Liquid biofuels, new opportunity for peat

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Summary

The EU has set a binding target for all member states to increase the share of traffic biofuels up to 10 % by 2020. There are several possibilities to produce biofuels: biogas from waste and plants, ethanol from grain, potatoes and sugar plants, and vegetable oil from plants. 2nd generation biofuels like Fischer-Tropsch biodiesel can use a wide variety of raw materials such as wood, peat and all kinds of biomass. This will become a very important issue in future, because there will be a shortage of raw materials when the EU countries try to reach the renewable energy target of 20 % by 2020.

According to research conducted in Finland, peat is a very suitable raw material for FT diesel. The tar content of the raw gas is smaller than in wood, and the quality of the product gas is high. The quality of peat is stable, and the supply of peat can be secured for decades. The peat that is harvested from drained peatlands fulfils all the sustainability criteria of the new EU Renewables Directive, including a minimum of 35 % reduction in greenhouse gas emissions according to Life Cycle Analysis. Finland could produce a significant share of traffic fuels from peat for hundreds of years. Outside the EU, the largest reserves of peat are in Canada and Russia.

Key index words: Peat, biodiesel, biofuel

Introduction

The purpose of this paper is to look at the possibilities of using peat as a raw material for biodiesel. On 23 January 2008, the EU Commission proposed a new Directive on the promotion of the use of energy from renewable energy sources. The overall target for renewables is 20 % of the final energy consumption by 2020. This target varies between the member countries, depending on the renewable energy sources, but every country has a binding target of 10 % for traffic biofuels by 2020 (Commission of the European Communities 2008). The target means that the amount of total renewable energy should increase from 100 Mtoe up to 351 Mtoe by 2020, and there should be no increase in the use of energy in the EU (Ragwitz *et al.,* 2005). In the next 12 years, the use of biomass should increase from 70 Mtoe up to 195 Mtoe, which is nearly three times the amount used today. The biggest resources of biomass in the EU are agriculture (46 Mtoe), waste (100 Mtoe) and forestry (47 Mtoe). Growth can only be seen in agriculture, and the target for 2020 is 95.8 Mtoe. The total sustainable biomass potential is 234.7 Mtoe by 2020 (AEBIOM 2007). This means that almost all the potential should be used and the growth would come from agriculture. It is very likely that there will be a shortage of biomass in the EU. Peat resources were not included in this inventory.

Requirements for biofuels

The new directive sets sustainability requirements for biofuels, based on Life Cycle Analysis. There will also be a Fuel Quality Directive which will set fuel quality criteria for biofuels. Biofuels should fulfil the following criteria:

- Greenhouse gas reduction should be at least 35 % in the well-to-wheel chain.
- The production of biofuels should not endanger biodiversity.
- The production of biofuels should not decrease the production of food.
- The production of biofuels should not significantly decrease the carbon stock of the land area (land use change).
- Biofuels should fit into the distribution chain of the present traffic fuels, and they should be suitable for use in vehicle engines.
- Biofuels should increase the security of supply and self sufficiency.
- The production of biofuels should create jobs in the countryside.
- The production of biofuels should be cost efficient.
- The production of biofuels should be certified.

Biofuel production methods

Biofuels are classified into first generation and second generation biofuels. The first generation biofuels are already on the market, and the second generation biofuels are at the demonstration phase. The first generation biofuels are: biogas from manure, waste and green plants, biodiesel from oil plants, and ethanol from sugar plants, grain and potatoes. The problems rising from the first generation biofuels are as follows:

- The greenhouse gas savings target of 35 % is difficult to achieve (ethanol from grain).
- The fuel does not suit the present distribution system or vehicle engines (biogas).
- There is a limit in mixing biofuel with mineral fuel (ethanol, biodiesel from plants).
- The fuel quality does not meet the targets of the Fuel Directive (biodiesel from plants).
- Fuel production competes with food production (agricultural raw materials).
- Raw material production endangers biodiversity.

The most promising technology for 2nd generation biofuel production is gasification and Fischer-Tropsch synthesis. In this process, the raw material first goes through a gasification process. The aim of the process is to produce pure H_2 and carbon oxide. The product gas is then cleaned in readiness for the Fischer-Tropsch synthesis. In the synthesis, biodiesel or other fuels are formed by catalysts. About 55 % of the raw material is transformed into fuel and about 35 % into heat, which can be used as a heat and power source. The overall efficiency is about 90 %. The potential raw material base is wide, and almost all materials containing carbon can be used. The fuel quality is high and very suitable for the present vehicle engines and distribution systems. The process is widely used in South Africa, with coal as a raw material. As to biomass, several demonstration projects have been launched.

Peat as raw material for biofuel

Availability

Even within the EU, there are huge reserves of peat, especially in Finland, Sweden, Estonia and Latvia. Also Ireland has a lot of peat. For instance in Finland, there are 9.4 million ha of peatland, which is about 30 % of the land area. About 50 % of the peatland area is drained for forestry and agriculture, about 45 % is pristine peatlands, and only 0.6 % is used for peat production. The energy content of the Finnish peatlands is 58 000 TWh, which is 6-7 times more than the energy content of the Finnish forests. According to Virtanen *et al.* (2003), technically exploitable peat reserves are as big as 12 800 TWh, which equals the known North Sea oil reserves. These peat reserves, however, only account for 14 % of the total peatland area. Sweden has about 10 million ha of peatlands and Estonia 1 million ha, which means that there are good possibilities to use peat as raw material for biofuel.

Technical aspects

The economy of a Fischer-Tropsch plant is better if the plant is large enough. The minimum commercial size is estimated at 260 MW fuel capacity. This means that the raw material requirement of the plant is about 2 TWh/a. If forest residue is used as raw material, it is very difficult to guarantee the supply of raw material for the life time of the investment. Peat deliveries, on the other hand, can easily be guaranteed for 15-20 years even if the demand is heavy. If the plant uses both wood and peat, the availability of raw material would be secured.

Technically peat is a very good raw material. The heating value is good, the quality is stable and moisture content low. With the new harvesting technology developed by Vapo, peat is an ideal raw material for the process. According to gasification tests, the tar content in the peat product gas is lower than in the gas produced from wood, and the quality of the product gas after cleaning is as good. (Kurkela *et al.*, 2007; Hernàndez and Moilanen, 2007; McKeough and Kurkela, 2007.)

Environmental aspects

Recent studies in Finland and in Sweden have shown that drained peatlands are sources of greenhouse gases. The reason is that peat decomposes when the water level goes down (Uppenberg *et al.*, 2001; Nilsson *et al.*, 2004; Holmgren *et al.*,2006; Laine, 2007). The total emissions in Finland are estimated to be over 10 million tons of CO_2/a, which is almost the same as the emissions from road traffic in Finland. In Sweden, the estimated emissions are even bigger: 20 million tons of CO_2/a. When peat from drained peatlands is harvested and used as raw material for biofuel, and when a cutaway bog is afforested or used for agriculture, the emissions from the peatlands stop, and the area turns back to a carbon sink. If the biomass grown on a cutaway bog is used as raw material for biofuel, the use of peat decreases greenhouse gas emissions by more than 35 % during a life cycle of 300 years (Kirkinen *et al.,* 2007).

Conclusions

Peat is an extremely suitable raw material for biofuel for the following reasons:

- Peat is a good raw material for biodiesel.
- There is a lot of peat in the Nordic and Baltic Region countries, in Russia, and in Canada.
- According to Life Cycle Analysis, peat harvested from drained peatlands can achieve a reduction of 35 % in greenhouse gases.
- Peat harvesting in drained areas does not endanger biodiversity; besides, peat harvesting areas remain small in any case.
- As a raw material for biofuel, peat does not endanger food production.
- The use of peat increases the energy self sufficiency in countries like Finland. If Finland uses 2 % of its peatland areas for biofuel production, the country could produce 50 % of its traffic fuels for 50 years.

References

Association européenne pour la Biomasse, European Biomass Association (AEBIOM) 2007. *Boosting Bioenergy in Europe* - Final Report.

Hernàndez, E., Moilanen, A. (2007). Laboratory characterisation of biomass and peat feedstocks for UCG gasifier. VTT-R-05202-07.

Holmgren, K., Kirkinen, J., Savolainen, I. (2006). The climate impact of energy peat utilization - comparison and sensitivity analysis of Finnish and Swedish results. IVL Swedish Environmental Research Institute.

Kirkinen, J., Savolainen, I., Soimakallio, S. (2007). Greenhouse impact of the production and use of peat-based Fischer-Tropsch diesel. VTT.

Kirkinen, J., Minkkinen, K., Penttilä, T., Kojola, S., Sievänen, R., Saarnio, S., Silvan, N., Laine, J. and Savolainen, I. (2007). Greenhouse impact due to different peat fuel utilization chains in Finland - A life cycle approach. *Boreal Environment Research*. **Vol 12:** 211-223.

Kurkela, E., Simell, P., McKeough, P., Kurkela, M. (2007). UCG-projekti, loppuraportti. Kaasutusprosessin tutkimus ja kehitys. VTT-R-4948-07.

McKeough, P., Kurkela, E. (2007). Process evaluations and design studies in the UCG project (2004-2007). VTT-R-05650-07.

Nilsson, K. & Nilsson, M. (2004). The Climate Impact of Energy Peat Utilization in Sweden - the Effect of Former Land–use and After–treatment. IVL:B1606.

Ragwitz, M., Schleich, S., Huber, C., Resch, G., Faber, T., Voogt, M., Coenraads, R., Clejne, H., Bodo, P. (2005). FORRES2020: Analysis of the renewable energy sources' evolution up to 2020.

Uppenberg, S., Zetterberg, L., Åhman, M. (2001). Climate Impact from Peat Utilization in Sweden. IVL Report. B 1432.

Virtanen, K., Hänninen, K., Kallinen, R-L., Vartiainen, S., Herranen, T., Jokisaari, R. (2003). Suomen turvevarat 2000. Geologian tutkimus-keskus. Tutkimusraportti 156. Espoo.