

Transport biofuels: exploring links with the energy and agriculture sectors

Transport biofuels are being promoted as a useful means of greening the transport sector. However, impacts on the development of renewable energy and the intensity of agricultural land use need to be taken into account when assessing the overall environmental benefits.

The advantages of biofuels in transport

Fuels processed from crops and other organic material — biofuels — offer several advantages to the transport sector. They can help to reduce the growth in carbon dioxide (CO₂) emissions from transport

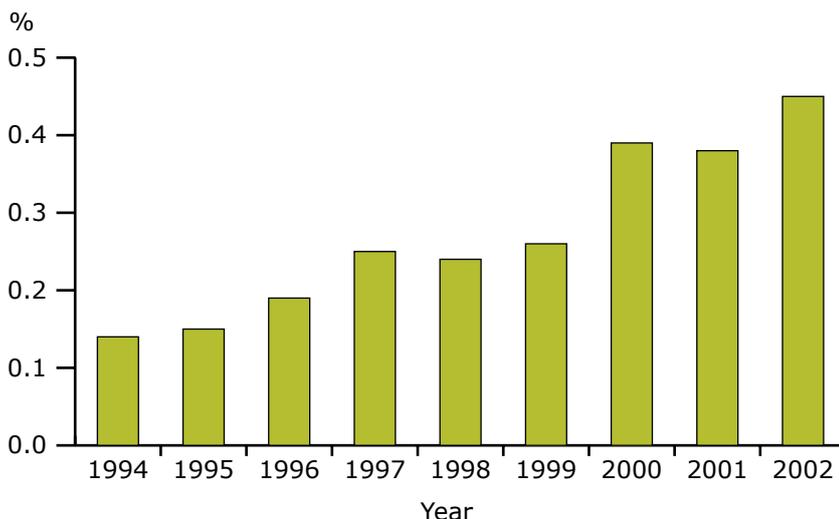
as a contribution to meeting the European Union's commitments under the Kyoto Protocol. By reducing transport's 98 % dependence on petroleum oil, they can also help to diversify and improve the security of fuel supply. Furthermore, they can provide alternative sources of income in rural areas of the EU.

The EU biofuels directive

The 2003 biofuels directive (1) aims to substantially increase the use of these fuels for transport, and in particular for road transport. National measures are to be taken by countries across the EU aiming at replacing 5.75 % of all transport fossil fuels (petrol and diesel) with biofuels by 2010.

To give an indication of the size of the task, biofuels accounted for only about 0.45 % of EU road transport energy consumption in 2002. However, though absolute levels are low, the production of biofuels is growing rapidly. The share was only 0.25 % in 1999, but estimates based on production capacity indicate that it could reach 1 % by 2004. If such growth rates are maintained, then the indicative target for 2010 could be achievable for the EU as a whole.

Share of biofuels in total transport consumption 1994–2002



Source: See reference (2).

Note: Data for 2002 are based on production rather than consumption of biofuels.

Table 1 Production of transport biofuels in 2002, 1000 tons oil equivalent

	Biodiesel	Bioethanol	Total
Germany	401		401
France	326	57	383
Italy	187		187
Spain		110	110
Sweden	1	31	32
Austria	22		22
Denmark	9		9
United Kingdom	3		3
Total	949	198	1 147

Source: See reference (3).

Nearly two thirds of the biofuels were produced in France and Germany where taxation regimes encourage their use. Italy and Spain are also large producers.

While the directive therefore seems to be taking effect in the transport sector, it is important to take a wider perspective on the overall impact of the directive. Depending on the options chosen, CO₂ emissions from energy production and agriculture can increase, and biofuel crop production can impact on the biodiversity of farmland. Such side effects must be taken into account when assessing the overall environmental benefits for society. This briefing describes these possible impacts on other sectors.

Energy production

Conversion of crops (biomass) to transport biofuels gives

lower energy savings and reductions in greenhouse gas emissions than other energy uses of biomass. This is because energy is required to convert the biomass to suitable fuels, lowering the net energy yield. By comparison, directly burning biomass in a power plant to produce electricity is significantly more energy efficient.

Diversion of land from the production of other energy crops to production of transport biofuels should therefore not be encouraged, because other energy crops have a greater overall potential for reducing CO₂ emissions. Any such diversion would also make it more difficult to achieve the indicative target of a renewables share of 12 % of gross inland energy consumption in 2010 (4) and the indicative targets that have been set for the share of renewable energy sources in electricity production (5).

Agriculture

In the following it is assumed that the required biofuel crops are produced in Europe. Import of biofuels or crops for biofuels will of course reduce or remove the environmental impacts described below, although it does raise other issues, such as the impact on biodiversity in producing countries. Large scale import of bioethanol from Brazil and other countries has been identified as a possibility.

Changes in land use

The biofuels directive influences the demand for a range of crops in Europe: oil crops such as oilseed rape, sunflower and soya for conversion to biodiesel; and starch crops such as wheat and sugar beet that provide the raw material for bioethanol, a petrol substitute.

Current price structures and food demand in Europe and world-wide mean that the increased demand for biofuels can be only partially met by reducing food production from potential biofuel crops (6). The total land area under crop production is therefore likely to increase. Studies (7) indicate that biofuel crops would take up between 4 % and 13 % of the total agricultural area in EU-25 (depending on the choice of crops and technological development) if the 5.75 % target of the biofuels directive is to be fully met and all crops are home grown.

Table 2 Land use requirements for different biofuel-crop combinations

Biofuel-crop combination	EU-15*%	EU-25*%
All rapeseed	10.0–11.1	8.4–9.4
Half and half rapeseed and wheat	9.0–15.5	7.6–13.1
Half and half sugar beet and wheat	5.6–11.8	4.7–10.0
Half and half sugar beet and woody biomass	4.8–6.4	4.1–5.4
All woody biomass	6.5–9.1	5.5–7.7

Source: See reference (7).

Note: The ranges convey estimated variation in crop productivity.

The lowest land use would come from an equal mix of sugar beet and woody biomass, while the most land-intensive single crop is rapeseed and the most land-intensive crop combination is one containing wheat.

In this context it is important to note that, relative to production capacity, the demand for diesel is higher than the demand for petrol in Europe. The market for biodiesel is therefore stronger than for bioethanol. However, crops for biodiesel (such as oilseed rape) generally require more land for the same amount of energy (fuel).

Taking into account the need to increase the production of other energy crops in order to meet the renewables targets referred to above, the total area needed for energy crops is estimated to be of the order of 11–28 % of current total agricultural area in EU-25 (7).

The possible impacts of this increased demand for land are discussed in the following.

Impact on carbon dioxide emissions

If long term fallow land is used for the production of energy crops or intensive food production in order to meet increased demand for land, significant quantities of CO₂ will be released — possibly enough to negate for many years the CO₂ benefits from switching to biofuels. This is because CO₂ is released from soil when organic matter is mineralised, a process that is speeded up by ploughing. More CO₂ is released from soils with large quantities of organic matter such as fallow land or grassland (8).

Impact on biodiversity

The EU has set itself the goal of halting the loss of biodiversity in Europe by 2010. Protecting so called high nature value farmland in Europe, mainly characterised by extensive farming practices, has been identified as a key element in achieving this goal. A recent report from the United Nations Environment Programme and the EEA (9) highlights the importance of such farmland and points to serious decline in the conservation status of these areas.

If extensively farmed land is converted to energy crop production or intensive food production in order to meet the increased demand for land, biodiversity will be lost as a result, because in most cases this would mean intensified production patterns. However, some biofuels systems could support nature-friendly land management: for example, ethanol production from abandoned coastal grasslands in the Baltic States.

Conclusions and further work

Ongoing analysis points to some preliminary conclusions for developing further biofuel crop production:

- limiting the demand for land. The lowest land use requirement would come from a combination of sugar beet and woody biomass;



- exploiting win win solutions, such as use of extensive grasslands for the production of ethanol from grass when technologies become available;
- researching low intensity alternatives — such as woody biomass — to the arable crops that currently dominate the biofuels market.

The European Environment Agency is currently studying in more depth the potential impact of large scale energy crop production on agricultural land use, farmland habitats and related biodiversity. The outcome will support evaluations of the impacts of the biofuels directive on agriculture and biodiversity at Member State and European level.

References

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