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# Development of Biomass Utilization in Latvia

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**Abstract.** This paper describes an efficient and appropriate use of biomass in Latvian conditions as well as analyzing the current situation, leading to recommendations for rational use of biomass and the full implementation of the Latvian energy sector. In recent year's Latvian energy sector development analysis shows, that there is a positive tendency - an increase of local and renewable energy share of energy balance. The paper will be identified for future development opportunities, and will undertake an analysis of renewable energy consumption forecasting in accordance with the renewable energy potential assessment, taking into account the effective use of innovative technologies and ecological aspects of the energy sector.

Increasing use of biomass for district heating (and cogeneration), also increase the efficient use of biomass in cost efficiency and reducing of GHG emissions. Efficient use of biomass analyzed in the paper, taking into account technical, legislative, institutional / organizational, economic, information and financial aspects. Promoting of the efficient use of biomass will increase national energy independence.

## Key words

Biomass, energy balance, cogeneration, district heating, biomass utilization.

## 1. Introduction

The most common types of fuel: wood, wood products (wood chips, sawdust, bark, remnants, etc.), special products (briquettes, pellets, charcoal), that in Latvia heat supply widely used as well as wood waste and recyclable wood. Fuel wood preparing economic feasibility evaluate by comparing the planned forest exploitations residues volume, production costs and the expected price of chips [5]. Other indicators those are necessary for the calculation of production costs the length of the access road and transportation distance to the consumption areas. In order to increase technical efficiency, recommended the coincident realized the forest exploitations residues preparation of a several handy wood felling and use single stowage.

The main potential for wood use in district heating is existing natural gas heat sources as the basis of the heat load forecast is not expected to be the formation of a new heating system. In optimistic scenario as a result of construction development the heating zone could be expanded.

Other fuels (coal, peat, oil products) in district heating are used in very small quantities and no significant base for wood fuel use increase. According to the statistics and calculations of natural gas boilers for heating the average total heat load is about 370 MW, the average heat load for heating - 270 MW. However, in practice, wood fuel can be used also for small cogeneration heat plants (CHP), cogeneration equipment operating under summer periods (hot water) heating load, but a large enough base load in heating period, which would be used for wood fuel use equipment installations.

Service sector is not expected to be taken into account as the potential use of wood, because these consumers in the future as the main criterion will choose a higher comfort of energy use. Industry enterprises in different sector mainly have its own specificity requirement for technological processes, so one type of fuel substitution by other fuels can be problematic. Therefore, it can be assumed that the wood fuel in industry practically will not replace other types of fuels. It is could be expected that in household sector accordingly to increased energy prices energy efficiency measures will be implemented more rapidly and in larger quantities and as a result a sharp increase of heat load in household sector is not expected in the nearest future.

The main advantages of biomass use are that it is a local fuel and the environmental impact is relatively small. Biomass negative aspects of high technology costs, low thermal performance and logistical problems.

## 2. Fuel wood in Latvian energy balance

Latvia is one of the most forested countries in Europe, because forests occupy 45% of the total area. An average of 1.23 ha per capita, which is 4.5 times more than the average in Europe The total forest area is 2.95 million ha [1].

An important role in the total wood consumption balance holds fuel (energy) wood, which is currently used primarily for energy production for heat. Wood is used in cogeneration process in certain small power plants, and its use is limited (about 200 thousand. $m^3$ per year [2]).

In 2009 the Latvian total primary energy consumption was 183.8 PJ, and self-sufficiency in the total primary energy consumption was 33.2%. Biomass as the main fuel from domestic sources in the total primary energy consumption was 28.6 % and hydropower and wind power for electricity production was 6.9 %. Wood is used for all kinds of heating centralized, local and individual [1].

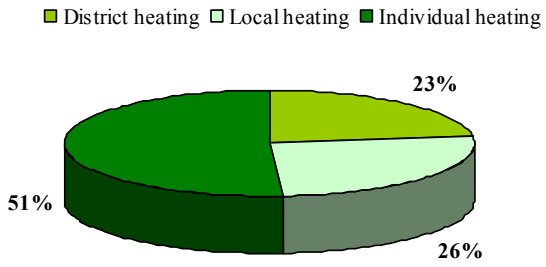


Fig.1. Fuel wood use for energy production in 2009.

The highest wood utilization rate is in household that uses about the same amount of wood fuel as in central and local heating together.
Currently, for on energy used the following wood types:

- wood processing;
- forest exploitations residues;
- woodprocessing products - chips, sawdust, bark, remnants of wood dust;
- special products - briquettes, pellets, charcoal.

Heat for sale produced 678 boiler houses and 56 cogeneration plants, which are produced 7.31 TWh of heat (2009). For heat and power production was mainly used natural gas. The fuels used for heat energy production in the following proportion - as fuel natural gas was 76.8%, wood chips - 12.5%, wood - 3.6%, fuel oil - 3%, other types of fuel - 4% (Fig.3).

District heating is structure of the consumption in recent years has not changed, and the central heating was up to 65-70%, and hot water supply - 30-35%. Heat for industry from the total realized heat amounted as 1.4 % for households - 73.7%, other consumers - 24.9% (Fig.2). The realized thermal energy breakdown by the regions was as follows: Riga - 51.7%, and suburb region - 11.5%, Vidzeme - 6.2%, Kurzeme - 10.2%, Zemgale - 7.8% and in Latgale - 12.6 %.

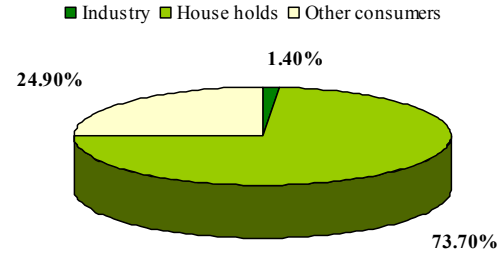


Fig.2. District heating structure, 2009.

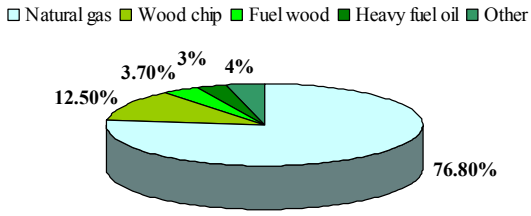


Fig.3. Heat energy production by fuel types, 2009.

Since the 95th year's fuel wood is exported to various European countries and wood export has a growing tendency.

Fuel wood exports almost twice exceed the transformation sector (boiler houses and cogeneration plants) consumption, and could be one of the potential sources of the required amount of wood use in cogeneration, as well as the conversion from fossil fuels to renewable. The determinative factor in the wood export or for domestic use in the future will play wood fuel price.

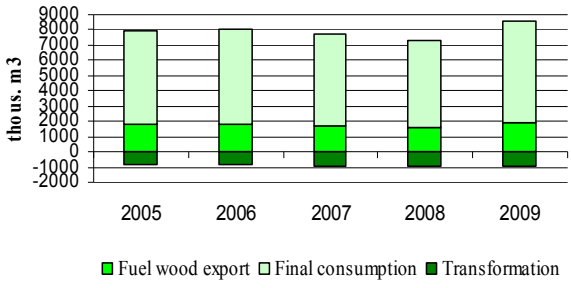


Fig.4. Fuel wood use in Latvia.

## 3. Potential of fuel wood resources

Numerous investigations on wood resources potential assessment have been done in past 10 years in Latvia [2, 3]. The average data of the results of this investigations summarized in Table I.

Table I. Fuel wood potential.

| Fuel wood type | Potential, million $m^3$ per year | Potential, PJ | Potential, million MWh |
|---|---|---|---|
| fuel wood (roundwood of little value) | 1,8 - 2,4 | 12 – 16 | 3,3-4,5 |
| felling wood waste (including sapling care ) | 1,8 - 2,7 | 12 - 18 | 3,3-5,0 |
| brushwood | 0,3 - 0,75 | 2 - 5 | 0,6-1,4 |
| stumps | 0,1 - 0,4 | 0,7 - 3 | 0,2-0,7 |
| annual amount of naturally drying wood | ~ 0,3 | ~ 1,5 | ~0,6 |
| wood processing by-products and waste | 1,6 - 4,5 | 14 - 37 | 3,0-8,4 |
| secondary wood waste from garbage | ~ 0,3 | ~ 1,5 | ~0,6 |
| Total | 6,2-11,35 | 44,5 – 82,5 | 11,5-21,1 |

The lower limit of the potential of assessment is less than the already energy consumed of the wood resource (16.5 million. MWh or 8.8 million $m^3$ [3]), excluding the exported quantity - 6.8 million MWh or 3.6 million. $m^3$ [3], while the current rate of use of wood with exports reaching fuel wood potential upper limit. This means that for sustainable wood use it should be provided that its extraction does not exceed the wood resources recovery. Therefore, the first serious attention should be paid for better, more effective and efficient use of wood in existing systems in terms of the following activities:

- Increase efficiency of heat production process;
- Increase efficiency of heat transfer process;
- Increase efficiency to consumers.

## 4. Fuel wood production

Fuel wood can be obtained from forest exploitation and wood processing:

- Thinning, forest exploitation (firewood, branches and tops);
- Wood residues (sawdust, bark, shavings, wood dust);
- Recyclable wood (containers, furniture, building components);
- Energy wood plantations.

The use of forest exploitation residues production processes and heating gradually increasing. However, the main forest exploitation prepared assortment of fuel wood is still wood. Wood chips from forests exploitation residues produced a number of companies, including JSC "Latvian State Forests".

Forest exploitation residue volume is usually 35-45% of roundwood assortment. Most forest exploitation residues are spruce and mixed deciduous trees that grow in clay and loam grounds. Comparatively less is the pine forest residues in poor sandy grounds.

Forest exploitation residues for fuel preparation (mainly it is collection) procreate a technological losses, which in industrial production circumstances are up 30-40% of the theoretical forestry residues amount.

Table II. The forest exploitation residues evaluation.

| Forest owner | Deciduous tree, mil. $m^3$ | Spruce, mil. $m^3$ | Pine, mil. $m^3$ | Total, mil. $m^3$ |
|---|---|---|---|---|
| Dominant species distribution in primary cutting | | | | |
| State | 1,4 | 0,8 | 1,6 | 3,8 |
| Private | 3,6 | 1,5 | 1,6 | 6,7 |
| **Total** | **5,0** | **2,3** | **3,2** | **10,5** |
| Forest exploitation residues in primary cutting | | | | |
| State | 0,64 | 0,30 | 0,47 | 1,41 |
| Private | 1,60 | 0,60 | 0,48 | 2,68 |
| **Total** | **2,24** | **0,90** | **0,95** | **4,09** |
| Technically useful forest exploitation residues in primary cutting | | | | |
| State | 0,42 (50 %) | 0,20 (25 %) | 0,20 (25 %) | 0,82 |
| Private | 1,05 (61 %) | 0,41 (24 %) | 0,25 (15 %) | 1,71 |
| **Total** | **1,47 58 %** | **0,61 24 %** | **0,45 18 %** | **2,53 100 %** |

## 5. Biomass use for heat supply and for cogeneration

Detailed analysis of the Latvian electricity and heat energy balance was made and showed that co-production of electricity and heat in one process (i.e. cogeneration) is to be developed from the both viewpoints - from energy supply security in the state and from non-utilized heat load potential in DHSs [5].

The mentioned heat load of DHSs has been evaluated as the total and for the most populated places. The results obtained will be used in the future for modeling the development of heat load potential on the state's level. The really reachable cogeneration potential is 459.7 MW, from which 339.2 MW is the average heat load for heating and 120.5 MW – for hot water preparation. The fuels and applied technologies used in cogeneration were assessed and the most sustainable solutions for the Latvian conditions were indicated [4].

The most advisable fuel types for cogeneration that could be advisable are gas and biomass:

- the natural gas is the most profitable fuel from the technological viewpoint as well as from those of a fuel's thermally-technical parameters and environment protection. Its main drawback is hidden in political and economic (price) risks connected with the monopolistic position of a

supplier as well as with gas price increasing in the last years;
- the main advantage of biomass is that it is a domestic resource; and, its impact on the environment is insignificant. The negative aspects of biomass utilization are high costs of the new (highly efficient) technologies, its poor thermally-technical parameters and the associated logistics problems;
- with the aim of fuels diversification for cogeneration it is reasonable to use, in minor quantities, also coal and peat; however, these fuels (especially taking into account not very high capacities in Latvia) are costly, which is mainly connected with the necessity to install equipment for flue gases cleaning in order to meet the environment protection requirements. It should also be taking in account that the peat extraction and, therefore, possible deterioration of the ecosystem might be negatively perceived from the of environment protection viewpoint;
- at cogeneration it is technically possible to use also oil products; the main hindering factor is here the high price of these products.

Taking into account the development level of cogeneration technologies and investment expenses, in Latvia in the nearest 10-15 years in the residential places with sufficiently well developed corresponding heat loads it is realistic to introduce into practice such widely applied technologies as steam turbines, gas turbines, combined cyclic and internal combustion motors, etc. [4].

Fuel wood prices increase promote:
- Forestry work costs increase (fuel, salaries etc.);
- Reduction in the number of suppliers;
- A significant increase of fuel wood demand in local and external market in the last 5 years,;
- The high cost of wood residues from small cuttings and processing plants;
- Because of its cost so far been little used wood residues from felling areas and small processing plants;
- The prices of wood chips in the Scandinavian countries continue to grow, so for the local producers of wood it is advantageous to export those.

Fuel wood prices could be reduced due to:
- New technologies for forest exploitation and fuel logistics development;
- Improving the roads, and increasing maximally road use;
- Taxation and equal distribution of EU structural funds for agriculture and forestry sector.

Detailed analysis of the Latvian electricity and heat energy balance shows the necessity to develop biomass cogeneration in residential places where natural gas is not available but, at the same time, the heat load potential is rather high.

One of the main goals of the energy policy and climate change mitigation policies in Latvia is the promotion of the development of renewable sources of energy - biomass energy, hydro-, wind- and geothermal energy.

Biomass fuel is the most important domestic fuel and widely used already in Latvia and it is determined in Energy Program as well as in other official documents that the biomass part on fuel consumption will be significant in future also.

The National Development Plan for 2007-2013 stresses the importance of renewable energy, including biomass, in the effort to ensure sustainable development. It provides for promotion of the use of renewable natural resources and alternative energy sources in the production of energy (heat and power), including the use of biomass in CHP, maintaining agricultural land for the production of agricultural products, and increasing the contribution of the agricultural sector in the production of raw materials for heating and transport fuel [6].

As known, Latvia has signed the UNO General Convention “On climate changes” and the Kioto protocol; this means that our state takes an obligations to promote implementation of the mentioned measures at the national and the inter-national level, which would allow for reduction in the total emissions.
One of the ways how to reduce the concentration of green-house effect gases is to use biomass as a renewable energy resource in order to replace the most widely employed fossil fuels – coal and oil products. When burnt, biomass emits carbon dioxide gases in a volume that is neutral for the environment; this means that the amount of harmful emissions and therefore negative impact on the environment followed by its degradation is considerably reduced. Utilization of biomass in a heat production process is not only an environment-friendly but also economically-efficient solution [5].

## 5. Conclusion

Use of biomass is exceptionally significant in such a small country like Latvia, where their domestic energy resources are scanty, including biomass from agriculture and rapid growing tree plantations despite climate conditions.
The fuel wood is a significant national resource, which can be utilized for energy production in order to increase the security and independence of energy supply; the energy projects consider its wide use as one of the co-burning products. However, the energy wood is mainly meant for local utilization.
The use of by-products of forest exploitation for heat energy production can give a considerable effect in the energy economy, especially in the regions of concentrated location of these renewables.
The lowest assessment mark of the potential is lower than the annual consumption amount of wood resources, excluding the exported wood resources. The current tendency to raise prices of fossil fuel resources may foster the development of the potential use of wood resources.

Biomass utilization needs some changes in legislation system in Latvia, in technologies for biomass burning, as well as in biomass storage system and activities for biomass effective utilisation should especially be aimed at the

- harmonization of the taxes, prices and tariffs;
- harmonization of the legislation in energy;
- implementation of the EU environment quality standards to reduce the NOx,, SO2 emissions;
- certification of imported fuels and establishment of fuel quality control mechanism.

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