

POSSIBILITIES FOR RENEWABLE ENERGY PRODUCTION ON FARMS

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Abstract

An analysis of the consumption of energy resources in 1990 and 2010 revealed a significant change in the consumption pattern – the proportion of firewood rose. However, a draft strategy for the country's energy industry in 2030 envisages a very sharp increase in the consumption of renewable energy sources (RES). The present research identifies the possibilities for increasing the production of RES. It shows the possibilities for increasing the production of firewood and outlines the significant possibilities for increasing the production of RES in agriculture. It was ascertained that the achievement of targets to increase the output of RES by 30% in 2020 and by 70% in 2030 compared with 2010 was possible.

Key words: renewable energy sources (RES), firewood, biogas production on farms.

Introduction

Significant changes in the consumption of energy resources have occurred in Latvia since 1990. Their consumption decreased 40% over a twenty year period. The consumption pattern of energy resources also changed. It is a positive fact that the consumption of renewable energy sources (RES) significantly increased. The proportion of firewood consumption increased threefold, whereas the proportion of consumption of coal and oil products significantly decreased. A positive fact is that the import of electrical energy accounted for less than 20% of its total consumption in 2010 (44% in 1990). RES accounted for only 13.1% in the consumption pattern of primary energy sources in 1990, while presently their proportion has risen to a third.

The consumption pattern of primary energy sources in Latvia in 2010 was as follows: oil products – 32.2%, natural gas – 30.6%, firewood – 25.5%, electrical energy – 8.0%, coal – 2.2%, biogas – 0.3%, and others – 1.2%. It means that RES accounted for 32.9% of the total energy consumption. According to the draft “Energy Strategy 2030” (14 December 2011) developed by the Latvian Ministry of Economics, the proportion of RES in the energy consumption pattern has to reach 40% in 2020. Yet, in 2030, RES might account for half of the country's final energy consumption.

The draft “Energy Strategy 2030” envisages significant increases in the output of RES – 30% in 2020 and 70% in 2030 compared with 2010.

The mentioned national strategy envisages a very fast increase in the output of renewable energy sources. Researchers conduct comprehensive research on it, while at the same time discussions occur on whether such an increase in the output of renewable energy sources is possible and whether it is needed.

The research aim is to ascertain the possibilities for increasing the output of renewable energy sources in Latvia.

Research tasks:

- 1) to identify the possibilities for producing renewable energy sources;
- 2) to survey biogas facilities on farms;
- 3) to identify the possibilities for producing renewable energy sources of agricultural origin.

Materials and the methodology

The newest draft “Energy Strategy 2030” (14 December 2011) developed by the Latvian Ministry of Economics in cooperation with scientists was used to elaborate the paper. In the analysis of the consumption of primary energy sources, data of the Central Statistical Bureau for 2010 were used and compared with corresponding indicators for 1990.

Previous research findings of researchers were used for identifying the prospects for producing and exploiting renewable energy sources. To ascertain the possibilities for increasing the output of renewable energy sources of agricultural origin, data of a survey of farms and biogas facilities were used.

To obtain and process data, the following research methods were employed: the monographic method, synthesis, sociological surveying of farms, as well as the logical and constructive methods.

Results and discussion

Presently, the most significant RES in rural areas is forests, i.e. firewood, which accounted for a fourth in the energy consumption pattern in 2010. Forest lands occupy almost half of the area of Latvia, therefore, their role in producing RES will be increasing. According to studies, the growing stock of timber does not decline irrespective of intensive logging and exports of wooden products; it even increases and exceeds 630 mln m³ (2010, V. Striķis et al.).

According to calculations performed by L.Bite and K.Makovskis (2011), firewood accounts for almost 80% of RES in the consumption pattern of

Table 1

Characteristics of biogas facilities on farms in 2011

| Regions | Number of biogas facilities | Energy capacity MW | Substrates (number of facilities) | | |
|------------------|-----------------------------|--------------------|-----------------------------------|-------------------|----------|
| | | | manure | biomass of plants | other |
| Zemgale | 12 | 11.8 | 12 | 12 | - |
| Kurzeme | 11 | 11.2 | 10 | 10 | 1 |
| Rīga | 8 | 6.0 | 8 | 8 | - |
| Vidzeme | 8 | 10.0 | 6 | 6 | 2 |
| Latgale | 6 | 5.6 | 5 | 5 | 1 |
| In Latvia | 45 | 44.6 | 41 | 41 | 4 |

Source: data of the authors' survey

primary energy sources. By using findings of also other authors (M. Graudums, V. Lazdāns, 2010; A. Pelane, I. Ukenābele, 2008), these researchers found that by-products such as tree branches, stumps, etc. were insufficiently exploited. Yet, A. Broņka and A. Zvirbule-Bērziņa (2011) developed principles for local governments regarding exploiting firewood resources, i.e. they presented the opportunities for increasing thermal efficiency by modernising boiler houses powered by firewood. According to the studies, the exploitation of firewood, which is the most popular renewable energy source, may be increased by 16% in 2020 and 30% in 2030 compared with 2010. Therefore, the proportion of firewood in the energy consumption pattern will reach 27.7% in 2020 and 30.3% in 2030. Thus, that part of the draft national energy strategy, developed by the Ministry of Economics, which deals with increasing the consumption of firewood might be achieved. Regardless of the possibilities identified for increases in the consumption of firewood as well as in its exploitation efficiency, the proportion of firewood in the RES consumption pattern will decrease from 77.8 (2010) to 69.9 (2020) and 60.5 (2030) percent, as other RES in the energy consumption pattern will increase much faster (2011, Enerģijas...).

According to the energy strategy forecasts for 2020 and 2030, the consumption of biogas and liquid biofuels (bioethanol and biodiesel fuel) has to sharply increase. The consumption of biogas and liquid biofuels totalled 0.56 PJ or 0.9% of the total consumption of RES in 2010; in 2020 and 2030, it would already reach 1253 PJ or 14.7% and 24.17 PJ or 21.8%, respectively (2011, Enerģijas...).

According to the energy strategy, it is necessary to rapidly develop a new industry – energy production – in rural areas.

The previous analyses and studies indicate that the future development of the energy sector, to a great extent, depends on agriculture. It is a positive fact that farms are responsive and started producing RES.

A survey of farms conducted at the end of 2011 showed that 45 biogas facilities operated or were built. Of the biogas facilities, 12 with a capacity of 11.8 MW were located in Zemgale planning region, 11 with a capacity of 11.2 MW were situated in Kurzeme planning region, 8 with a capacity of 10 MW – in Vidzeme planning region, 8 with a capacity of 6 MW – in Rīga planning region, and 6 with a capacity of 5.6 MW – in Latgale planning region. One can see that the biogas facilities are located across the entire Latvia. Several such facilities are at the stage of designing or construction (Table 1).

Manure, biomass of plants, and production by-products are used as substrates in biogas production. In biogas production, 41 farms used manure, 41 farms processed green biomass of plants, and 4 farms – by-products from agricultural production. By-products from agricultural production or food trade were partially used or it was possible to use them at other biogas facilities as well.

Of the 45 biogas facilities surveyed, 23 started producing electrical energy. These facilities started using thermal energy as a by-product as well. A biogas facility project was completed on nine farms, while such a project was at the stage of implementation on 38 farms.

The number of biogas facilities broken down by installed electrical capacity was as follows: 22 with a capacity of less than 1 MW, 12 with a capacity of 1 MW, and 11 with a capacity within 1-2 MW. The total installed electrical capacity of biogas facilities built or being under construction will reach almost 45 MW or on average 1 MW per farm.

Various amounts of funding were approved and paid out for constructing biogas facilities in 2011 (Table 2).

The distribution of biogas facilities by amount of electrical energy sold within the renewable purchase obligation a year (MWh) was as follows: 15 facilities sold less than 5 000, 18 – within 5 001 – 10 000, and 11 – more than 10 000.

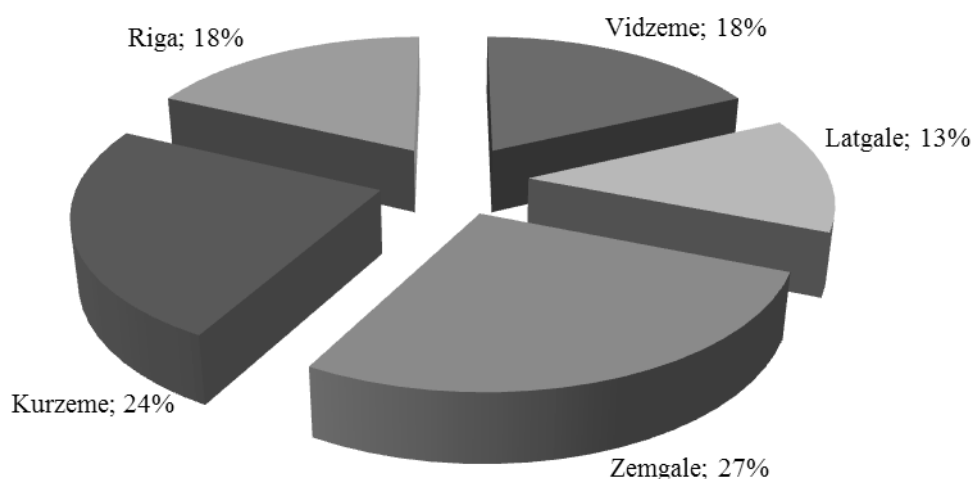
The survey showed that the farms engaged in producing biological energy sources were located

Table 2

Number of biogas facilities by amount of public funding for construction in 2011, mln LVL

| Groups of biogas facilities by amount of funding, mln LVL | Number of biogas facilities by amount | |
|---|---------------------------------------|----------|
| | approved | paid out |
| less than 0.5 | 6 | 12 |
| 0.6-1 | 23 | 5 |
| more than 1 | 11 | 6 |

Source: data of the authors' survey



Source: data of the authors' survey

Figure 1. Percentage distribution of the farms engaged in producing renewable energy sources by region in Latvia in 2011

across the entire Latvia, although a slightly leading position belonged to Zemgale region (Fig.1).

To rapidly increase the output of biogas and liquid biofuels, it is necessary, first, to find out the potential of producing and exploiting agricultural energy crops and the economic conditions; second, to determine the development possibilities for the output and exploitation of manure and other agricultural and food production wastes (by-products) for biogas production and also to set the economic conditions for developing intensive livestock farming. Third, institutional mechanisms, funds, and qualified human resources are needed for producing RES of agricultural origin.

Several researchers such as A.Kalniņš, A.Adamovičs, Z.Gaile, V.Dubrovskis as well as scientists from Riga Technical University (RTU) have published their findings on production and exploitation of RES. These researches are continued and extended; the number of researches performed by scientists of Latvia University of Agriculture and RTU over the recent years proves it.

According to the survey of farms as well as studies carried out by the Latvian Advisory and Training Centre in 2011 and its publication "Demonstrations in Crop and Livestock Farming 2011", approximately 1000 ha of agricultural land are needed for producing

substrates for a biogas facility with an electrical capacity of 1 MW. Such an area is needed for growing feed for livestock, of which a by-product – manure used in biogas production – is produced as well as for growing green biomass.

At least an area of 0.5 mln hectares of agricultural land may be exploited for growing green biomass in Latvia. Such an area, according to land use data of various institutions, is not exploited or is used extensively (Zemes...2011). Such an area may provide resources for biogas facilities with a total electrical capacity of approximately 500 MW. It means one biogas facility may be built in every rural parish.

According to studies on the conditions of producing and exploiting agricultural energy crops, large-scale intensive agricultural production has to be promoted and financial investments and entrepreneurial farmers have to be attracted. Experience shows that presently, the best conditions are observed in Zemgale region (2010, J. Klāviņa et al.).

Zemgale is the least wooded region compared with the other regions. However, it has the most fertile soils. The average fertility of agricultural land is 38 points, while in Zemgale it is 56 points. The highest proportion of arable land is in Zemgale compared with the other

regions of Latvia. The total area of arable land in Latvia was 1190 thousand hectares in 2010, of which 291 thousand hectares or 24% was in Zemgale. Zemgale region is an area of intensive agriculture. Around half of Latvia's agricultural incomes are gained in Zemgale, although only one fourth of arable land is located in this region. It means that agricultural intensity in this region is twice as high compared with the other regions (2010, FADN data).

An analysis of FADN data showed that the highest proportion of economically largest farms, compared with the other regions of Latvia, was observed in Zemgale. An average area of agricultural land per farm was also greater in Zemgale. Besides, farms having a greater area of agricultural land had a greater total standard gross margin. Yields of crops were also higher in this region. It indicates that intensive agricultural production is specific to Zemgale. Yet, yields are equal if the economically largest farms are compared among various regions. It means that the economically largest farms of various regions having appropriate resources and modern agricultural technologies perform equally. The yields of energy crops (sunflower, maize etc.) in Zemgale in 2010 were 40% higher than in 2005. In general, yields of livestock feed crops tend to increase, which indicates an increase in the level of agricultural technologies. These trends also point at large possibilities for growing agricultural energy crops at optimal costs.

The researches conducted showed that large investments as well as a large area of agricultural land and intensive production, which was specific to modern large-size farms, were required to engage in producing RES for biogas production. At the same time, studies of foreign literatures and experiences of farmers showed that it was possible to engage in the production of RES by means of agricultural cooperation, i.e. by cooperating with medium-size farms or by building biogas facilities of small capacity.

The analysis of survey data for farms and the findings of scientists showed that the output of biogas and other biofuels envisaged in the strategy, according

to the Ministry's of Economics forecast, might be reached.

Conclusions and proposals

It is necessary to develop energy production on farms in order to meet the sharply increasing demand for renewable energy sources (RES); a survey of farms shows that 45 biogas facilities operated or were built on farms in 2011.

Biogas facilities are located in all the regions of Latvia. Presently, the best possibilities for their development are in Zemgale which is a developing region of intensive agriculture. Yet, in the future, with increase in intensive agricultural production in the other regions, the output of renewable energy sources will increase there as well.

An analysis of the performance of biogas facilities of farms and the research findings as well as the calculation show that it is possible to meet the demand for RES produced in Latvia as envisaged in the Energy Strategy if 0.5 million ha of agricultural land are engaged in the production of RES.

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