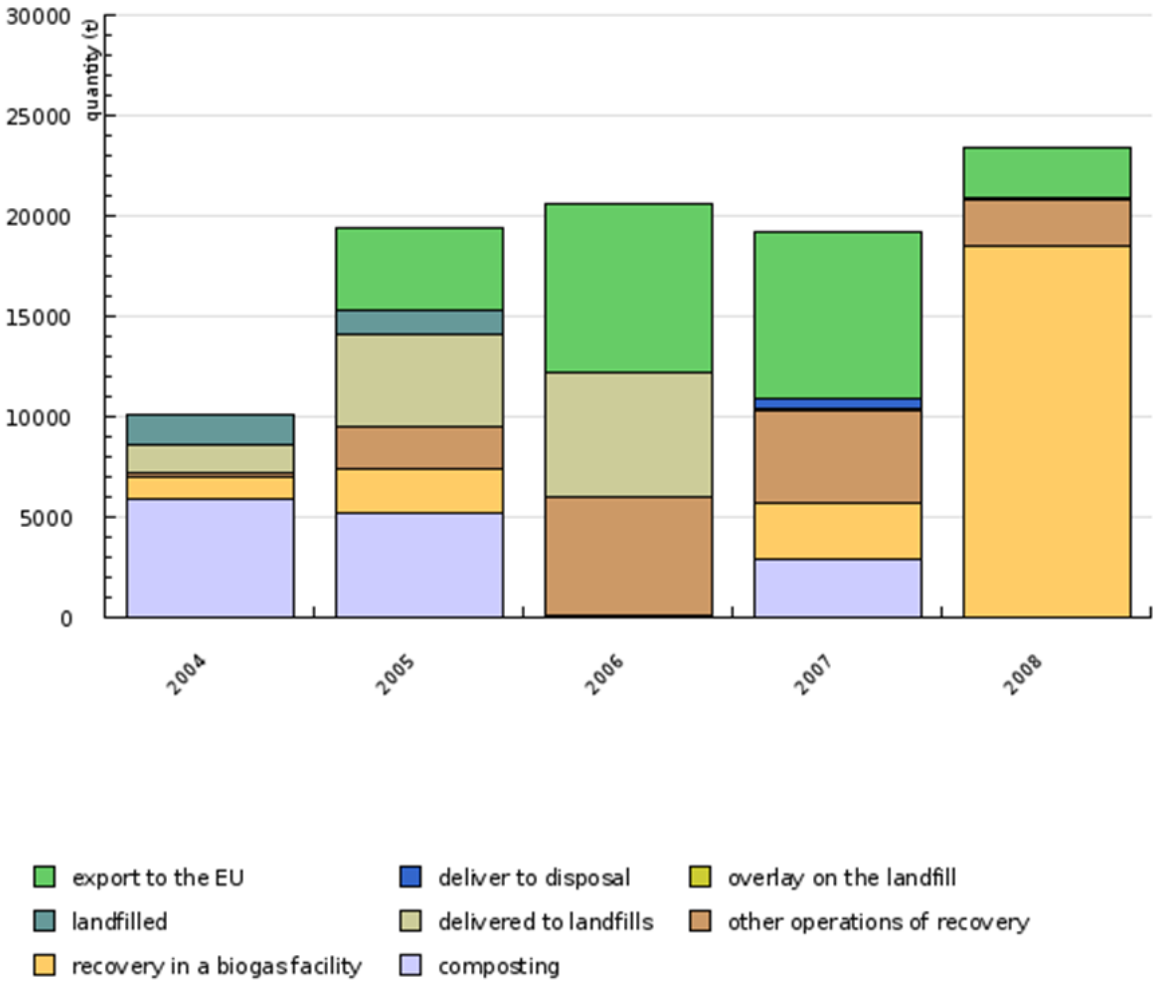

Figure 5-2: Organic kitchen waste management (EARS).

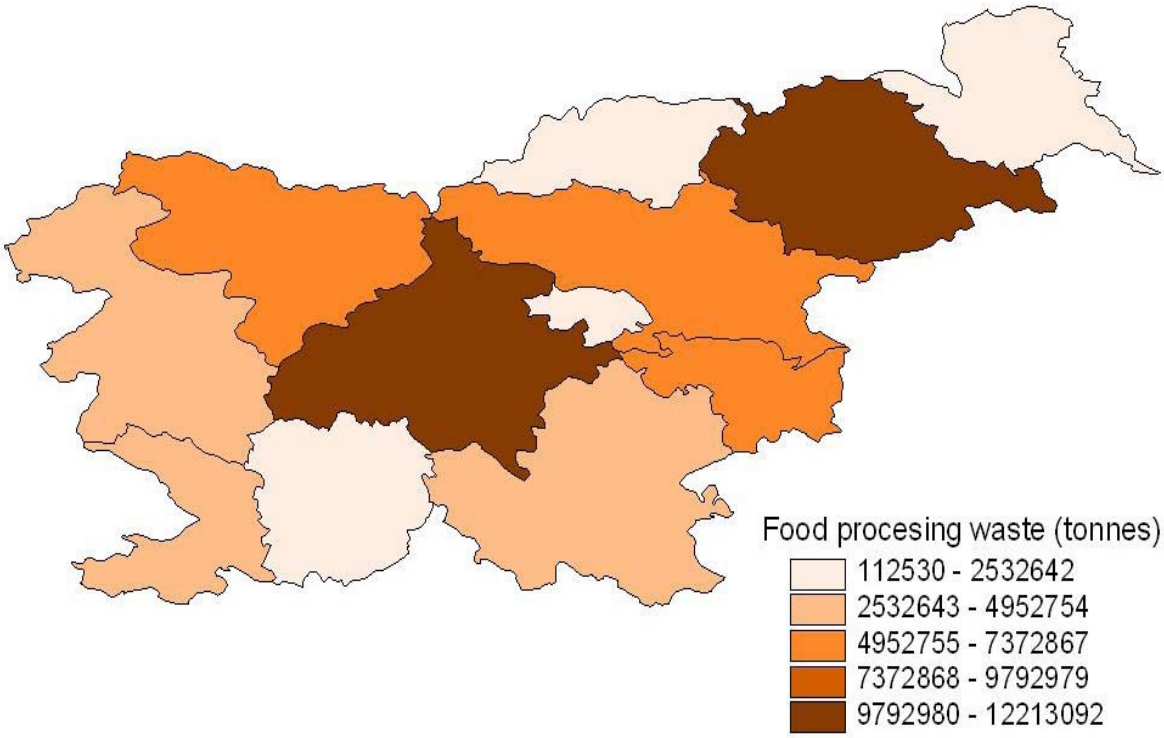

Figure 5-3: Distribution of food processing waste.(BigEast, 2009)

Organic solid municipal waste

In case, that we consider entire population and number of tourists, we can determine largest amount of solid organic municipal waste, that for central Slovene region amounts to 350.000 tons per year. Other Slovene region have also potential for ensuring of solid urban waste.

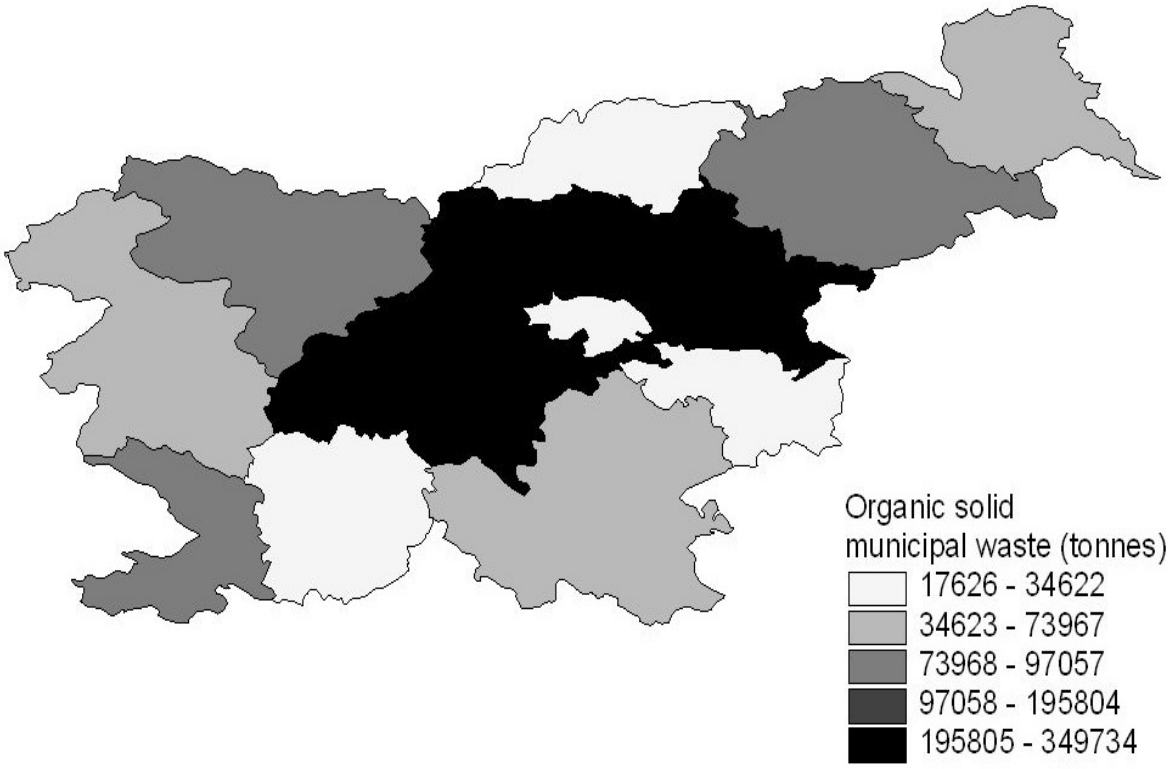

Figure 5-4: Distribution of organic waste in Slovenia. (BigEast, 2009)

Sewage sludge

Sludge from wastewater treatment plants is defined as waste material that is a by-product of wastewater purification in wastewater treatment plants or remains after emptying domestic wastewater cesspools.

Sludge is generated in wastewater treatment plants. In the past years, more than half of it was disposed of at non-hazardous waste landfills; however, since 15 July 2009 untreated sludge from urban waste water treatment plants may no longer be deposited in landfills.

The sludge contains 40-50% of organic substances and its decomposition contributes to the release of greenhouse gasses. Professional opinions regarding recovery and further use of sludge from waste water treatment plants are split. Sludge from wastewater treatment plants is rich in organic substances, and hence, some experts advocate its deposition on agricultural land. However, the sludge produced in combined wastewater treatment plants in urban and industrial areas can contain hazardous substances. Owing to their volume and characteristics, these substances can have a negative effect on agricultural areas or the quality of groundwater. Therefore, sludge must undergo biological, thermal or chemical treatment or long-term storage, or any other appropriate treatment before it is used on agricultural areas in order to reduce its fermentability and the health hazards resulting from its use.

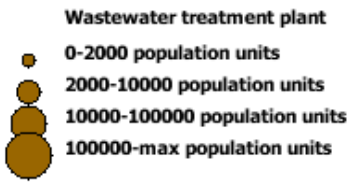

Figure 5-5: Location of waste water treatment plants. (EARS, Atlas of environment)

Pedological maps and laboratory research by the Agricultural Institute of Slovenia show that, so far, the soil in Slovenia is in general rich in organic substances (on 86.2% of agricultural land above 2%, and on 30.9% of land above 4%). Such relatively favorable situation derives from the fact that grassland prevails in the structure of agricultural land and that rather large quantities of manure are used on arable land and permanent crops.

The Operational Programme of environmental and transport infrastructure development 2007–2013 states that, for the time being, all our wastewater treatment plants neither have any special facility for sludge disposal, nor do they, at their present quality level, meet the requirements for depositing into land; as considering the fact that large portions of land in Slovenia are declared as either water protection zones or Natura 2000 area, or special protection area (SPA), management of sludge from waste water treatment plants is a crucial issue. The Operational Programme of discharge and treatment of urban wastewater and rainwater provides that se sewage sludge shall be incinerated, if sewage sludge cannot be safely deposited into land. Priority for the incineration of sewage sludge is given to urban areas with no other possibilities of sludge recovery. Construction of one or two facilities for waste-to-energy treatment or incineration of the remaining waste and sewage sludge has been envisaged.

According to the Environmental Agency of the Republic of Slovenia, Slovenia generated 19,800 tonnes of sewage sludge (dry substance) from urban and combined waste water treatment plants in 2008. About 8 thousand tonnes were deposited on landfills for non-hazardous waste, about 7 thousand tonnes were incinerated, slightly over 2 thousand tonnes were composted, and about 3 thousand tonnes were exported for artificially prepared soils and other recovery procedures. Use in agriculture has not been recorded since 2006. Figure 5-2 presents management of sludge from the waste treatment.

Biologically recover of sludge at appropriate plants, especially at regional waste management centers, and particularly those types of sludge that are less contaminated with heavy metals or not at all. To ensure sufficient facilities for thermal treatment of waste, where up to 70,000 tonnes of sludge from wastewater plants drained to 30% of dry matter can be recovered. (Waste Water Treatment Plants Database, EARS, 2009)

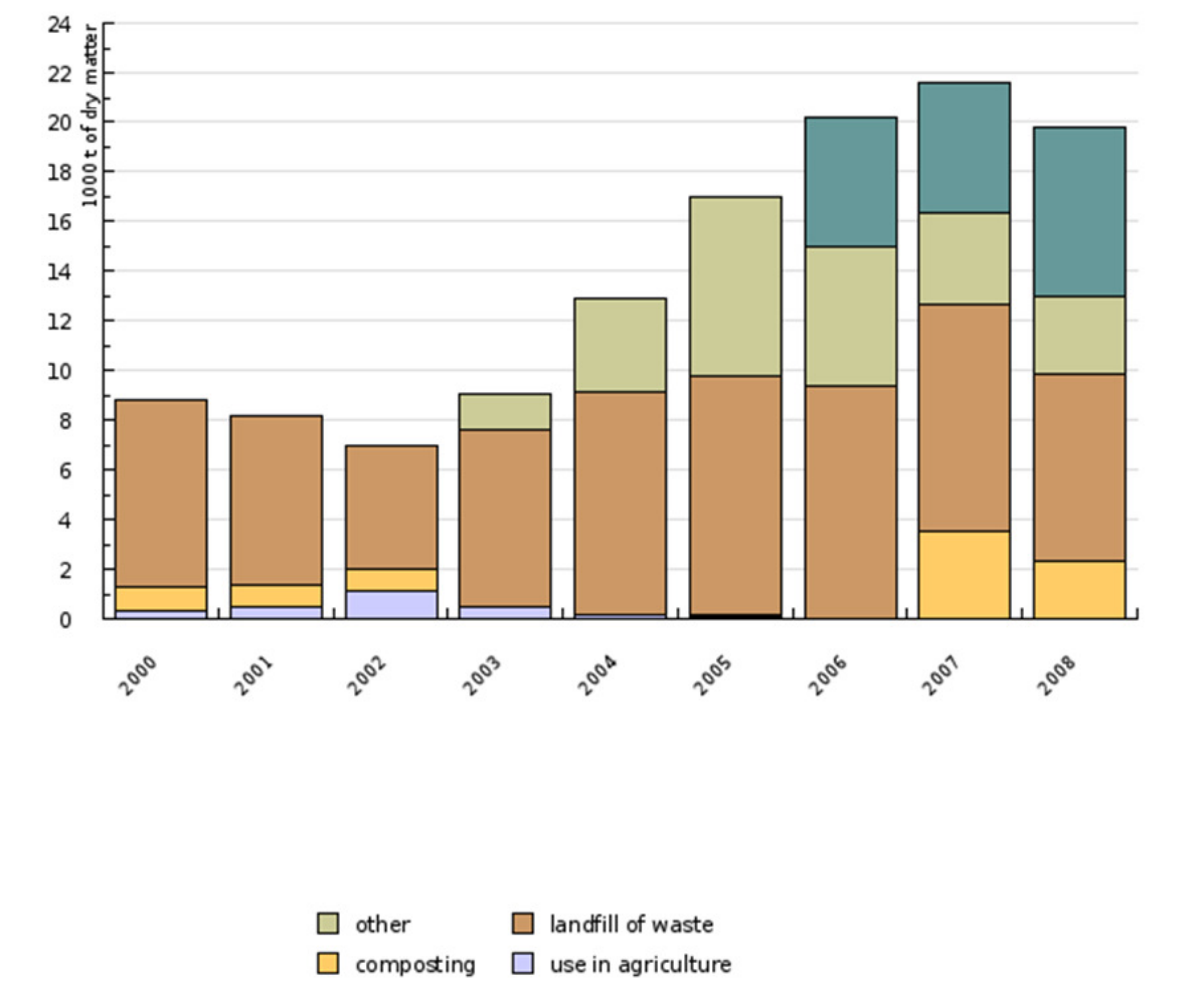

Figure 5-6: Management of sludge from the waste treatment (EARS).

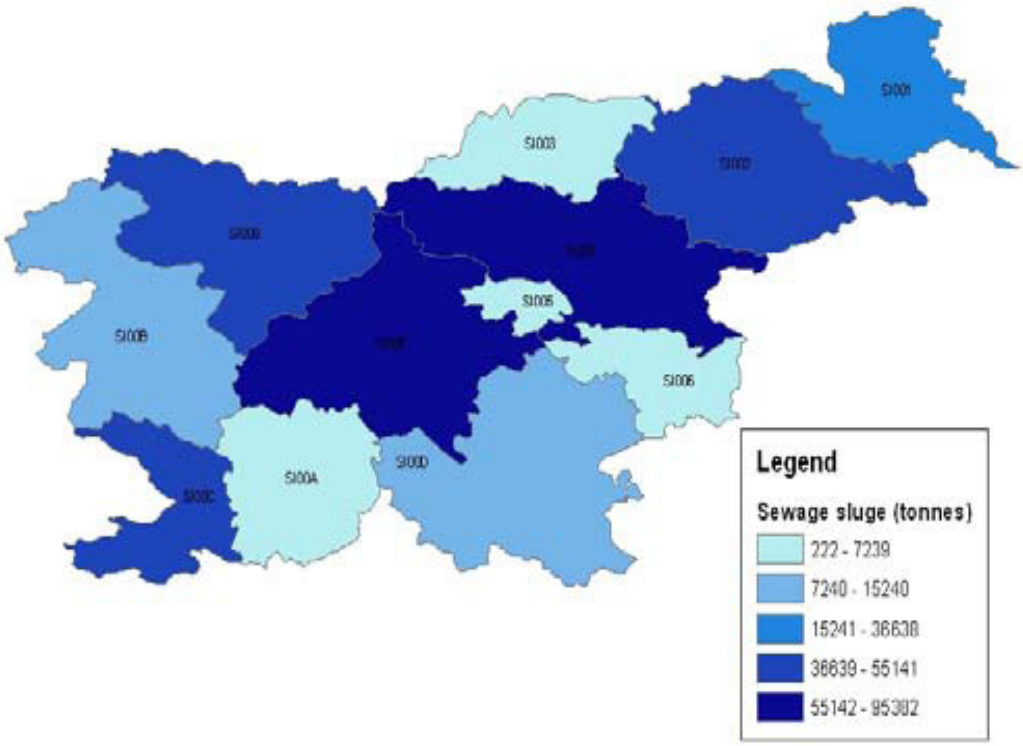

Figure 5-7: Distribution of Sewage sludge by regions. (BigEast, 2009)

Waste edible oils and fats

The management of waste edible oils and fats (hereinafter: waste edible oils) generated by kitchens in the perform of their food business and in households, is regulated by the Decree on the management of waste edible oils and fats (Official Gazette of the Republic of Slovenia, No. 70/08). Among other provision, the Decree stipulate that waste edible oils may not be mixed with other types of waste, released into the municipal sewer system, into small municipal treatment plants, cesspits (septic tanks) or directly into water, nor can they be discharged into or onto land.

According to the Environmental Agency of the Republic of Slovenia, the quantity of generated and collected waste edible oils is slightly increasing. The quantities collected by registered collectors and quantities collected within the performance of public service for collection and removal of municipal waste both contributed to this increase. In 2007, 2,035 tonnes of such waste was generated, and 1,955 tonnes were collected.

The prevailing management mode is export to EU Member States for recycling into biodiesel. To that end, 1,310 tonnes of this waste were exported in 2007, and other methods of recovery were provided for 383 tonnes. To date, there is no industrial biodiesel production from waste edible oils in Slovenia. The production of biodiesel on the industrial level requires an environmental protection permit as stipulated in the Decree on activities and installations causing large-scale environmental pollution (Official Gazette of the Republic of Slovenia, Nos. 97/04, 71/07 and 122/07). (Waste Water Treatment Plants Database, EARS, 2009)

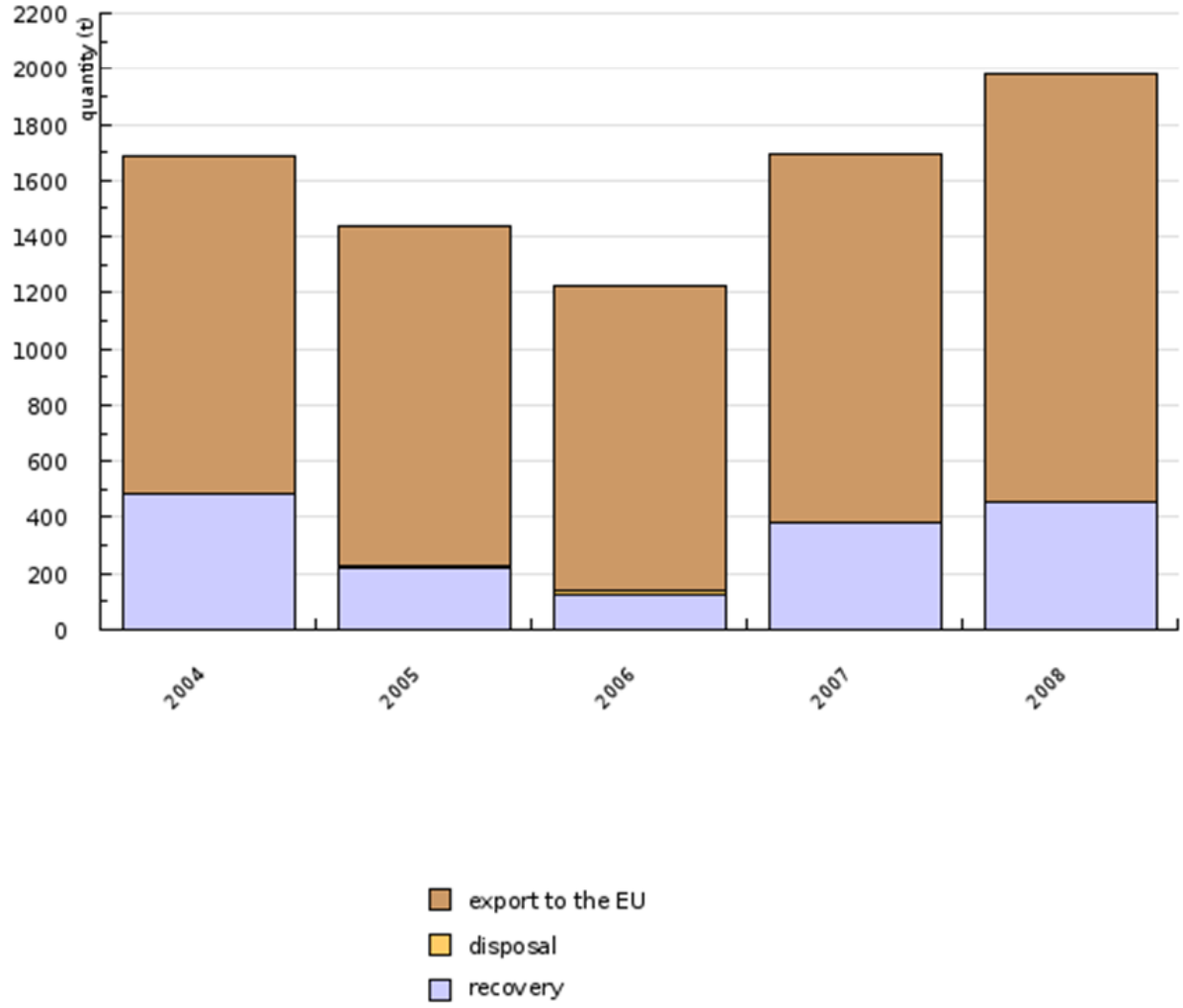

Figure 5-8: Edible oil waste and fats management (EARS).

Municipal waste

Economic growth brings about increased use of natural resources and, consequently, larger quantities of waste are generated. This is particularly evident in households which have in recent years generated growing quantities of waste due to developed consumption and higher purchasing power of the population.

In Slovenia, municipal waste management is the responsibility of local communities; the majority of activities is now performed at intermunicipal level, and will be executed at regional level in the near future. All issues of waste management need to be resolved within the capacities of regional centres.

According to the Environmental Agency of the Republic of Slovenia, about 430 kg of municipal waste is generated per capita annually in Slovenia. According to the Statistical Office of the Republic of Slovenia for the years 1995 and 1998, the numbers were somewhat higher (515 and 523 kg per capita per year). However, the methodology for collecting data on waste

generated was slightly different, so it would be difficult to conclude that the quantity of waste generated had fallen. According to the 2002 data, 411 kg of municipal waste per capita was generated in Slovenia.

In the period 2003-2007, the quantity of collected municipal waste increased from 402 kg to 437 kg per capita. In 2008, 922,829 tonnes of waste were generated and the quantity increased to 453 kg per capita. In the period 2003-2008, the quantity of collected municipal waste increased by 17 % in Slovenia.

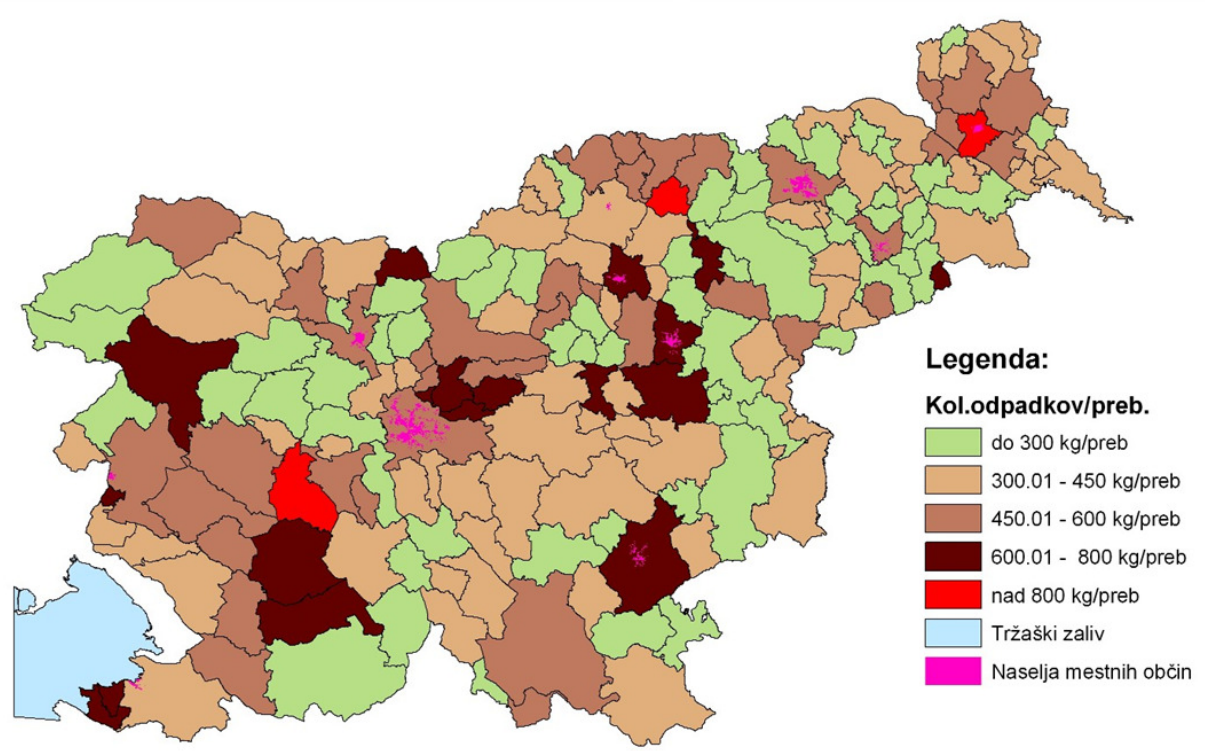

Figure *5-9: Generation of municipal waste. Amount is in kg per capita. (EIONET)*

With regard to municipal waste management, disposal still prevails. In 2008, 71% (800 thousand tonnes) of waste were deposited. Compared to 2002, it is an increase of 30% in municipal waste disposal. In 2008, 29 % of municipal waste (360 thousand tonnes) were recycled, which actually is by 44-times more than in 2002, but the share of recycling remains too small in comparison to waste disposal.

In view of the amendments in the legislation, the establishment of regional waste management centres, taxes and financial guarantees provided for landfill operators, the deposited quantities of waste are expected to decrease.

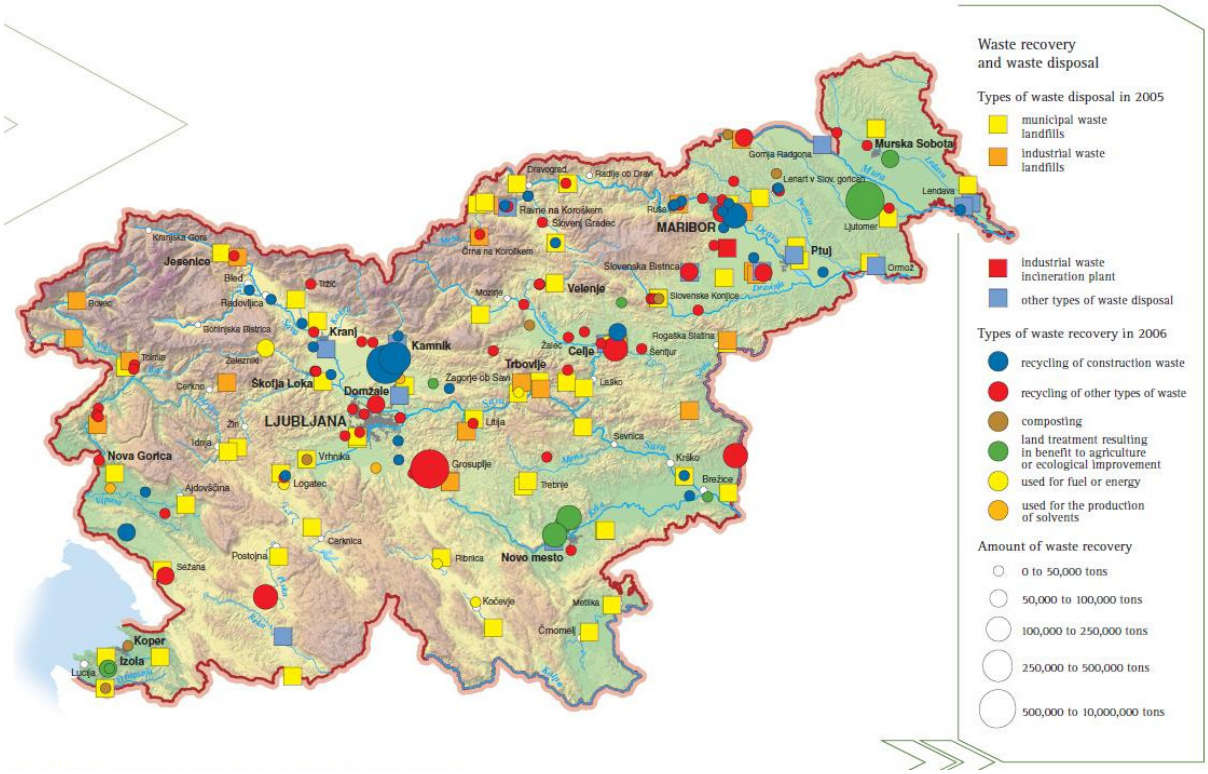

Figure 5-10: Generation and collection of waste. (EARS)

5.2. Regional Distribution of Biogas Plants

In Figure 5-4 locations of biogas plants in operation in Slovenia have been presented.

Figure 5-11: Biogas plants in Slovenia. (KIS, 2010)

Biogas plants:

1. Biogas plant in Dobrovnik (Gjerkeš, s.p.) – power: 1 MW.
2. Biogas plant Lendava – ECOS, d.o.o. (Pavlinjek) – power: 4.2 MW.
3. Biogas plant Kolar 1 – Logarovci (Kolar, s.p.) – power: 1 MW.
4. Biogas plant Kolar 2 – Ginjevec (Kolar, s.p.) – power: 1 MW.
5. Biogas plant Bioterm, d.o.o. (Anton Flere) – power: 0.272 MW.
6. Biogas plant Nemščak – Panvita Ekotech, d.o.o. –power: 1.46 MW.
7. Biogas plant Motvarjevci – Panvita Ekotech, d.o.o. – power: 0.839 MW.
8. Biogas plant farm Ihan (FI-EKO, d.o.o.) – power: 0.526 MW.
9. Biogas plant in Zgornje Pirniče (Petač, s.p.) – power: 1 MW
10. Biogas plant Črnomelj – BIOENERG, d.o.o. – power: 1.36 MW.
11. Biogas plant in Sobetinci – Vargazon, s.p. – power: 1 MW.
12. Biogas plant Ilirska Bistrica – BIO FUTURA, d.o.o. – power: 1.1 MW

There are some biogas plants in planning or under construction:

1. Biogas plant in Sobetinci – Vargazon, s.p. – power: 3.6 MW.
2. Biogas plant in Dobrovnik – Gjerkeš, s.p. – power: 2.4 MW.
3. Biogas plant in Ormož – Šijanec, s.p. – power: 1.2 MW.

4. Biogas plant in Dolič pri Destrniku – Arnuš – power: 1.2 MW.
5. Biogas plant in Središče ob Dravi – Jurša, s.p. – power: 1.2 MW.
6. Biogas plant in Markovci – Tadič – power: 1.2 MW.
7. Biogas plant in Noršinci – Cigut – power: 1.2 MW.
8. Biogas plant in Vučja vas – Keter Organica – power: 3.6 MW.
9. Biogas plant in Lešje pri Majšpergu – Tacinger – power: 2.4 MW.
10. Biogas plant in Nova vas pri Ptuju – Lacko – power: 1.2 MW.
11. Biogas plant Rückert NatUrgas® Perutnina Ptuj – power: 1MW.

5.3. Model Region(s)

Slovenia has no Model Regions.

6. LESSONS LEARNT FROM FAILED PROJECTS

One bad experience is in one village where potential investor is still planning to build bigger 1.5 MW biogas plants in the center of this village. Although, the new location is on old farm it is located in the city center and people are strongly against building huge digesters and having lots of trucks driving the input into the plants. This is an example where biogas plant should be located in the margin of the village. It is also a problem in the size of the biogas plant. Smaller, located in farms bled in with the existing infrastructure and in this cases local people is satisfied with the solution for bad small.

7. SPECIFIC ASPECTS

7.1. Country Characteristics

After Slovenia joined the European Union a lot has changed on biogas production in the country. Import of the technology, equipment and materials is a simple task now. (However, also export of raw material, this fact has to be taken into account as already plays an important role on biogas market!) Because of the (EU) regulation on the waste, food production and environmental protection also the number and quantity of substrates is raising considerably. In the last years we are facing a rapid development of the biogas plants, which allow for more efficient biogas production and the raising price of fossil fuels is only another supporting factor for increased use.

7.2. Summary of Positive Aspects

Five biogas plants in Slovenia are result of Keter Organica (development and knowledge). In Keter Organica they developed, with the knowledge of their researchers, the technology, engineering, computer control system, correct biological process and composition of biogas plants. They have designed and construct biogas plant on key, taking into account the needs of investors. Up to now they have built mostly 1 MW power biogas plants. In year 2010 they developed biogas plant called Mini Organica, which is suitable for smaller farmers ant it has power to 50 kW. It cost approximately 420 thousand euro and it is suitable for farmers with ten hectares of cultivable land and 30 head of cattle. In Keter Organica they also provide the necessary documentation, including studies and approvals and building permission before starting the investments.

Together with the former adviser to United Nations for fermentation Alexander Nizamov they are developing technologically advanced device for simultaneous production of biogas and bioethanol, where they will be use all redundant heat from combustion of biogas.
With disclosure of latest plans, the company Keter Organica managed to classify Slovenia in the world's top innovations for obtaining alternative energy. Biogas plant Keter Organica in village Ginjevec in the northeast of Slovenia will be the first in the world, where it will be possible with biogas plant upgrading to use excess heat for bioethanol production.

At the moment they have the biggest investment in Vučja vas, it is worth 11 million euro. There they are building the second largest institute in Europe for the development in field of biogas, which will include renewable energy research centre and the most powerful, 3.6 MW biogas plant Organica, which will be upgraded for bioethanol production. At the institute they will be introduce a new plants, which could be with rapid growth replaced the current plants, such as corn. (Keter Organica)

7.3. Summary of Negative Aspects

Biogas plants that would use only manure and slurry from animal farms are practically not built anymore. Agricultural, food processing and catering industry products and byproducts are used as a feedstock or co-substrates. For treating various types of waste various regimes apply, which need to be taken into account seriously.

Communities often are not supportive of the use of innovative technologies because they are unwilling to assume risks associated with testing and use of these schemes in their neighborhoods. Strengthening of social acceptance (sensitization, information, participation, etc.) is needed.

8. REFERENCES

/1/ AKTRP - Agency for Agricultural Markets and rural Development. http://www.arsktrp.gov.si/en/; accessed 1.2.2011.
/2/ Anton Melik Geographical Institute, Scientific research Centre of the Slovenian Academy of Sciences and arts, Ljubljana. http://www.zrc-sazu.si/moa/karte__.htm; accessed 3. 2. 2011.
/3/ ApE. 2008. Project:BiG>East, Barriers for biogas implementation in Slovenia. 13p.

/4/ BigEast. 2009. Estimation of the potential feedstock availability for biogas production in Eastern Europe. 55 p. http://www.big-east.eu/slovenia/slovenia.html; accessed 3. 2. 2011
/5/ Borzen – Slovenian Power Market Operator. http://www.borzen.si/eng/; accessed 1.2.2011.
/6/ Delo. 2010. Največ potenciala za proizvodnjo bioplina v Pomurju in Podravju. http://www.delo.si/clanek/126421; accessed 3.1.2011.
/7/ Environmental Agency of the Republic of Slovenia. 2009. Waste Management Database. http://kazalci.arso.gov.si/?data=group&group_id=18&lang_id=94; accessed 2.2.2011.
/8/ Environmental Agency of the Republic of Slovenia. Atlas of environment. http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US; accessed 3. 2. 2011.
/9/ European Environment Information and Observation Network. Presentation of data on waste management in Slovenia. http://eionet-si.arso.gov.si/Dokumenti/GIS/odpadki/index_en_html; accessed 3. 2. 2011.
/10/ Hervardi. Statistical regions of Slovenia. http://www.hervardi.com/regije_v_republiki_sloveniji.php; accessed 3. 2. 2011.
/11/ http://www.eles.si/en/index.aspx; accessed 20.1.2011.
/12/ http://www.eurobserv-er.org/pdf/baro200b.pdf; accessed 20.1.2011; Biogas barometer, November 2010.
/13/ http://www.geoplin.si/eng/; accessed 20.1.2011.
/14/ http://www.kis.si/pls/kis/!kis.web?m=0&j=EN#nav; accessed 20.1.2011.
/15/ http://www.stat.si/eng/index.asp; accessed 24.12.2010.
/16/ http://www.umar.gov.si/fileadmin/user_upload/publikacije/izzivi/2010/aEI_2010.pdf; accessed 23.12.2010.
/17/ Keter Organica. http://www.keterorganica.com/; accessed 31. 1. 2011.
/18/ Kmetijski inštitut Slovenije (Agriculture institute of Slovenia). 2010. The report about state of agriculture and of forestry in year 2009. http://www.kis.si/pls/kis/!kis.web?m=36&j=SI#nav; accessed 31. 1. 2011.
/19/ Ministry of Economy. 2010. National action plan for renewable energy for period 2010-2020 http://www.mg.gov.si/fileadmin/mg.gov.si/pageuploads/Energetika/Porocila/AN_OVE_2010-2020_final.pdf; accessed 31. 1. 2011.
/20/ Vindiš P., 2010. Multi-criteria model for evaluation of energy crops for biogas production, Ph.D Thesis, University of Maribor. 139 p.

ANNEX: SUPPLEMENTARY FIGURES AND TABLES

Figure 1: Statistical regions of Slovenia. (Hervardi)

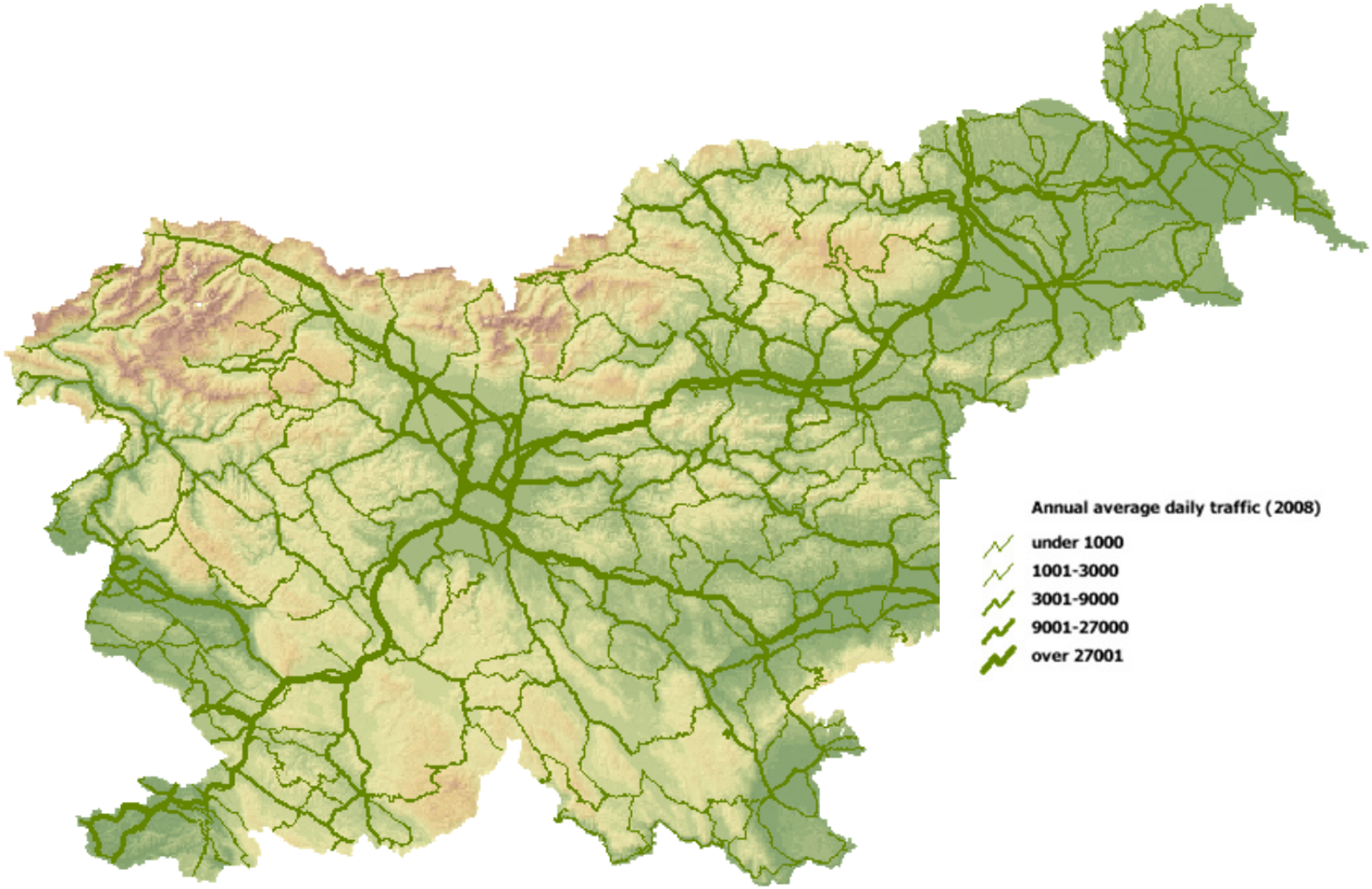

Figure 2: National road infrastructure and annual average daily traffic in year 2008. (EARS, Atlas of environment)

Table 1: Regional GDP, current prices, annually from 2004 to 2008. (SORS, 2010)

		SLOVENIA	Notranjsko-kraška	Obalno-kraška	Goriška	Gorenjska	Osrednjeslovenska	Pomurska
Structure (Slovenia=100%)	2004	100	2	5,4	5,7	8,5	35,6	4,2
	2005	100	1,9	5,4	5,8	8,5	35,7	4,1
	2006	100	1,9	5,4	5,7	8,4	36,1	4
	2007	100	1,9	5,5	5,7	8,4	36,1	3,9
	2008	100	1,9	5,6	5,6	8,3	36,1	3,9
Per capita,	2004	13599	10489	14055	13020	11635	19504	9240
EUR (current exchange rate)	2005	14369	10923	14625	13833	12258	20600	9594
	2006	15467	11571	15815	14902	13041	22322	10156
	2007	17123	12903	17807	16508	14497	24600	11160
	2008	18450	13672	19561	17696	15495	26118	11986
		SLOVENIA	**Jugovzhodna Slovenija**	**Spodnjeposavska**	**Zasavska**	**Savinjska**	**Koroška**	**Podravska**
Structure (Slovenia=100%)	2004	100	6,4	2,8	1,6	11,4	2,9	13,5
	2005	100	6,5	2,9	1,6	11,5	2,9	13,3
	2006	100	6,5	2,8	1,5	11,5	2,8	13,4
	2007	100	6,5	2,8	1,5	11,3	2,8	13,5
	2008	100	6,4	2,8	1,4	11,5	2,8	13,5
Per capita,	2004	13599	12476	10913	9610	12085	10534	11471
EUR (current exchange rate)	2005	14369	13316	11859	10016	12872	11305	12005
	2006	15467	14364	12492	10530	13752	11864	13020
	2007	17123	15938	13729	11326	15048	13175	14570
	2008	18450	17145	15207	12044	16555	14115	15745

Table 2: Changes in agricultural output in 2004 to 2009. (IMAD, 2010)

	Growth in production volume, in %						
	Structure in 2009,* in %	2004	2005	2006	2007	2008	2009
Crop production	52,0	46,7	-2,5	-12,6	3,9	-1,8	3,5
Of which: Cereals	5,2	42,7	-0,6	-13,7	8,8	8,0	-6,6
Industrial plants	2,4	17,3	16,0	-1,4	-29,1	-7,0	13,7
Fodder plants	16,0	49,8	11,2	-21,0	12,6	3,0	0,2
Vegetables and horticultural products	7,9	59,6	2,6	-12,2	-15,5	12,3	9,5
Potatoes	1,8	50,6	-16,1	-20,1	28,0	-20,2	6,2
Fruit	8,7	35,8	-16,8	1,5	1,2	-10,8	0,1
Wine	10,1	51,1	-20,1	-9,4	8,9	-11,9	10,9
Animal production	46,0	-3,3	-0,6	-2,0	4,3	-1,0	-6,2
Of which: Animals	28,1	-3,9	-1,7	-2,6	3,4	-1,4	-9,3
Cattle	12,3	-3,3	-2,3	-4,7	4,2	1,2	-11,5
Pigs	6,1	-2,9	-6,8	4,9	-6,4	-6,6	-20,2
Poultry	8,4	-6,9	4,1	-9,4	19,6	0,4	2,6
Animal products	17,9	-2,4	1,1	-1,1	5,6	-0,3	-1,9
Milk	14,1	-2,9	1,8	-2,5	3,8	-1,9	-1,7
Eggs	2,8	-9,3	-2,7	5,9	23,8	12,3	-0,4
Total agricultural goods output	98,1	19,5	-1,6	-7,5	4,1	-1,4	-1,2
Agricultural services	1,9	3,4	8,8	0,0	-14,0	4,8	-4,1
Total agricultural output	100,0	19,2	-1,5	-7,3	3,7	-1,3	-1,2

Source: SORS; calculations by IMAD. *Structure of the value of agricultural production at basic prices, which include subsidies on products.

Table 3: Export/Import volume in EUR/year from 2008 to 2010 (in 1000 EUR). (SORS, 2010)

	2008		2009		2010*	
	Export	Import	Export	Import	Export	Import
Germany	3744071	4318172	3166060	3136130	2630353	2639703
Italy	2394598	4159628	1862543	3027931	1655232	2545936
France	1292944	1176902	1360825	946877	1129393	780853
Austria	1555059	2830490	1251085	2243009	1100027	1747614
Croatia	1693907	834982	1240893	629882	906386	532267
United Kingdom	471384	333240	378077	219907	336852	189995
Czech Republic	486475	564037	388373	440826	323156	365326
Hungary	616049	896087	458786	646539	398992	562736

Poland	694726	410789	468418	359083	467006	299305
Slovakia	360725	309262	275378	238287	194189	223850
Spain	270016	602858	189766	464043	170181	326135
Belgium	201959	482978	178798	388048	151435	317058
Netherlands	343197	751318	254224	566953	267238	477637
Russia	799914	355890	519421	208047	404891	206775
US	276520	420953	209373	330640	197779	148213

*first 9 months.

Table 4: Predicted technologies of renewable energy sources in traffic from 2010 to 2020, Slovenia. (AN OVE, 2010)

(ktoe)	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Bioethanol/bio-ETBE	3,9	4,1	4,6	5,3	6,4	7,6	9,2	11,1	13,2	15,7	18,5
Biodiesel	36,6	38,8	43,3	50,2	59,6	71,6	86,3	103,8	124,2	147,4	173,7
Hydrogen from renewable sources	/	/	/	/	/	/	/	/	/	/	/
Renewable electrical energy	5,4	6,0	6,2	6,5	6,7	7,0	7,5	8,2	9,0	9,7	10,5
Road traffic	0,0	0,0	0,0	0,1	0,1	0,1	0,3	0,5	0,7	0,9	1,1
Non road traffic	5,4	6,0	6,2	6,4	6,6	6,8	7,2	7,8	8,3	8,8	9,4
Other (like biogas, vegetable oil, etc....)	/	/	/	/	/	/	/	/	/	/	/

Table 5: Area sawn, production and yield from 2005 to 2009. (SORS, 2010)

	Harvested area (ha)	*Production*		*Harvested area (ha)*	*Production*		*Harvested area (ha)*	*Production*	
		total (t)	*yield kg/ha*		*total (t)*	*yield kg/ha*		*total (t)*	*yield kg/ha*
	wheat and spelt			*rye*			*barley*		
2005	30059	141293	4701	1320	4092	3100	15451	61239	3963
2006	32083	134449	4191	766	2126	2775	17044	61623	3616
2007	32040	133339	4162	820	2509	3060	18532	67904	3664
2008	35413	160297	4527	714	2080	2913	19229	76788	3993
2009	34534	136904	3964	892	2318	2599	20089	70793	3524
	oats			*maize -grain*			*buck wheat - main crop*		
2005	2731	7629	2793	42369	351168	8288	222	242	1090
2006	2471	6285	2544	39839	276106	6931	360	376	1044
2007	2332	5547	2379	40906	308259	7536	351	360	1026
2008	1887	4987	2643	43698	319902	7321	323	395	1223
2009	1773	4260	2403	38611	302600	7837	403	458	1136
	buck wheat - secondary crop			*millet - main crop*			*millet - secondary crop*		
2005	589	1211	2056	306	456	1490	321	442	1377
2006	187	121	647	120	162	1350	48	123	2563
2007	458	401	876	113	130	1150	231	412	1784
2008	438	337	769	137	182	1328	110	133	1209
2009	641	535	835	84	90	1071	52	69	1327

	hops			*rapeseed*			*sugar beet*		
2005	1453	2501	1721	2260	5352	2368	5057	260095	51433
2006	1507	1916	1271	2809	4991	1777	6684	262031	39203
2007	1572	2157	1372	5358	14740	2751	-	-	-
2008	1638	2304	1407	4442	10949	2465	-	-	-
2009	1660	2669	1608	4424	9845	2225	-	-	-
	potatoes			*turnip - secondary crop*			*fodder beet and kohlrabi*[1)]		
2005	6306	144714	22949	661	12143	18371	1469	34997	23824
2006	5900	106974	18131	625	11463	18341	731	14335	19610
2007	5736	131050	22847	597	11187	18739	1045	20890	19990
2008	4427	100319	22661	503	9948	19777	858	18110	21107
2009	4175	103425	24772	493	9083	18424	897	18053	20126
	fodder carrot[1)]			*silage maize*			*grasses (including mixtures)*[1)]		
2005	119	1896	15933	30465	1447113	47501	12574	84522	6722
2006	84	1082	12881	26730	1045520	39114	12073	70474	5837
2007	62	739	11919	25972	1092365	42059	11292	73626	6520
2008	58	775	13362	25663	1106505	43117	11610	74771	6440
2009	75	1159	15453	24980	1148894	45993	11385	74251	6522
	grass-clover mixtures			*clover and alfalfa*			*permanent grassland*		
2005	9317	51894	5570	3070	23004	7493	304906	1712588	5617
2006	12615	82299	6524	2481	15763	6353	285000	1331879	4673
2007	13163	90950	6910	3090	21084	6823	297284	1525021	5130
2008	15358	111004	7228	3548	25441	7171	285973	1572064	5497
2009	16213	123383	7610	3624	26294	7256	267304	1538221	5755

[1)] *Main and secondary crop.*

Table 6: Persons in employment by most important activities, Slovenia, october. (SORS, 2010)

Activities	Persons in employment
Manufacturing*	188,432
Manufacture of fabricated metal products, except machinery and equipment**	29,914
Manufacture of electrical equipment**	18,817
Manufacture of machinery and equipment**	13,450
Wholesale and retail trade, repair of motor vehicles and motor-cycles*	111,189
Retail trade, except of motor vehicles and motorcycles	55,760
Wholesale trade, except of motor vehicles and motorcycles	40,502
Wholesale and retail trade and repair of motor vehicles and motorcy-cles	14,927
Construction*	77,128
Education*	64,361
Human health and social work activities*	53,576
Public administration and defence, compulsory social security*	52,038
Transportation and storage*	47,726
Professional, scientific and technical activities*	47,646
Agriculture, forestry and fishing*	33,305
Accommodation and food service activities*	32,859

*Total
**First three most important branches.