

**Comparison of wood fueled district heating in the regions of
Östergötland (Sweden), Tartu (Estonia) and Vidzeme (Latvia)**

Report in the project Wood Energy and Cleantech

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Introduction

This report is prepared in the framework of Central Baltic Interreg IV A programme Wood Energy and Cleantech project. The project aims to share knowledge and skills in environment-friendly use of wood fuels in district heating. Organizations from Sweden, Estonia and Latvia are participating to Wood Energy and Cleantech project. As a part of this project a market analysis was performed and is summarized in the following report.

The paper is a comparison of the capacities and demand of wood based energy in the regions of Östergötland County in Sweden, Tartu region in Estonia and Vidzeme planning region in Latvia.

1. General data

While Östergötland county is an administrative unit, the region of Tartu is legally not clearly defined. In this case Tartu region consist of the counties of Võru, Põlva, Valga and Tartu county, the area is also called „Lõuna-Eesti“. Vidzeme planning region also is not an administrative territorial division. The planning regions of Latvia are not administrative territorial divisions, since they are not mentioned in the law that prescribes the administrative territorial divisions of Latvia.

The study started with collecting data on the basis of a uniform model used in all three regions. The data for the studies came from official statistics and was also collected from several companies. The model with results from Östergötland is shown in appendix A and the results from Tartu region are in appendix B. In Vidzeme region there was not enough reliable data to justify the use of this model. The data of 22 boiler houses show`d that the efficiency of these plants is almost 100% or more and in one case - it is less than 40%. That discrepancy could be caused by different reasons, like weak or no accounting of purchased fuel,lack of information or the heat energy is calculated wrong. One of the important activities for boiler houses in Vidzeme in the future is to make the inventories more exact.

In some cases indirect calculations was necessary. For example for the data from the use of wood fuels in individual houses in Tartu region. The numbers are based on current knowledge. Statistic from the year 2009 and 2010 was used in the study, in some cases also earlier years, depending on the availability of data. The availability of data differs very much in the regions. In Östergötland the data is easier accessible and up to date because more inventories have been made. In Estonia the accessibility of the data differs from case to case. The data collected during this study was from most cases plausible, but some inventories used for the study where not exact or incomplete, even the data provided by the statistics Estonia was in some cases different from the reality. In the estimation about wood usage in residential buildings indirect calculations had to be made.

The chosen regions are by their area and population quite similar, as shown from table 1.

Table.1. General data of partnerregions.

	SE, Östergötland County	EE, Tartu region (Tartu-, Võru-, Põlva- and Valga Counties)	LV, Vidzeme Region
Area	9987 km ²	9507 km ²	15246 km ²
Population	424 333	252 630	235 576
Population density (pers/km ²)	42,48	26,57	15,45
Number of municipalities	13	55 (+7 towns)	25 (+1 town)
Forest percentage	64%	48,14%	54%
Annual wood Consumption	2665 GWh	1650 GWh	237GWh
Wood fired Boilerplants	10 (large)	111 (small and medium size)	120
Number of Wood fueled CHP plants	3	1	0 (7 on natural gas)
Total of installed capacity for wood fueled district heating and CHP, MW	2700	1381	331.6

1.1. District heating in Östergötland

A general overview of the Östergötland region from a cleantech and wood energy perspective shows that district heating are well spread in the region. However, the large concentration of wood energy are in the larger district heating nodes; Norrköping and Linköping as well as in the larger mills in the society of Boxholm (Rörvik Timber) and in the society of Kinda (Södra Timber). Also the Skärblacka mill and the Braviken mill are of a regional importance. The most of the wood fuel in the district heating system consists of different forms of wood chips as well as branches and tops. 75 % of the wood energy goes to heating and 25 % of the energy goes to electricity production.

In Östergötland 38 % of the energy supplied are coming from biofuels. The percentage of wood fuel is almost 40 % of all the bio energy usage in the region. This means that totally in the region almost 20 % of the energy usage comes from bio fuel.

Östergötland is importing wood fuel even though the growth of regional forests are increasing.

The district heating potential is possible to see in the use of fuels in the district heating systems. The following is a list of other fuels used in the system, which might be replaceable (or some of them might have been replaced already):

- Municipality of Boxholm: -
- Municipality of Finspång: Oil (6400 MWh) and Waste (73600 MWh)
- Municipality of Kinda: Oil (10 700 MWh) and Industrial Waste Heat (16 900 MWh)
- Municipality of Linköping: Coal (100 500 MWh), Oil (70 000 MWh), Other fossil fuels (106 410 MWh), Waste (1 153 900 MWh), Electricity (90 000 MWh)
- Municipality of Mjölby: Oil (4155 MWh)
- Municipality of Motala: Oil (870 MWh) and in the Vattenfall Plant: Oil (1500 MWh), electricity (7870 MWh)
- Municipality of Norrköping and Söderköping: Coal (86 600 MWh), Oil (6000 MWh), Other fossil fuels (156 000 MWh), Waste (459 000 MWh) and electricity (52 000 MWh).
- Municipality of Vadstena: Oil (510 MWh) and electricity (710 MWh)
- Municipality of Valdemarsvik: Oil (1500 MWh)

- Ydre: -
- Municipality of Åtvidaberg: Electricity (660 MWh)
- Municipality of Ödeshög: Electricity (310 MWh)

It is easy to see that the two largest municipalities are having a great affect on the system in the entire region with their size. It is however important to notice that oil, electricity, industrial waste heat and waste might have technical and political reasons for why it is still in the system: the cold winters might need some oil in the system (or just for starting the boilers) and waste is being considered a bio fuel, which makes it interesting (it is also cheap). The industrial waste energy is already based on wood energy in most cases. Electricity might also be needed on some of the coldest days.

The following municipalities consider their district heating system to be expandable or that it has potential to ad more customers (according to the municipality climate- and energy plans):

- Municipality of Boxholm: potential to expand the district heating system.
- Municipality of Finspång: potential to use more industrial waste heat and also to use district cooling in the summer.
- Municipality of Kinda: -
- Municipality of Linköping: -
- Municipality of Mjölby: There are plans on building a new biofuel powered plant for district heating.
- Municipality of Motala: Produce more energy forest and potential to ad more customers to the existing district heating system.
- Municipality of Norrköping: Mentions the potential of symbiosis between different sectors in the district heating system.
- Municipality of Söderköping: -
- Municipality of Vadstena: -
- Municipality of Valdemarsvik: Potential in energy forests and waste (presumably for district heating purposes)
- Municipality of Ydre: Different bio fuels for district heating (energy forest for example)
- Municipality of Åtvidaberg: Energy forest and expansion of the existing district heating network are of interest.
- Municipality of Ödeshög: -

10 of the municipalities above have an energy plan in May 2011 – it is possible to say that most municipalities are seeing the potential of using more district heating.

1.2. South Estonian district heating

Conversion to local renewable fuel, like wood fuel, is EU and Estonian state policy. During this investigation an inventory about district heating networks and heat producers in the Tartu region (Southern-Estonia) was made to clarify woodfuel capacities and demand. Though the overall share of wood fuel in the region's energy balance is high, further expansion is possible.

The overview about the current situation in the region shows that the Tartu combined heat-and power-plant is dominating in the heat and electricity production of the region. There have been also investigations about CHP-s for smaller towns in the region, like Võru, but the plans have`nt come to realisation, because the technology for small scale biofuel CHP-s is expensive and not commonly introduced to commercial use in Estonia until now. The coming years and developments in wood gasification technologies will increase the feasibility of CHP plants for many of the smaller settlements in Estonia.

The inventory show`d that for example pellets are produced in quite big amounts, but rarely used in the region. This means export of pellets and income for the region, but also adds CO₂ emissions to the life cycle of wood energy.

Automated pellet boilers would be in today's state of technology an opportunity to cover peak demands. Until now the region uses oil- and gasboilers for peak loads and on sites where automatic small scale heat production is needed. The main thing in the cleantech concept is to look on the whole social and economic impact - in one hand the region gains money by selling pellets but loses money by buying oil and gas. The downside of pellets is, that they are very sensitive to water and will fall apart if they absorb too much humidity. That makes the storage of pellets for a longer period of time more difficult than for woodchips.

The region, especially the County of Tartu, has a lower density of forest areas than the other regions of Estonia. An average of 48% of the area in South-Estonia is covered with forest and only 34% in Tartu county is forest area (the lowest density in Estonia). The average in the whole country is 51% and the most forest has Hiiumaa County with 71% of their area. Hiiumaa is also unique because of their island situation and weak electrical grid connection to the mainland. This makes the island to one perspective location for a small scale CHP.

Because the region is quite sparsely populated, South-Estonia itself does not emit a reasonable amount of garbage for an economically operating incineration plant at the current state of technology. Theoretically it would be in the future possible to fire the Tartu CHP partly with waste. Tartu region emits approximately 80000 tons of waste in a year. For example, that is the same amount of waste that Finnspong heating station (Östergötland) uses in their waste burning block. Of course they have in Finnspong also a wood boiler and oil for peak demands and backup.

Long term objective is to ensure stable and as low as possible heat energy price in the Tartu region. The price should mainly depend from the efficiency of the energy source and district heating system. Selection of the technologies now and in the future will determine the development of the energy sector especially for heat supply of public and dwelling buildings.

1.3. District heating in Vidzeme

Development of the energy systems in Latvia and Vidzeme planning region depends from the short and long term objectives. At present each municipality tries to create a short and a long term objectives based on the bottom-up method.

The short term objective is to ensure heat supply as cheap as possible today. Currently this actually makes to select and install cheap and inefficient equipment. Very often it also forces to take unjustified decision to close the district heating system at all. Such decisions are taken in spite that in wholesale the goods usually are cheaper than in retail. Therefore it is important at the first stage to understand why the district heating suddenly becomes more expensive. Typically the fault is given to high losses in the district heating networks however engineering calculations always should be made.

Long term objective is to ensure stable and as low as possible heat energy price. The price should mainly depend from the efficiency of the energy source and district heating system. It should not be influenced by the policy of the fuel supplier. This means that the existing policy in Latvia would have to be changed as currently suppliers are limited to have a motivation and interest to improve the system.

Selection of the technologies now and in the future will determine the development of the energy sector especially for heat supply of public and dwelling buildings. There are at least four cases how the heating systems are managed in municipalities:

- In the parishes or cities where district heating systems have been closed inhabitants and local governments chaotically try to ensure the heat supply. Usually stoves or individual boilers in the apartments are installed. Flue gases are discharged through chimneys that are installed just outside the windows of the apartments. The number of chimneys on the facades of the buildings usually corresponds to the number of the apartments in the buildings or even to the number of the rooms in the whole building. In cases when the owners of the apartments have left abroad the heating system gets destroyed there. This is due to the fact that water in the system during the frost freezes and destroys the walls of the building.
- There are municipalities that are looking for solutions to keep the heating systems and install boilers outside or inside the buildings. The main factors here are the interest of the inhabitants and the vision of the municipality regarding the future development of the territory. There are buildings where pellet, woodchip and wood log boilers are installed and well operated. In the meantime there are places where boilers with low efficiency and high wood consumption.
- There are municipalities where the main fuel is natural gas. This is a comfortable solution for centralised district heating system, but it is imported and is also 2-3 times more expensive than local fuels.
- There are municipalities that decisively install and maintain energy efficient woodchip centralised district heating systems. These usually are municipalities that have a long term energy vision and implement activities to keep the heat tariff stable.

2. COMPARISON

Östergötland has district heating networks in all 13 municipalities. The plants are in many cases connected with each other into bigger district heating networks. In Tartu region 111 wood fired district heating facilities were listed in a inventory carried out during this project. In the few bigger towns like Tartu and Elva the district heating plants are also connected with each other. In Vidzeme there are 120 wood fired heating stations. All CHP-s in the region operate on natural gas, in Vidzeme region the dominating fuel is natural gas 50% and the share of woody biomass is 48%.

The fuels used in the district heating are quite different from region to region. In Östergötland the main fuels are non-refined woody biomass – 40% (top and branches is the largest post), waste – 37% and recycled woodchips 21% of all the fuels. Whereas in Vidzeme region the dominating fuels are natural gas (50%) and woody biomass (48%). In south Estonia region the main fuels used are woody biomass (46%) and natural gas (26%).

One general technological difference in the regions is that Östergötland has a smaller number of boilers and they are bigger than in Tartu and Vidzeme. The characteristic size for boilers in Tartu and Vidzeme is 1...5MW.

The similarity of Östergötland and Tartu is that they both have central dominating cogeneration plants which are mainly wood fired. The CHP of Norrköping (Händelöverket) and CHP of Linköping in Östergötland, and the Tartu CHP (Fortum) at the town border of Tartu. Vidzeme has at the moment no biomass fired CHP plants.

District heating is well developed In Östergötland county, with facilities in all thirteen municipalities (In Linköping and Norrköping there is electricity generation). Tartu and Vidzeme haven't district heating facilities in all of their municipalities. One of the reasons could be that the municipalities are much smaller in Vidzeme and especially in Tartu. Tartu region in this definition (the 4 counties) has 62 separate municipalities.

Östergötland has a well developed paper industry and uses wood derived black liquor as one resource for heat and energy generation. Tartu and Vidzeme are not using this kind of resource, because there are no paper mills with considerable size in the regions.

Östergötland uses waste as one important resource for heat production. Tartu doesn't have waste incineration at the moment. In Estonia the waste incineration plants are located near the capital in the north of Estonia and it is planned to utilize the household garbage of the whole country there. Also waste burning in small scale applications in South-Estonia would be possible, that would shorten the transport routes of waste and reduce the load on the environment. It would be in the future possible to fire the Tartu CHP partly from waste resources. Like the heat plant in Finspång (Östergötland) burns household waste from the Finspångs municipality, which is about 8000 tons/year. The plant has a waste incinerator with an installed capacity of 10MW in operation and, together with two oil-fired boilers of 10 MW each and a bio fuel boiler of 15 MW: totally the heating system has an installed capacity of 45 MW. The plant also receives waste from other municipalities - approximately 20-22000 tonnes year. The heat plant is also receiving industrial waste. At full operation, approximately 80-100000 tons of waste is burned. For comparison Tartu region produces approximately 80000 tonnes of waste a year.

One opportunity for the regions of Tartu and Vidzeme would be in the future micro scale CHP-s that operate on synthetic woodgas. The short term objective is to ensure heat supply as cheap as possible today. Currently this actually makes to select and install cheap and inefficient equipment. Very often it also forces to take unjustified decision to close the district heating system at all.

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APPENDIX A. The collected data about the wood fueled district heating in Östergötland.

Capacity and demand of wooden biofuels in the Östergötland region

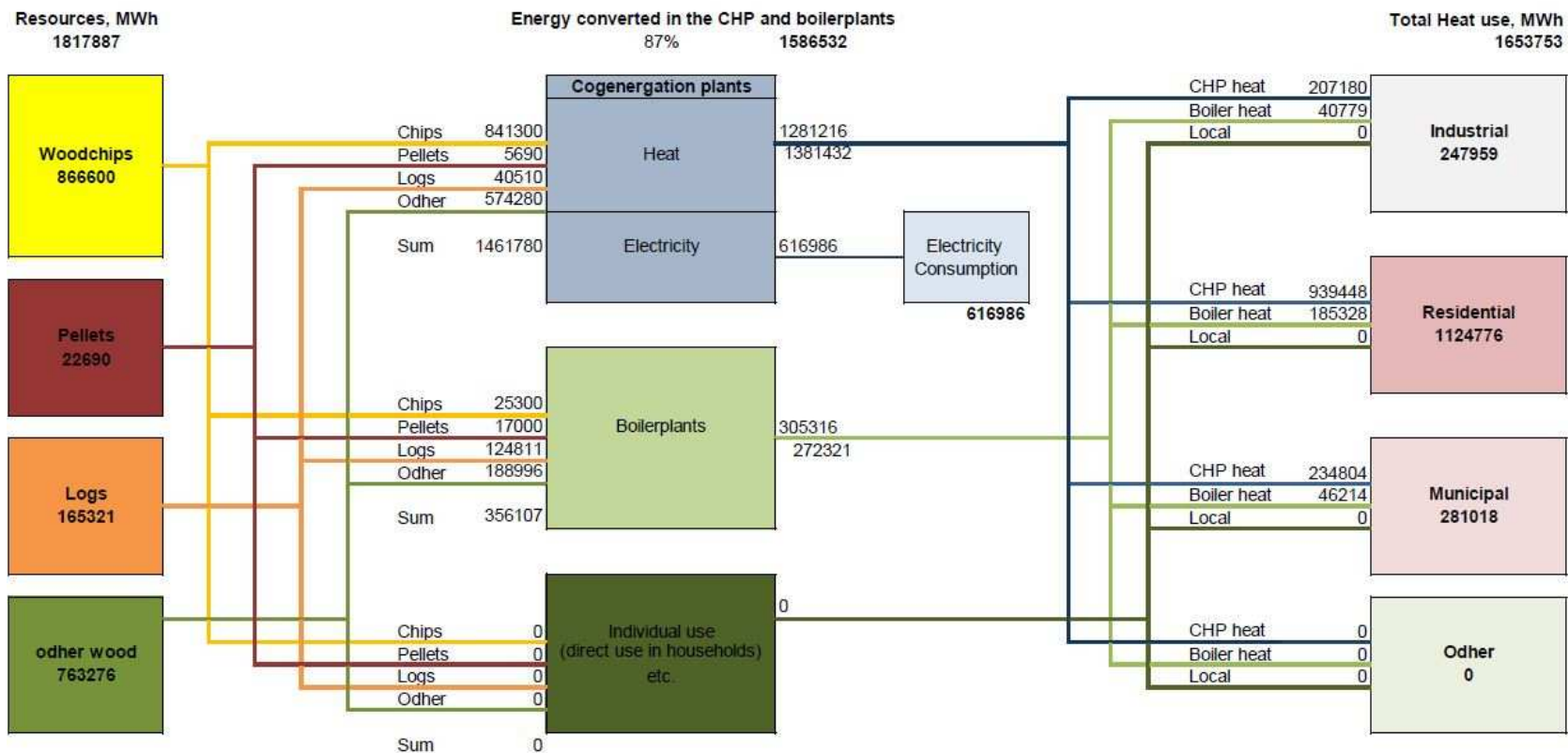
Region: Östergötland



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* This is the existing statistics, but there is some kind of discrepancy.
The municipalities of Ydre and Ödeshög are not being presented here, due to lack of data.



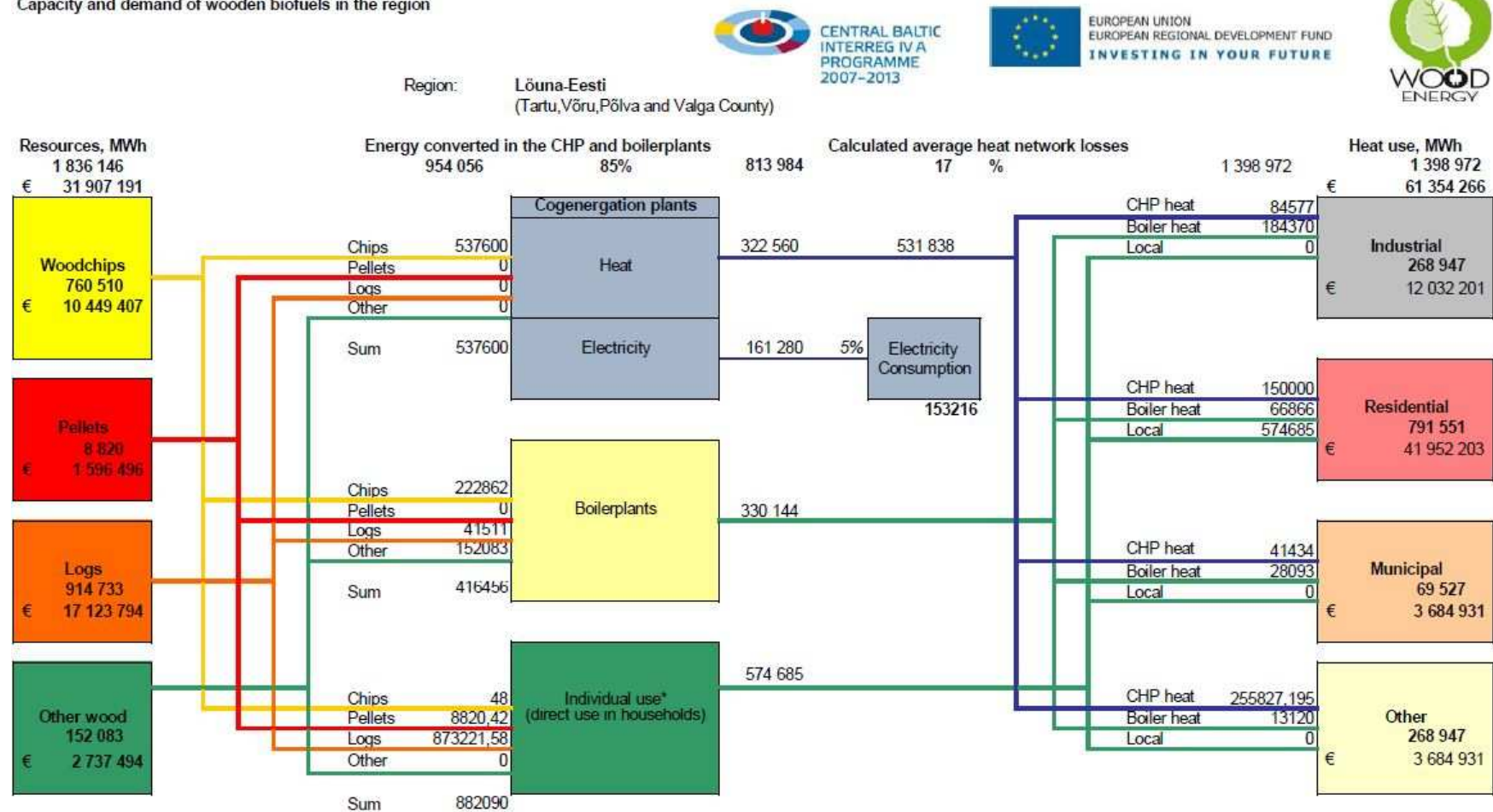
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APPENDIX B. The collected data about the wood fueled district heating in Tartu region.

Capacity and demand of wooden biofuels in the region



*Calculated indirectly on basis of statistics