European Association for the Development of Renewable Energies, Environment and Power Quality (EA4EPQ)	International Conference on Renewable Energies and Power Quality (ICREPQ'11) Convention Centre, Las Palmas de Gran Canaria (Spain) from 13 to 15 of April, 2011

Agricultural By-products and Waste Biomass Energy Potential in Latvia 2005–2009

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Abstract

Different kinds of biomass are important renewable energy sources in Latvia. Of course firewood, wood chips and pellets are the main part of biomass, because 54,7 % of the state area is covered by forests. But also other kinds of biomass can play a significant role in the heat and electricity production, especially at municipal heating facilities. Such kinds of biomass are various agricultural and food production residues, livestock breeding buy-products, sewage sludge, organic part of household and industrial wastes, etc.

In the present paper, changes of amount and distribution of variety of biomass forms in five year period are analysed. The biomass energy potential for different regions of Latvia for this period is calculated and discussed. The energy potential of agricultural by-products and organic waste are shown on the map of Latvia.

Key words

Renewable energy, agricultural by-products, biomass, sewage sludge, municipal and industrial bio waste, energy potential.

Introduction

The investigations of the most prevalent types of biomass detected, that the content of carbon in biomass organic matter modifies from 40 to 70 % and that such biomass can be used for energy production. Content of hydrogen is not so variable, it is about 1.5 %. As biomass in the natural form has low energy density, it arises logistic problems with biomass transporting and using as an energy source. It means that local amount of biomass and its distribution plays significant role for biomass utilisation.

The present report contains evaluation of various agricultural and food production residues, livestock breeding by-products, sewage sludge, combustible (organic) part of household and industrial wastes, etc. and their estimation as energy source in different planning regions of Latvia during the period 2005–2009.

1. Agricultural residues and by-products

The evaluation of herbage biomass resources in Latvia demonstrates that total potential of such biomass according to the sown area and production in 2006 was 1228 th. tonnes of straw and 187.6 tonnes of grain dryers [1]. Part of special energetic crops here is small, and main part is wheat, ray, barley, oats and rape straw and different residues from grains treatment. Figure 1 shows distribution of the amount and energy potential of this type of biomass in Latvia. Presented distribution regions correspond to statistical and planning regions of the state. Energy potential is calculated for direct combustion technology, fuel calorific value estimated as 3500 kcal/kg for dry mass.

Figure 2 shows the same distribution of herbage biomass and its energy potential in 2009. Comparison shows, that both distribution and energy potential changed very slowly.

Figure 3 shows evaluated biomass potential during five years for this type of biomass and appropriate energy content. Differences between years are small and we can state that this type of biomass can be used as determinate renewable energy resource.

There is only question, what type of technology for energy production can be used. Different technologies has various advantages, but also disadvantages, and what technology in concrete case can be used, must be calculated from economic, logistic, infrastructure, social, local governmental and other aspects. One of simplest is direct combustion of such biomass separately or in mixture with wood in pellet form. Second more popular technology is fermentation and gas production.

It is possible in Latvia substantially to increase amount of herbage biomass by growing special energy crops.

2. Livestock breeding by-products

Figure 4 shows energy potential, which can be produced as fermentation result of animal manure, and other livestock breading by-products and residues, using different biogas production technologies [2]. While the dislocation of largest farms is fixed, the changes of distribution for such kind of biomass are slow, but changes of animal totality does not exceed 10÷15 % in 5 year period. Biogas production technologies are the best for energy production from animals and birds manure, together with different herbage silage.

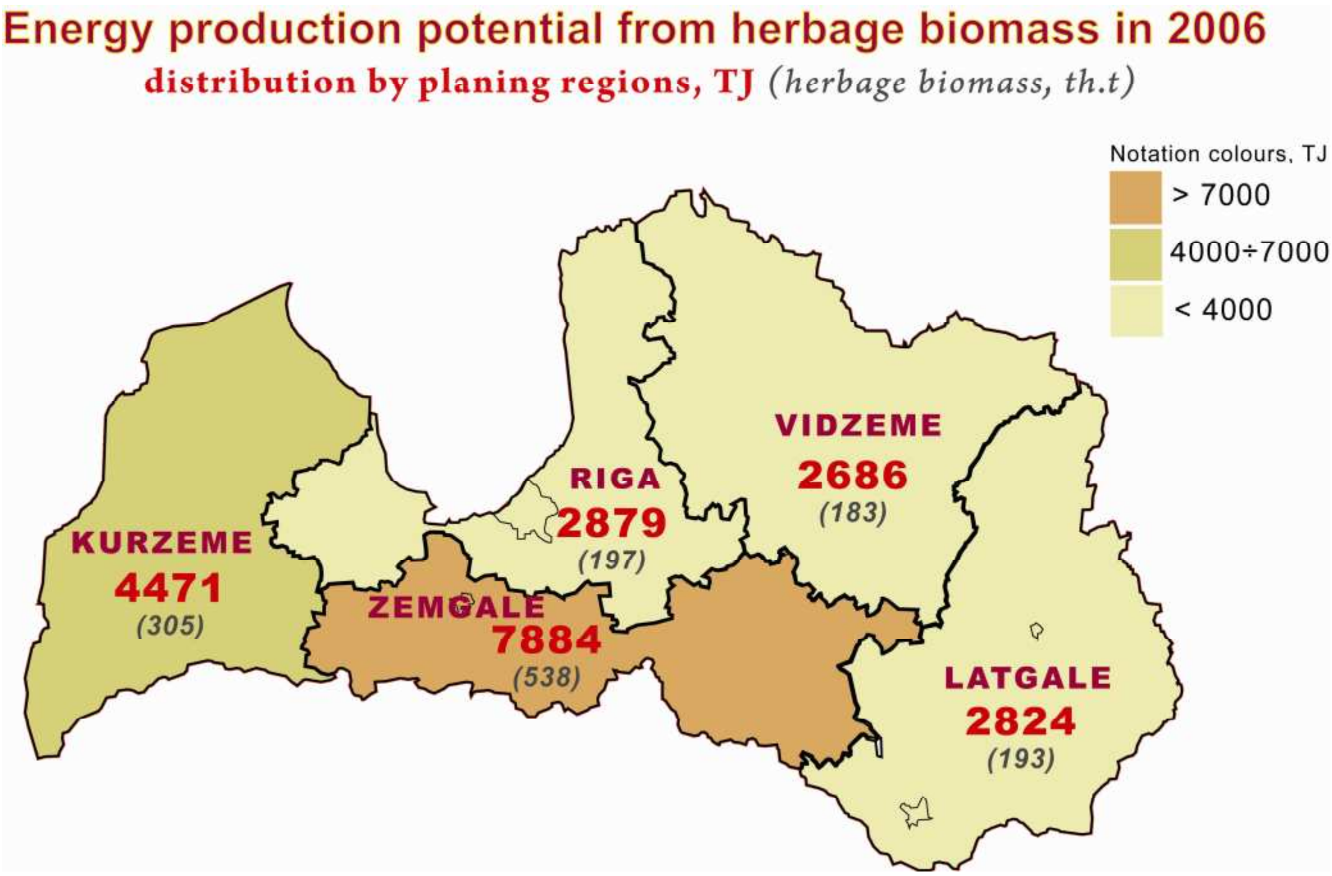

Fig.1. Energy production potential from herbage biomass in 2006.

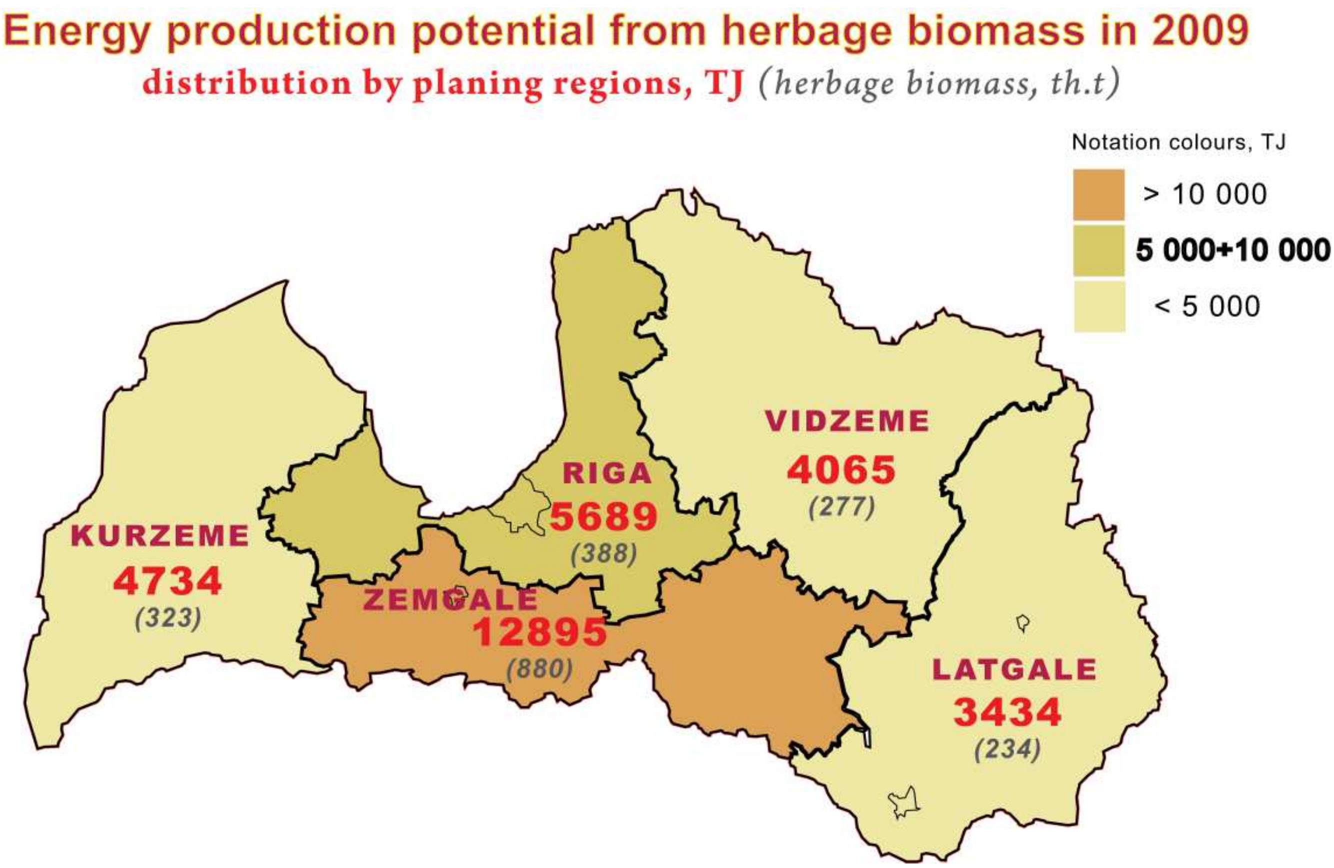

Fig.2. Energy production potential from herbage biomass in 2009.

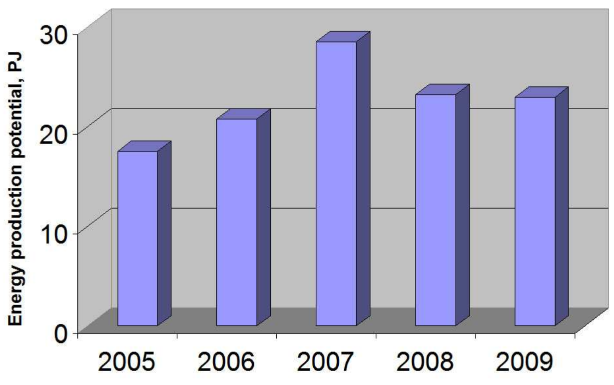

Fig.3. Energy production potential from herbage biomass.

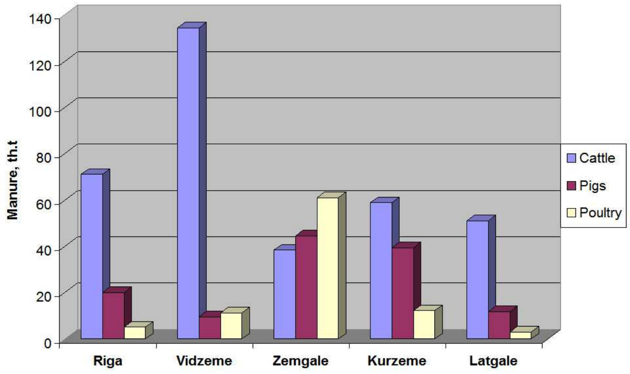

Fig.4. Animals and poultry manure biomass in statistical and planning regions of Latvia.

Fig.5. Distribution of animal and poultry manure common biomass in Latvia regions.

The distribution of such biomass common amount for statistical and planning regions of Latvia is shown on Latvia map — Figure 5.

First biogas plant in Latvia was built in Agriculture University Research farm Vecauce, which use cows manure and maize silage. It starts to produce biogas in year 2008. Today it works according as planed 260 kW electricity and 356 kW heat. Second biogas plant, which produce biogas from cows manure and maize silage started January 2010. It is foreseen power of about 0,8÷1MW electricity in this plant. It is planed, that in the nearest future 8 new agriculture biogas plants can start producing biogas.

Potential, which can be produced as fermentation result of animal manure, and other livestock breading by-products and residues is approximately 157 mill. m^3 per year — Figure 6.

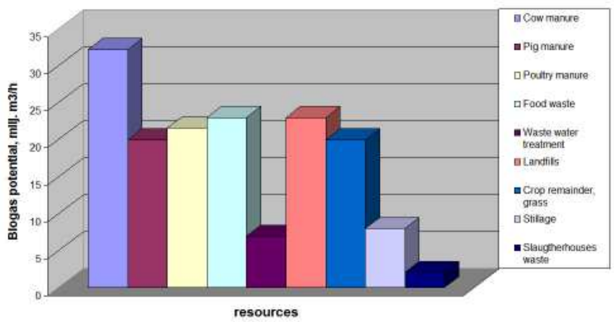

Fig.6. Biogas production potential in Latvia.

At this time there are only two working biogas plants in Latvia. Both of them are using cows manure and maize silage.
There is only one place in Latvia, where the energy from sewage is produced. Riga waste water treatment plant produces 400÷500 m^3/h of biogas. Three landfill sites are producing biogas from municipal waste. The biggest from them: Riga landfill Getlini produced 31130000 kW·h electricity and 38673492 kW·h heat in year 2009.

3. Energy crops

Total biogas potential from energy crops is approximately 1200 milj.m^3/year, because there are many ha free land in Latvia. Ministry of Agriculture in cooperation with Latvian country consultation and education centre Ltd undertook a survey of Available Land for Agriculture (ALA) in parishes to gain information about uncultivated farmland in municipality territories. Survey was undertaken in parish farms, covering 2440 thousand ha farmland, which are 99 % of territories usable for agricultural purposes in Latvia. The survey revealed information on territories which are not cultivated at least two years in a row. From the examined territories 363 505 ha were not regularly cultivated which make 14,9 % from the available agricultural land.

4. Waste water treatment sludge

Production of waste water sludge in Latvia is represented by Figure 7. [3]
About half of the mass is used as fertilizer in agriculture, but the other is stored in special basins or disposed in landfills — Figure 8. [4]

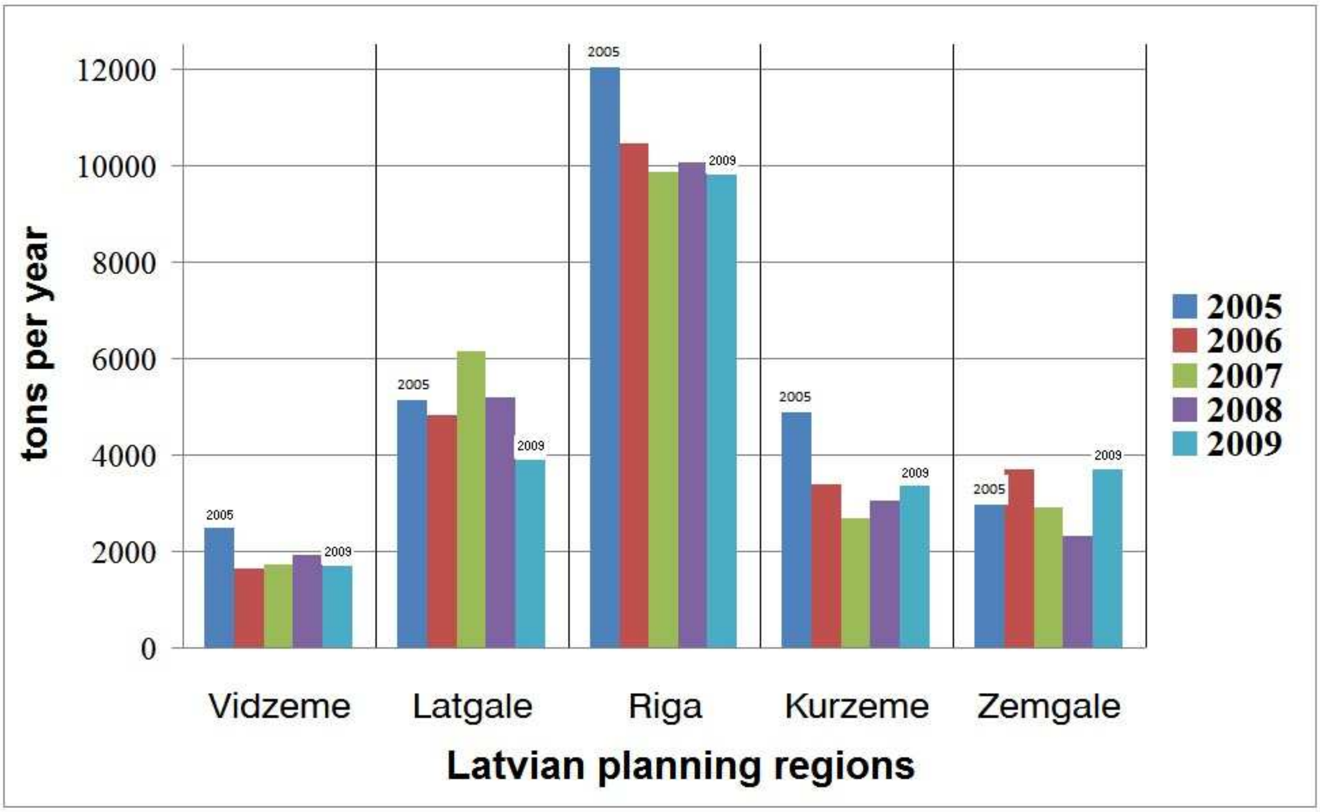

Fig.7. Produced sludge amount in Latvia, 2005–2009.

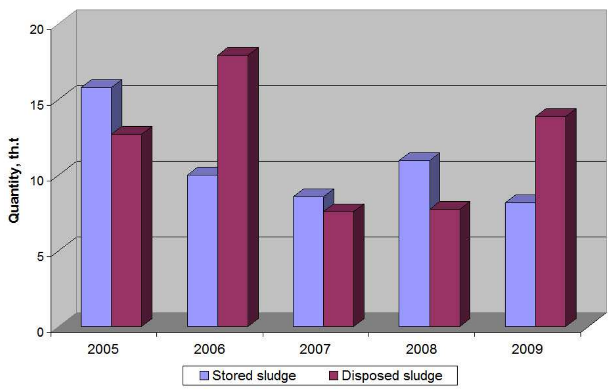

Fig.8. Energy potential from sludge.

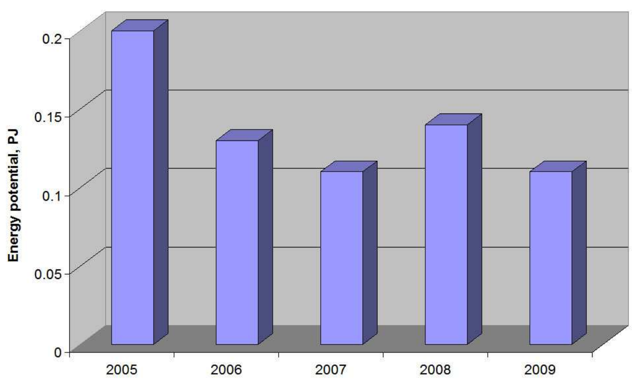

Fig.9. Potential of energy production from waste water treatment sludge.

Figure 8 represents the calculated energy gain if this amount of sludge will be converted by anaerobic digestion to biogas. The gain per year was detected by equation:

$E = q_1 * q_2 * q_3 * M$,

where M — mass of stored or disposed sludge in appropriate year;

q_3 — content of dry mass;

q_2 — produced biogas volume per kg of dry mass (~0.6 m^3/kg);

q_1 — calorific value of biogas (~ 21.5 MJ/kg).

Taking in account that disposed sludge contains only 15% of dry mass, but stored quantities are represented by dry mass, the energy potential from disposed sludge will be insignificant ~0.02 PJ per year. But the anaerobic digestion of stored sludge will be ~0,2 PJ per year (see Figure 9).

5. Household and industrial organic waste

Till the year 2010 the main quantity of biowaste was disposed. The latest data show that the composting of biomass is growing with each year. Figure 10 represents the disposed mass of municipal and industrial organic waste per inspected years (the content of organic waste in unsorted mass is ~56%) .

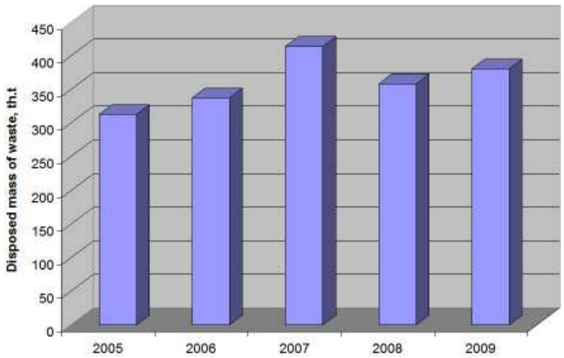

Fig.10. Disposed mass of municipal and industrial organic waste per year.

The treatment of unsorted waste can be provide by special incineration kilns, but sorted nonhazardous organic mass can be used for RDF production or implemented as energy source in cement kilns [5]. The calorific value of partly separated organic waste is 16÷20 MJ per kg. The figure 11 represents the calculated data for energy production from organic waste by combustion in cement kilns (q_1 = 16 MJ/kg).

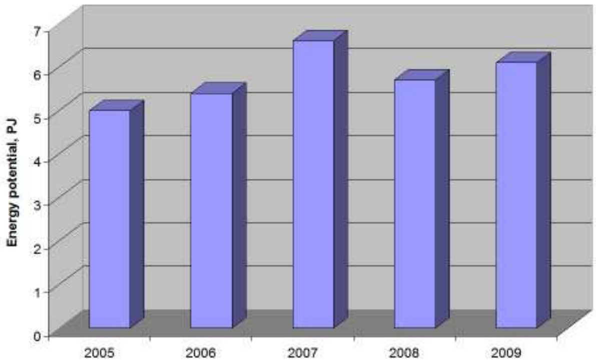

Fig.11. Calculated data for energy production from organic waste by combustion.

6. Conclusions

1. There is a considerable potential for producing energy from the biomass in Latvia.
2. The biggest future potential for biogas is from an energy crops.
3. Household and industrial waste biomass energy potential in Latvia is considerable for elaboration of different energy production technologies.

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