Case study 2 from Sweden

Measuring moisture content in wood chips

Background

The total energy used in the County of Kronoberg is about 6.6 TWh. The long term trend is increasing. In general, the non-renewable fuels are reduced, while renewable fuels have increased. The share of renewables in energy use has increased by around ten percentage points since 1990. The use of biofuels in the county is 2.2 TWh. Half of this is used in the heat - and power plants, 25 percent in industry, 20 percent in the domestic sector and 6 percent for biofuels for transport. The conversion to renewable heat production has been gradually implemented over the last few decades, and today is the use of fuel oil in the domestic sector almost gone. In the industrial sector there is a tendency to reduce the use of non-renewable fuels. In the transport sector, which is the great challenge, the share of renewables is increasing by about one percent annually. The biofuels in the region originates from 1. Biproducts from the industry, e.g. sawdust and bark and 2. Forest residues from clear cutting areas (primary forest fuels), e.g. branches and tops.

The utilization of the biproducts is effective and there is no further potential to increase the bioenergy from biproducts. But there is a big potential to increase the utilization of primary forest fuels from Kronoberg County. However, there are considerable uncertainties both in terms of how much today is taken from the forest and how big the potential is. In case of increased extraction, it is important to consider biodiversity and recycling of ashes to the forest.
Current situation: about 200 GWh branches and tops / year + approximately 200 GWh of stemwood.
Potential: 800-1400 GWh branches and tops per year depending on technology, approximately 250 GWh / year of trees of small dimensions.

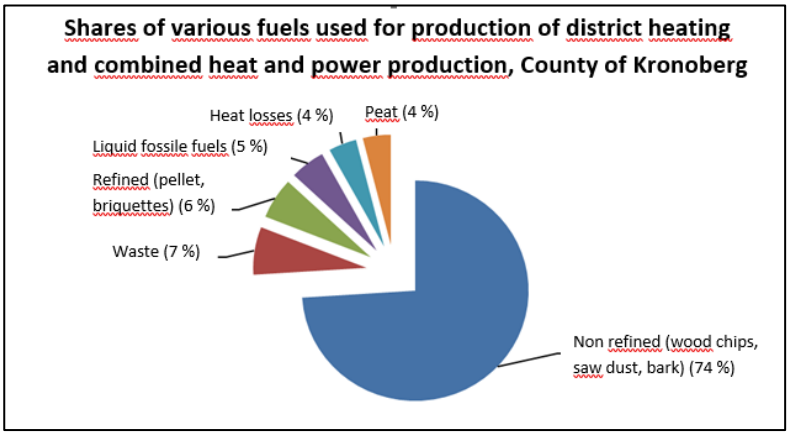

Figure 1: Fuels for production of district heating.

A figure is inserted, figure 1, to give an idea about the importance of the bioenergy in the region, and especially the unrefined biofuels. The biproducts from industry are, in addition to be used as a fuel without any refining, to some extent, used for production of refined fuels e.g. pellets.

Measuring of the moisture content

The extraction and logistics of biproducts, e.g. sawdust and bark are homogenous and easy to supervise, in comparison to woodchips which originates from e.g. branches and tops from clear cutting areas. The moisture content can differ a lot from one situation to another in the

latter case, hence it´s more challenging to measure the moisture content in wood chips. So for that reason this description will concern wood chips (primary forest fuels).

Figure 2: Branches and tops, to be chipped. (photo: Johanna Wallin)

There are two dominating alternatives to purchase woodchips. One is that the volume of the tile is measured upon arrival in industry. There is uncertainty about this packing ratio and how it changes during transport. An experience based conversion factor is normally used for reversal volume to energy. The second method is that the tile is weighed and the moisture content determined by selection of woodchip samples. Weighing and moisture determination can be done to calculate the amount of energy.

The moisture content of wood chips affects the energy value, according to Skogforsk (https://www.skogforsk.se/kunskap/kunskapsbanken/2015/fukthaltsmatning/), and is therefore the most important quality parameter. At present, the so-called oven method is the standard for moisture determination. You dry a sample of chips in an oven until constant weight has been achieved. One disadvantage of the method is that the measurement takes at least one day, which is a problem for many heat plants. The chips can be burnt long before the measurement result is established, which decreases the potential for optimal combustion. Even at smaller terminals, the oven method is too slow and / or too difficult, even if you want to know the moisture content before delivering the material to the customer. More rapid methods are requested. The majority of the heating plants in Sweden use weight and moisture content as base for payment but at some plants only volume.

There may be heat plants, where the measurement of the moisture content not is required. It is the situation when, for example, the boiler is feeded with various types of bioenergy from a nearby saw-mill. This is the situation in some communities in the county of Kronoberg, where the sawmill is located at the same spot as the heat plant and where the sawmill is the single supplier of fuel. The costs for the fuel will be calculated on basis on how much heat the facility has delivered.

Figure 3: Heaps of wood chips. (photo: Karin Abrahamsson)

<u>Modern measurement methods</u>

Two methods currently in progress but partly still at the development stage are NIR and RF. NIR (Near Infra Red) is based on technology where the material is irradiated with infrared light, the reflection of the light is used for moisture determination. RF (Radio Frequency Method) uses electromagnetic waves. NIR will be detailed here, of two reasons, firstly it is

the most deveoped method of the two, and secondly it is installed at the big CHP plant in Växjö, the biggest city in the county.

In this method, according to Karin Hägg (https://stud.epsilon.slu.se/12150/1/hagg_k_171106.pdf), we use light waves with wavelengths in the range 800 - 2500 nm. Since normal optical glass can be used at these wavelengths, the method fits well for on-line use. In addition, the instruments are robust and durable, which means they tolerate the environment that usually is the situation at measuring stations. How far the light penetrates the material depends on the composition, density, size and shape of the sample. By analyzing the light's reflection, you get information about the composition of the material. The method works best on materials that move on a conveyor because of the larger area can then be measured. NIR entails a very high investment cost, but in return you get results quickly and you can also measure both ash content and energy content in addition to moisture content. Lower analytical costs also justify an investment. The RF method is interesting but it can only measure moisture content and the technology is not tested to the same extent as NIR.

Figure 4: NIR prob for measurement of moisture content (photo: Bestwood)

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