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Usage of Biofuels in Sweden.

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In Sweden, biofuels have come into substantial use, in an extent that are claimed to be bigger than use of fossil oil. One driving force for this have been the CO₂-tax that was introduced in 1991 (1). According to SVEBIO:s calculations (2) based on the Swedish Energy Agency's prognosis, the total energy consumption in Sweden 2012 was 404 TWh. If the figure is broken down on the different energy sources (figure 1) one can see that the consumption roughly distribute in three different, equally sized, blocks, Biofuels, fossil fuels and water & nuclear power.

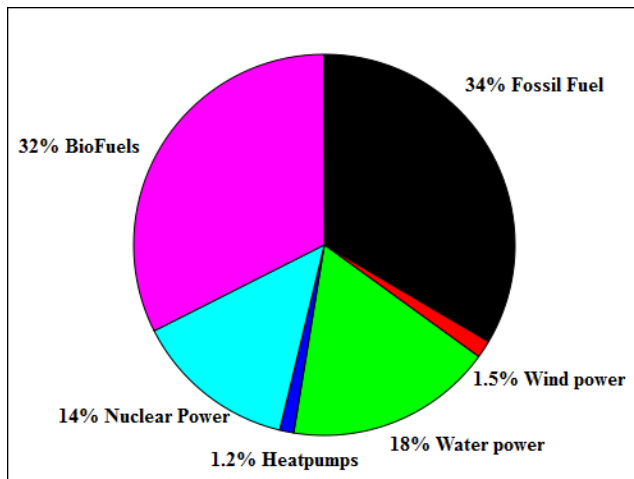


Figure 1 The total energy consumption, 404 TWh, in Sweden 2013 broken down on the different energy sources.

The major use of the fossil fuels is for transport and the water & nuclear power is used as electric power. The main use of the biofuels is for heating in the industrial sector and as district heating. In 2009 the consumption from those two segments was 85 TWh, and 10 TWh of bio power was co-produced giving an average biomass to electricity efficiency of 12%. This indicates a substantial conversion potential from hot water production to combined heat and power (CHP) production.

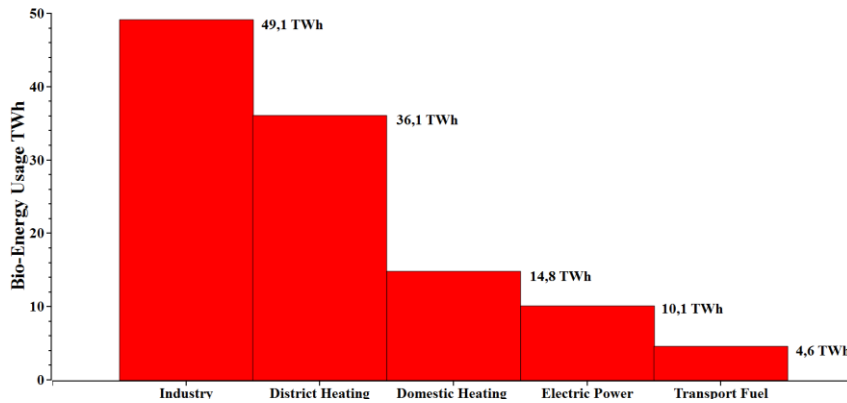


Figure 2 The bioenergy uses in Sweden 2009 (4)

In 2006 the pulp, paper and sawmill industry accounted for 95% of the bio energy consumption in the industrial sector, and the major biofuel consumed was black liquor (5). However, the pulp and paper industries also produced the black liquor in their own processes.

The major energy source (58%) for district heating during 2006 was woody biomass (chips, pellets etc.) followed by waste (24%), peat (6%) and others (12%) (5). The use of peat has probably decreased since 2006 since peat is no longer regarded as a renewable energy source.

While the use of biofuel for heating purpose is well developed and the bio-power is expected to grow, the use in the transport sector is small, 9 TWh or 7% in 2011. The main consumption there is due to the mandatory addition (5%) of ethanol to gasoline and FAME to diesel (6). The Swedish authorities have announced plans to increase the renewable content to 7.5 % in 2015 on the way to fulfill the EU's goal of 10 % renewable transportation fuels in 2020. However the new proposed fuel directive in EU says that a maximum of 5% renewable fuel may be produced from food sources like sugars and vegetable oils. Another bothersome fact is that, in principle, all rape seed oil produced in Sweden is consumed (95-97%) in the food sector, and consequently all FAME used (in principle) in Sweden is imported as FAME, rape seed oil or seed (6).

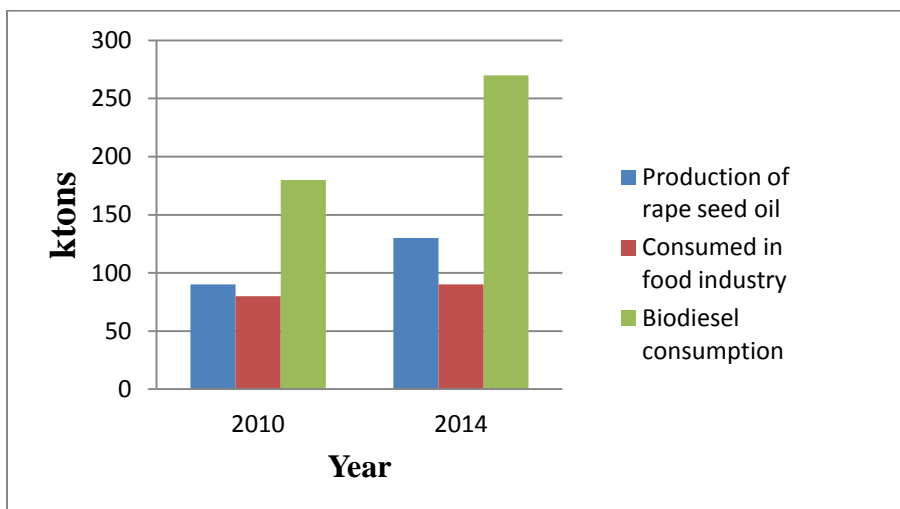


Figure 3 Production and consumption of rape seed oil in Sweden for 2010 and a prognosis for 2014. (6)

In Sweden a new source of biodiesel have emerged, tall oil diesel. Tall oil is extracted from black liquor and refined into a diesel fraction (not FAME) and can be mixed into fossil diesel, i.e. Preem Evolution diesel. The SUNPINE plant in Piteå have a capacity of 100 000 metric tons of tall oil diesel per annum, while the total potential in all of Sweden is claimed to be 200 000 tons (7). 100 000 tons of tall oil corresponds to 1% of the total diesel consumption in Sweden.

Accordingly, the profoundest task is to decrease the fossil fuel dependency in the transport sector, and clearly, the first generation biofuels can't do this on its own.

Biogas is a fuel gas with high methane content that can be used in a similar way to natural gas; for instance for cooking, heating and as transportation fuel. Today biogas is produced by fermentation of waste (municipal waste, sludge, manure), but a similar gas can be produced by gasification of biomass, for instance from forest residues such as branches and rots (GROT in Swedish). To get high efficiency in the production, the lower hydrocarbons, mainly methane, in the producer gas, should not be converted into synthesis gas. Instead a synthesis gas with high methane content is sought. This limits the drainage of chemically bonded energy, due to the exothermic reaction in the synthesis step (so called methanisation).

In 2011 0.7 TWh of biogas was produced in Sweden by fermentation of waste (6) and there were no production by gasification, at least not of economic importance. The potential seems to be large, though. In 2008 the total potential for biogas production, in Sweden, from waste by fermentation and gasification was estimated to 70 TWh (10 TWh fermentation and 60 TWh gasification) (8). This figure includes only different types of waste and no dedicated agricultural crops or dedicated forest harvest.

Activities in the biogas sector, by gasification, in Sweden are the Göteborgs energi's Gobigas project in Gothenburg and Eon's Bio2G-project, now pending, in south of Sweden.

If the producer gas is cleaned and upgraded into synthesis gas also other fuels could be produced. In Sweden methanol and DME productions are planned for in the Värmlands metanol-project and at Chemrecs DME production plant in Piteå.

References.

- 1) Bioenergy the Swedish experience.
Kjell Andersson, SVEBIO, 2012, Stockholm, Sweden, ISBN: 978-91-977624-4-1
- 2) SVEBIO, <http://www.svebio.se/english/bioenergy-facts>, 2013-05-20
- 3) Bioenergi Sveriges största energikälla", SVEBIO Report, April 2010
- 4) Small scale gasification: gas engine CHP for biofuels.
Jan Brandin, Ingemar Odenbrand, Martin Tunér, Linnaeus University, 2011, rapport, Växjö, Sweden, ISBN: 978-91-86983-07-9
- 5) Potentialen för bioenergi, SVEBIO Report, April 2008
- 6) Usage of bio-oils for biofuel production in Sweden
Lina Shahin, Linnaeus University, Diploma work, Växjö, Sweden, 2012,
- 7) Sunpine, Piteå, Sweden, <http://www.sunpine.se/>, 2013-05-20
- 8) Den Svenska biogas potentialen från inhemska restprodukter.
Linné M., Ekstrand A., Engelsson R., Persson E., Björnsson L. och Lantz M.
Avfall Sverige, Svenska Biogasföreningen, Svenska Gasföreningen och Svenskt Vatten, 2008