Perstorp
WINNING FORMULAS

Perstorp RME – greenhouse gas saving

Summary

This is a summary of the complete LCA report composed by Pål Börjesson, Peter Mårtensson and Marcus Svensson at Lund University.

The lifecycle of the RME produced by Perstorp BioProducts in Stenungsund has been thoroughly examined during the autumn 2008. (Update December 2010: This study was completed before the criteria in the RED, Renewable Energy Directive, were settled and can't be used for the purpose of complying with any of these criteria.)

According to the Renewable Energy Directive the greenhouse gas (GHG) emissions from regular diesel is 83.8 g CO_2 equivalents per MJ fuel.

As you can see in Figure 1 every activity in the lifecycle of RME has a certain impact on the climate. The sum of all the emissions in the lifecycle is 31 g CO_2 equivalents per MJ fuel for Perstorp's RME. This gives a 63 % saving of GHG emissions compared to regular diesel.

Below you will find details about each of the steps in the lifecycle.

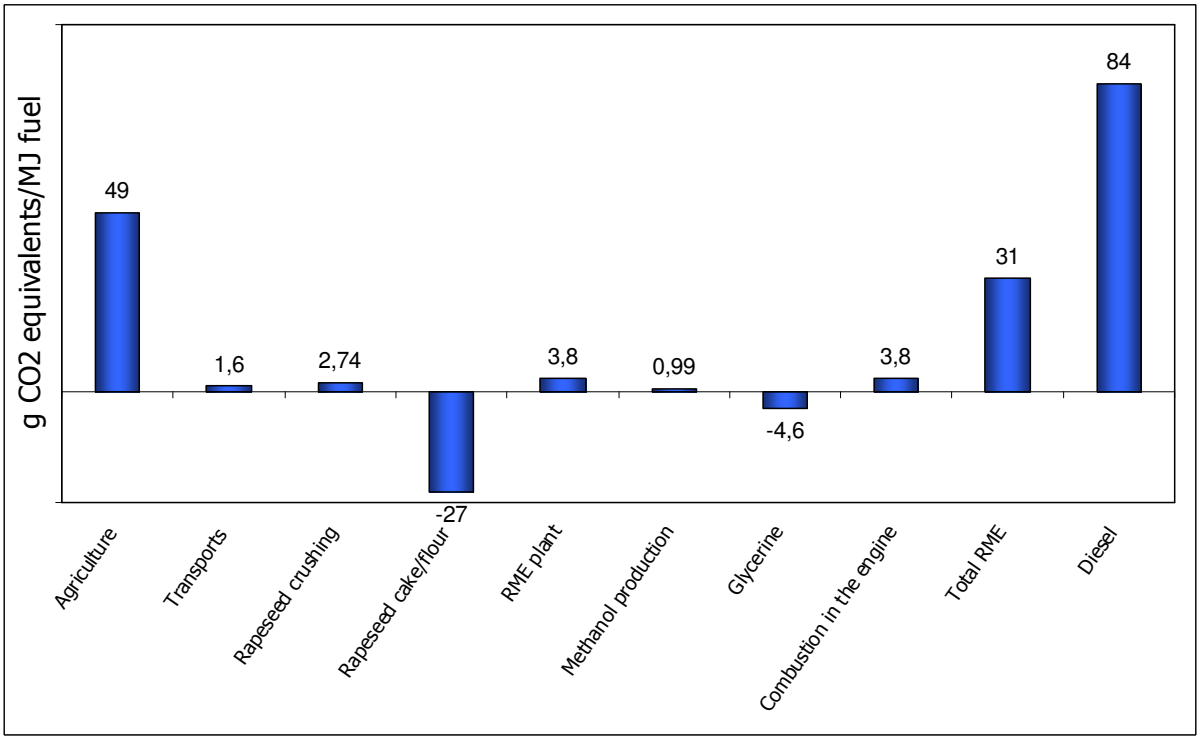

Figure 1: Greenhouse gas (GHG) emissions for every activity in the lifecycle of Perstorp's RME. The bar to the right shows the GHG emissions for regular diesel.

Energy balance

Since there's a question regarding the energy efficiency for biofuels in general the energy output and energy input have been analysed for Perstorp's RME. In Figure 2 it's seen that 1 MJ of energy input gives 3.9 MJ of products in the other end. Furthermore, straw is excluded, since straw is put back into the soil.

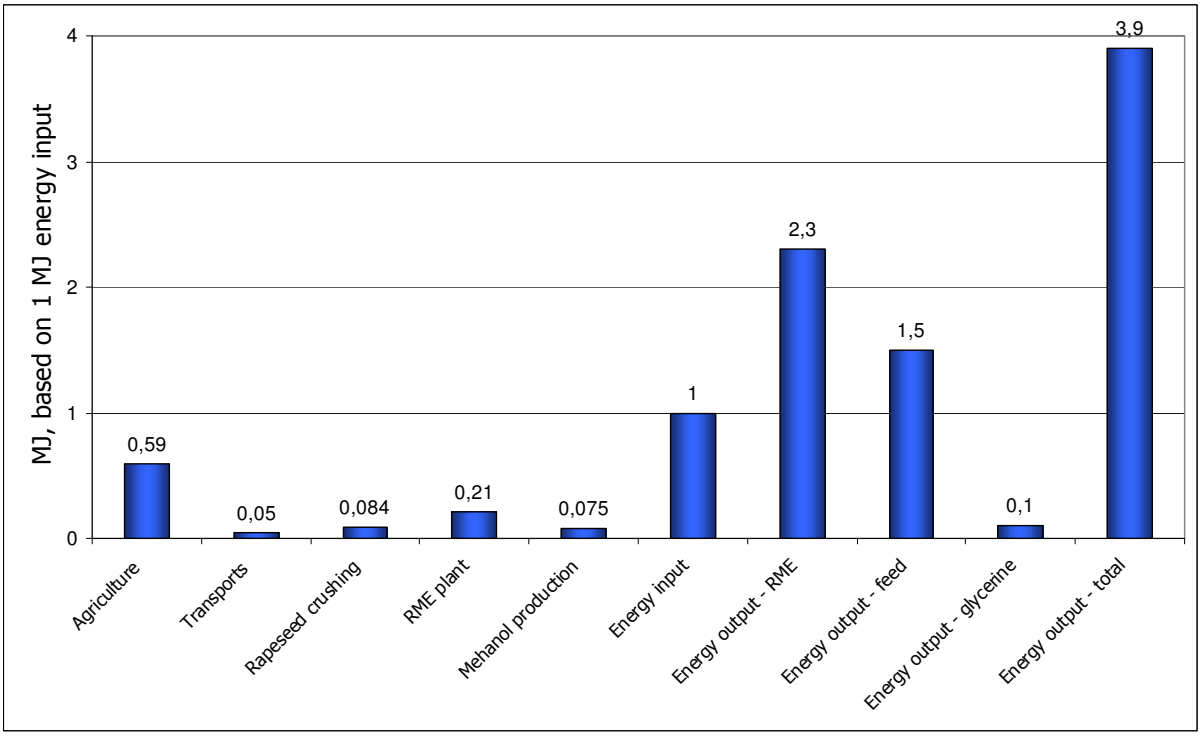

Figure 2: The diagram shows that 1 MJ energy input gives 3.9 MJ energy output.

Almost 60 % of the total energy input come from farming activities, which is the bar called "Agriculture" in Figure 2. The energy consumption in the RME plant is 21 % of the total energy consumption.

Agriculture

As we have seen, the factor with the highest impact on the carbon saving is agriculture. The production of fertilizer is included in farming activities which is a very energy consuming process. This step emits both CO_2 and N_2O, which both are greenhouse gases (GHG).

The global warming potential (GWP) is 298 times higher for N_2O than for CO_2. This means that even a small amount of N_2O emissions has a high impact on the climate.

Since the agriculture include production of fertilizer, emissions from the fields, agricultural activities (ploughing, sowing, harvesting, etc.) and drying Table 1 has been added to clarify how much each activity contribute to the GHG emissions in this part of the LCA.

GHG emissions in agriculture (kg CO_2 equivalents per ton dry rapeseed)							
Emission	Fertilizer production	Leakage	Machines/fuel	Drying	Additional	Total	%
CO_2	188	0	92	35	43	359	45%
CH_4	6	0	0	0	0	6	1%
N_2O	137	303	0	0	0	440	55%
Total	331	303	92	35	43	805	100%
%	41%	38%	11%	4%	5%	100%	

Table 1: GHG emissions in agriculture, expressed in kg CO_2 equivalents per ton rapeseed

As is shown in Table 1 the fertilizer production emits most GHG, followed by the emissions from the ground. Every farmland in the world has leakage of N_2O, with or without applied fertilizer. However, the amount of fertilizer applied to the soil affect the magnitude of this leakage (emission), but it's still not investigated how much this would differ.

Most of the machines used in the agriculture could use a renewable fuel, which would improve the LCA significantly. Tractors, harvesters and trucks could use RME for example, and then the agriculture bar in Figure 1 would be reduced with 11 %.

The fertilizer producers are also installing catalytic N_2O cleaning in their processes, which will have a very positive effect on this LCA.

Since the impact from agriculture can be reduced it's likely that the total GHG savings will be even higher in the future.

The average yield has been estimated to 3.2 tonnes of rapeseed per hectare, which is low compared to the yields that was monitored for the harvests in 2008 and 2009. A higher yield of rapeseed will also improve the total GHG savings for RME.

Transports

The GHG contribution from transports is very low compared to the other activities in the RME lifecycle.

The rapeseed is transported from the farmer on truck and boat. A big bulk load of rapeseed doesn't contribute very much to the GHG emissions. Thus, a shorter distance between the farmer and the crusher doesn't have any significant impact on the LCA.

The rapeseed oil goes on boat from the crusher to the RME plant, and the produced RME is sent by boat to the low-blend customers (distributors of diesel that blend in 5 or 7 % of RME into the diesel). This supply chain is very efficient as it is already.

Crushing of rapeseed

Perstorp is purchaser of rapeseed oil that has been crushed in Europe. The oil can be extracted with or without hexane. The main difference is that apart from the oil the product will be either rapeseed cake or rapeseed flour. Both are used as feed for animals and the rapeseed cake contains more fat (i.e. oil that hasn't been extracted).

For the greenhouse gas balance the difference is not very important, since both types of plants need energy for the process and the added distillation column has a small impact on total energy consumption.

Rapeseed cake or rapeseed flour

In Figure 1 there's a negative bar called "rapeseed cake/flour". This bar is negative because the feed produced in the rapeseed crushing replaces imported soymeal from South America.

The RME plant

The feedstock is to 90 % rapeseed oil, and the remaining 10 % is methanol. The products are 90 % RME and 10 % glycerine. No other raw materials are used, the catalyst is solid and the process is efficient. The reaction takes place under high temperature and high pressure which requires some energy input. Since the energy is considered to be fossil energy the process releases some CO_2 (3.8 g per MJ fuel, as shown in Figure 1).

Methanol

When methanol is produced some minor emissions of CO_2 are released into the atmosphere.

Glycerine

Glycerine or glycerol is 10 % of the products in the RME plant. In some applications glycerine replaces chemicals produced from fossil resources. Hence the negative bar called "Glycerine" in Figure 1.

Combustion in the engine

In the engine the RME is combusted and since the fuel is made of 10 % methanol this portion of CO_2 emission is considered as fossil. Hence the net emission of 3.8 g CO_2 equivalents per MJ fuel, as shown in Figure 1.

If there would be renewable methanol available the greenhouse gas emissions could be reduced with approximately 5 %.

Perstorp BioProducts AB, 2009-04-08

Anders Hultgren
Business Analyst

Perstorp BioProducts AB
Direct: +46 435 377 80
Mobile: +46 734 274 981
www.perstorpbioproducts.com