RESULTS FROM THE EUROPEAN CARBON LABELLING INITIATIVE CO_2STAR

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ABSTRACT: Today, passenger cars alone are responsible for around 12% of European CO_2 emissions. An opportunity to reduce CO_2 emissions in transport is provided by the use of biofuels with beneficial life cycle CO_2 emissions. The Carbon Labelling project (Project No. EIE/06/015) promotes the use of biofuels by implementing different labelling initiatives in Europe and applying the developed carbon label "CO_2Star" to biodiesel, efficient lubricants and biofuel based freight services. In a first step a supportable methodology for the quantification of carbon life cycle reductions was identified in co-operation with recent and on-going activities and methodologies by European and worldwide expert groups such as SenterNovem (NL), ifeu Institute (DE) and Imperial College (UK). In a second step the Carbon Labelling initiative actively promoted this carbon reduction to consumers. Finally, a consumer survey was conducted in order to assess the success of this initiative and the acceptance of GHG labels. This paper gives an overview about the current discussion on carbon reductions in the transport sector, different GHG calculation methodologies, and about the results of the 'Carbon Labelling' project which is supported by the Intelligent Energy Europe Programme.

Keywords: biodiesel, liquid biofuel, CO_2 balance, socio-economic aspects, labelling, CO_2 emission reduction

1 INTRODUCTION

Road transport is the second largest source of greenhouse gas emissions in the European Union (EU) after power generation. Road transport contributes about one-fifth of the EU's total emissions of carbon dioxide (CO_2) and it is one of the few sectors where emissions are still rising rapidly. Currently, passenger cars alone are responsible for around 12% of EU CO_2 emissions.

Currently, opportunities for reducing carbon dioxide emissions in the transport sector are discussed in order to meet European greenhouse gas reduction targets. Therefore, the European Commission wants car manufacturers to cut the average CO_2 emissions of new car fleets to 130g/km by 2012, 18% lower than 2005 levels [1]. Improvements in motor technology would have to reduce average emissions to 130g/km, while complementary measures would contribute a further emissions cut of up to 10g/km, thus reducing overall emissions to 120g/km. These complementary measures include efficiency improvements for car components, such as tyres and air conditioning systems, and a gradual reduction in the carbon content of road fuels, notably through greater use of biofuels.

One opportunity to support CO_2 emission reductions in the transport sector is to raise the awareness of consumers. This can be done by informing consumers about CO_2 emissions of cars per kilometre.

Another opportunity is to inform consumers about the CO_2 reduction potential of biofuels when compared to fossil fuels. This approach is encouraged by the Carbon Labelling project [2]. The aim is to create and implement a European label for CO_2 reductions through biodiesel and fuel efficiency measures.

2 THE CARBON LABELLING PROJECT

The overall objective of the Carbon Labelling project is to reduce carbon emissions in the European transport sector by promoting the use of biodiesel and improved lubricants. This will raise awareness of consumers and thus increase the use of biofuels (biodiesel) in Europe. The work programme of the Carbon Labelling project includes the following work packages which are implemented by project partners from Germany, United Kingdom, The Netherlands, Poland, and Malta:

- Carbon Life Cycle Assessment
- Carbon Label for Fuels
- Carbon Label for Freight Services
- Carbon Label for Lubricants
- Support for Biofuels in New EU States
- Consumer Survey
- Dissemination Activities

The Carbon Labelling project (www.co2star.eu), is coordinated by WIP Renewable Energies (Germany) and supported by the European Commission under the Intelligent Energy – Europe Programme (October 2006 to September 2008).

Figure 1 shows the logo selected by the project consortium for the promotion of CO_2 reduction in transport through biodiesel and fuel efficiency measures.

Figure 1: CO_2Star logo developed for the Carbon Labelling project

3 CARBON LIFE CYCLE ASSESSMENT

In the framework of this Carbon Labelling Initiative supportable methodologies for the quantification of carbon life cycle reductions were identified in co-operation with recent and on-going activities and methodologies by European and worldwide expert groups from research, industry and politics involved in carbon life cycle assessments. An application of carbon LCA methodologies within the Carbon Labelling project is necessary in order to define scientifically proven carbon reduction numbers. Therefore, approaches of SenterNovem (NL), ifeu Institute (DE) and Imperial College (UK) were compared to each other and to the methodology proposed by the European Commission [3].

3.1 Methodology of the European Commission

The European Commission has issued a Draft Directive "on the promotion of the use of energy from renewable sources" on 23 January 2008 [3]. Currently, this Draft Directive is under review by the European Parliament and the Member States.

Article 17 of the Draft Directive covers the calculation of the greenhouse gas impact of biofuels and other bioliquids. According to this Article, the greenhouse gas emission saving from the use of biofuel and other bioliquids shall be calculated as follows:

(a) "for biofuels, where a default value for greenhouse gas emission savings for the biofuel production pathway is laid down in Part A or B of Annex VII, by using that default value;"

(b) "by using an actual value calculated in accordance with the methodology laid down in Part C of Annex VII; or"

(c) "by using a value calculated in accordance with the methodology laid down in Part C of Annex VII as the sum of actual values for some of the steps of the production process and the disaggregated default values in Part D or E of Annex VII for the other steps of the production process."

This Draft Directive also includes "Rules for calculating the greenhouse gas impact of biofuels, other bioliquids and their fossil fuel comparators" in Annex VII. Table I shows "Typical and default values for biofuels if produced with no net carbon emissions from land use change" included in Annex VII of the Draft Directive.

Table I: Typical and default values for biofuels if produced with no net carbon emissions from land use change [3]

biofuel production pathway	typical greenhouse gas emission saving	default greenhouse gas emission saving
sugar beet ethanol	48%	35%
wheat ethanol (process fuel not specified)	21%	0%
wheat ethanol (lignite as process fuel in CHP plant)	21%	0%
wheat ethanol (natural gas as process fuel in conventional boiler)	45%	33%
wheat ethanol (natural gas as process fuel in CHP plant)	54%	45%
wheat ethanol (straw as process fuel in CHP plant)	69%	67%
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	56%	49%
sugar cane ethanol	74%	74%
the part from renewable sources of ETBE (ethyl-tertio-butyl-ether)	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE (tertiary-amyl-ethyl-ether)	Equal to that of the ethanol production pathway used	
rape seed biodiesel	44%	36%
sunflower biodiesel	58%	51%
palm oil biodiesel (process not specified)	32%	16%
palm oil biodiesel (process with no methane emissions to air at oil mill)	57%	51%
waste vegetable or animal oil biodiesel	83%	77%
Hydrotreated vegetable oil from rape seed	49%	45%
Hydrotreated vegetable oil from sunflower	65%	60%
Hydrotreated vegetable oil from palm oil (process not specified)	38%	24%
Hydrotreated vegetable oil from palm oil (process with no methane emissions to air at oil mill)	63%	60%
pure vegetable oil from rape seed	57%	55%
biogas from municipal organic waste as compressed natural gas	81%	75%
biogas from wet manure as compressed natural gas	86%	83%
biogas from dry manure as compressed natural gas	88%	85%

Furthermore, the Draft Directive gives guidance on how to calculate greenhouse gas emissions from the production and use of transport fuels:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{ccs} - e_{ccr} - e_{ee}$$

E = total emissions from the use of the fuel;
e_{ec} = emissions from the extraction or cultivation of raw materials;
e_l = annualised emissions from carbon stock changes caused by land use change;
e_p = emissions from processing;
e_{td} = emissions from transport and distribution;
e_u = emissions from the fuel in use;
e_{ccs} = emission savings from carbon capture and sequestration;
e_{ccr} = emission savings from carbon capture and replacement; and
e_{ee} = emission savings from excess electricity from cogeneration.

Greenhouse gas emission savings from biofuels and other bioliquids shall be calculated as:

$$SAVING = (E_F - E_B)/E_F$$

E_B = total emissions from the biofuel or other bioliquid; and
E_F = total emissions from the fossil fuel comparator.

Since this Draft Directive is currently under review, changes in the GHG calculation methodology may be implemented. For the CO_2Star campaign at Q1 fuelling stations rape seed biodiesel (RME) is used. According to the Draft Directive, the default value is 36% and the typical value is 44% (Table I). These numbers were published in the Draft Directive in January 2008.

3.2 Methodology of Senter Novem

In The Netherlands an Excel based GHG calculation tool (Figure 2) was elaborated by Ecofys, CE Delft, and SenterNovem in order to provide scientific support for policy decisions. The calculator can be applied for several biofuels (including biodiesel and biomethane) and for several feedstocks.

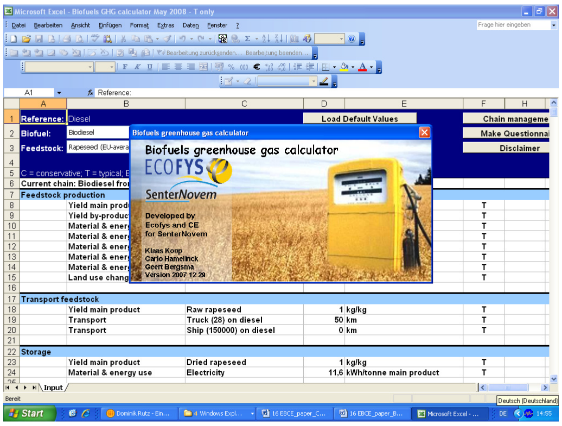

Figure 2: Biofuels GHG calculator of Senter Novem, The Netherlands

For biodiesel, the calculator includes data on feedstock production, transport and storage of feedstock, extraction, refining, esterification, and for the transport of the biodiesel. Figure 3 shows the result for calculating default values for RME in Europe and 65.3% GHG reduction is calculated if compared to fossil diesel.

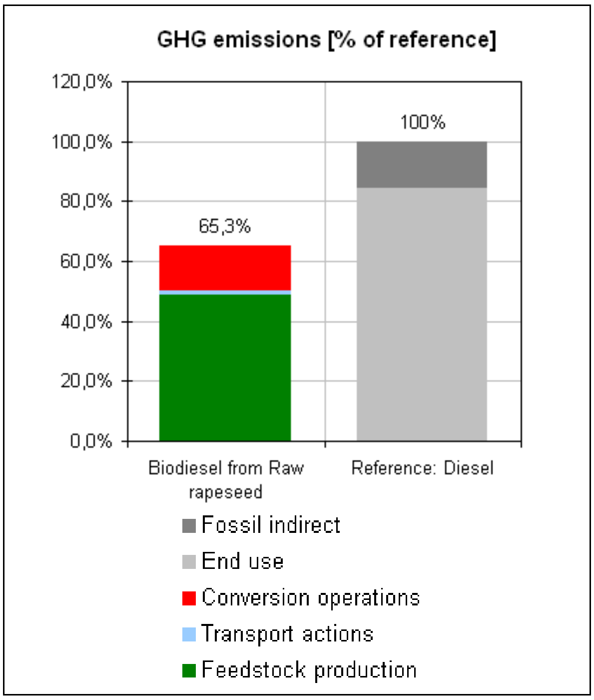

Figure 3: Default value of GHG emissions of RME in Europe

3.3 Methodology of ifeu Institute

The ifeu Institute, Germany, implemented several projects [4, 5, 6, 7] in order to compare GHG balances of liquid biofuels with conventional liquid fuels. All calculations are based on complete life cycle comparisons. Thereby, different production sites, different production methods (conventional and organic farming) and different applications (passenger cars, buses, lorries, tractors) are investigated. The following biofuels are in the research portfolio of the ifeu Institute:

- Biodiesel (from rapeseed, sunflowers, soybeans, canola, coconut oil, recycled plant oil, animal grease)
- Plant oil (from rapeseed, sunflowers)
- Bioethanol (from sugar-cane, sugar-beet, corn, wheat, potatoes, molasses, lignocellulose)
- Bio-ETBE
- Biomethanol
- Bio-MTBE
- Bio-DME
- BTL
- Other (non-liquid) biofuels for transportation such as biogas and hydrogen

According to the experts of the ifeu Institute, 60% GHG reduction can be calculated for RME which is produced in Germany.

3.4 Methodology of HGCA/Imperial College

The Biofuels GHG calculator developed by Imperial College London [8] and the Home Grown Cereals Authority (HGCA) is a spreadsheet-based tool (Figure 4) for calculating the GHG emissions resulting from the production and use of wheat-based bioethanol and rapeseed biodiesel in the United Kingdom. It uses input data describing the entire production chain for any given batch of these biofuels, calculates the GHG emissions and compares the emissions with those produced from the production and use of an equivalent quantity of petrol or diesel. It is based on standard life-cycle analysis (LCA) principles, using user input or default data to produce inventories of inputs, outputs and GHG emissions for all supply chain stages. The resulting well-to-tank (WTT) emission figures allow appropriate comparisons between different biofuels and between biofuels and fossil fuels. For each WTT calculation, the calculator guides the user through a set of steps in a life cycle inventory, before presenting the results and allowing for examination of the detailed calculations. Each step of the calculations is presented on a separate page, so that users may more easily focus on those steps of most interest to them and simply accept defaults for those steps of less interest or over which they have little control. Thus a farmer can focus on analysing the GHG impacts of farm level choices, while simply accepting suggested defaults for fuel production plant and other supply chain parameters [9].

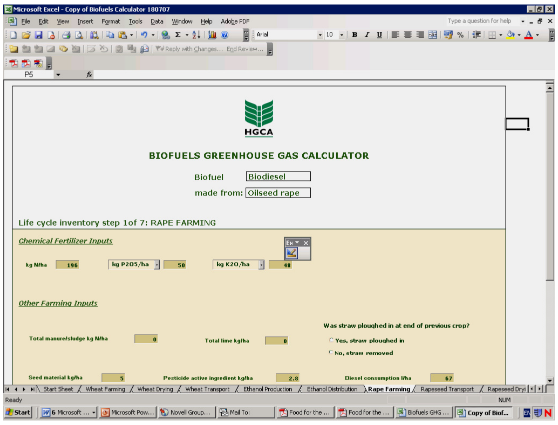

Figure 4: Biofuels GHG calculator of Imperial College and Home Grown Cereals Authority, UK

The default value for biodiesel from rapeseed which is calculated by this tool is 21.8%. The largest GHG emissions in this biodiesel process are related to fertilizers, pesticides, and seeds (1087 $kgCO_{2eq}/t$) followed by N_2O emmissions from soil (1017 $kgCO_{2eq}/t$), biodiesel production (517 $kgCO_{2eq}/t$), on-farm fuel use (89 $kgCO_{2eq}/t$), biodiesel distribution (13 $kgCO_{2eq}/t$), oilseed transport (10 $kgCO_{2eq}/t$), and oil seed drying and storage (7 $kgCO_{2eq}/t$). On the other hand, 489 $kgCO_{2eq}$ per ton of biodiesel are credited for the production of co-products.

4 BIODIESEL LABELLING

The German fuel distributor Q1 has 115 retail fuel stations in Germany, of which 100 are selling at least one alternative fuel. Q1 implemented the carbon labelling pilot programme (CO_2Star) at its fuel stations to provide information to consumers about environmental and economical benefits of biodiesel (B100). This campaign was launched on 12 July 2007 at a Q1 fuel station in Osnabrück, Germany (Figure 5).

Figure 5: The CO_2Star team at the launch of the labelling initiative at Q1 in Germany

For the fuel labelling initiative at Q1, it was agreed upon by the project consortium and the members of the Advisory Board that for the pilot labelling initiative of biodiesel (B100 RME) at Q1 fuel pumps a CO_2 reduction of 60% were promoted based on results of the ifeu Institute (Figure 6).

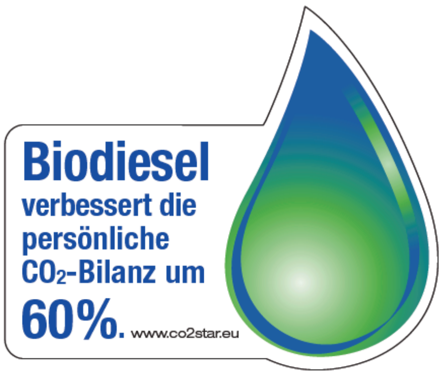

Figure 6: CO_2Star sticker

Figure 7 shows a Q1 fuel pump for B100 and information material about the CO_2Star campaign. A sticker which shows that biodiesel reduces 60% of CO_2 emissions is shown in Figure 6.

Figure 7: Q1 fuel pump for B100 and information material about the CO_2Star campaign

5 FREIGHT LABELLING

The carbon labelling initiative for freight services is implemented in cooperation with the 'Schoon product, Schoon vervoerd' pilot project in the Netherlands.

In January 2007 the pilot project Green products (sustainable production and safe products), Green transport (sustainable transport)' (in Dutch 'Schoon product, Schoon vervoerd') started in the Netherlands involving freight company services in the horticultural sector. This project is an initiative of a powerful consortium with several leading Dutch parties in production, trade and distribution of flowers, plants, vegetables, and fruits. The project comprises the set-up of biodiesel (B30) refuelling stations at different locations as well as the introduction of CO_2Star labels on the trucks transporting these products. A refuelling station for B30 has been installed.

Figure 8 shows the sticker for the trucks running on B30 in the Netherlands.

Figure 8: CO_2Star poster of the labelling campaign in The Netherlands

6 LUBRICANT LABELLING

Another initiative of the Carbon Labelling project is the development and implementation of a CO_2Star for lubricants. With innovative (synthetic) lubricants 2-6% fuel savings can be achieved and thus, carbon emissions can be reduced. The German fuel retailer Q1 identifies high quality lubricants and implements the CO_2Star label on its products. Detailed information for consumers on fuel savings and emission reductions are provided at the CO_2Star website.

The CO_2Star campaign is also linked to the information campaign on lubricants by the dena (Deutsche Energie Agentur, Germany) "ich-und-mein-auto" [10]. This campaign informs consumers about efficiency savings through improved lubricants.

7 CONSUMER SURVEY ON CARBON LABELS

In order to assess the consumer acceptance of the CO_2Star label, two consumer surveys were implemented in Germany and in the United Kingdom.

7.1 Consumer Survey at Q1 Fuel Pumps

In the framework of the CO_2Star campaign at Q1 fuel pumps, Q1 made a consumer survey in summer 2007 in order to assess the acceptability of a carbon label and to investigate the buying behaviour of German fuel customers [11]. The most important questions included:

- What are the most important motives when buying fuels?
- How aware are consumers about Climate Protection linked to their individual transportation?
- How do consumers assess the product biodiesel?
- Are consumers willing to contribute to Climate Protection by using climate friendly fuels?
- Would they pay a higher price for those fuels?

The most dominant result of this survey is the high importance of price for fuels. Diesel and biodiesel prices are of highest relevance for German clients. The biodiesel clients are even more price sensitive than the fossil diesel clients.

Being confronted with a pro climate statement the majority of persons underline their willingness to contribute to climate protection. However, this contribution is strictly limited if it affects the own purse. Only a minority would pay a surcharge for climate friendly fuels.

The knowledge about carbon reduction potential of biodiesel is very low, even among biodiesel consumers. This underlines the necessity to extend the educational advertisement of biofuels. Activities like the Carbon Labelling Project are accepted but it takes a long way to get the knowledge to the consumer.

On the other hand this study underlines the importance of monetary benefits for biofuels. The consumer is not willing to pay a higher price for biofuels. Currently, only tax exemptions will boost the sale of high blend biofuels (B100).

In Germany, taxation of biodiesel which was introduced in August 2006 (after full tax exemption until 2006) has led to a decline in biodiesel sales. This controversial decision contradicts the propagation of B100 as a carbon friendly fuel in Germany.

Figure 9: On-site consumer survey and information at Q1 fuel pumps

7.2 Consumer Survey in the UK

The consumer survey in the United Kingdom was implemented by the Home Grown Cereals Authority and The Oxford Partnership in January/March 2008. This two-staged survey included qualitative and quantitative sections. Emphasis of this survey was on the CO_2Star label and its acceptance in the public. For the qualitative survey, 8 focus groups were involved and for the quantitative survey 583 respondents answered to the questionnaire.

One of the main findings of this survey was that there is a large lack of knowledge about biofuels and especially about the RTFO (Renewable Transport Fuel Obligation) which was implemented on 1 April 2008 in the UK. There is virtually a complete lack of awareness in the UK of the introduction of blended fuel at the pumps from April. The full report of this survey will be available on the www.co2star.eu website in August 2008.

8 CONCLUSION

In conclusion, the importance of GHG reductions in the transport sector is shown by several studies [12, 13, 14, 15, 16] and by the current energy policy of the European Union [1, 3].

GHG calculation methodologies for liquid biofuels are currently under development. A selected methodology is also an integral part of the Draft Directive of the European Commission [3]. Currently, default values for the GHG savings of RME range between 21 and 65% due to different input data and different allocation methods for co-products. The CO_2Star campaign at Q1 fuel stations promoted 60% GHG reductions which is based on scientific results of the German ifeu Institute.

GHG reductions for lubricants are much smaller than for liquid biofuels (between 2 and 6%). Carbon Labelling initiatives on lubricants and on freight services are still under development.

Finally, the two consumer surveys showed that carbon labels only support purchasing decisions, but are of minor importance compared with the fuel price. Thus, the most important factor to promote biofuels is favourable frameworks, such as e.g. tax exemptions. Another result of the surveys was the general lack of knowledge of consumers about biofuels. The Carbon Labelling project contributes to raise public awareness and to increase consumer knowledge about biofuels.

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