NOVEMBER 2007 Policy Brief

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Biofuels for Transport: Policies and Possibilities

Introduction

Bioenergy and biofuels are of growing public and private interest at a time of rapidly rising world energy demand and high oil prices. Amid concerns over climate change, they are also increasingly under the spotlight as a "cleaner" alternative to fossil fuels.

But are biofuels for transport a viable alternative to power our cars, trucks and buses? Do they deliver the expected environmental benefits? And what role should public policy play in their development?

Biofuels are liquid fuels for road vehicles and include bioethanol made from crops such as cereals and sugar cane and biodiesel originating mainly from rapeseed-, palm- and soya oil. Higher demand for these crops to supply the biofuels industry is good news for farmers who produce them, but perhaps not for intermediate and final consumers who will face higher feed costs and increased food bills. There are also questions as to whether higher demand will cause new land to be given over to biofuel crops, with a negative impact on the environment. Research is looking for ways to produce fuels from other crop sources, but the required technology is still some years away.

So although using biofuels to partly replace fossil fuels is widely assumed to deliver a number of energy security, environmental, and economic benefits, these are actually smaller than expected and unlikely to be delivered by current policies. Additional research on the economics of biofuels and related agricultural markets, on the environmental costs and benefits of biofuel production using different feedstocks, and on a wider range of energy policy alternatives – including those that might accelerate the scientific and technological development of second generation biofuels – is needed.

This *Policy Brief*, jointly produced by the OECD and the IEA, looks at the current situation with biofuels in road transport, and how governments can balance all these elements when crafting policies for energy and biofuels. ■

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What are bioenergy and biofuels?

Bioenergy refers to different forms of renewable energy produced from biomass. Biomass comprises any organic material of plant or animal origin, derived from agricultural and forestry production and resulting by-products, and from the renewable portion of industrial and urban wastes, used as feedstock for producing bioenergy and other non-food products. Bioenergy includes biofuels, biopower, bioheat, and (rural) off-grid energy (such as firewood). Biofuels are mostly in liquid form and are used to power combustion engines in road transport. Today two main types can be distinguished: bioethanol and biodiesel. With today's first generation technologies, bioethanol is mostly produced from sugar cane, cereals and sugar beet; biodiesel is derived from any source of fatty acids, such as soybean, rapeseed, palm oil and other vegetable oils but also from sources such as animal fats or used frying oils.

Technologies are being developed that make it possible to use cellulosic material, such as wood and plant stems and leaves, to produce so-called "second generation" bioethanol and to enable the use of any type of biomass to produce synthetic fuels. While at present such technologies are prohibitively expensive for transport use, there is considerable potential for their commercial application over the medium term. ■

Why do governments want to promote biofuels for transport?

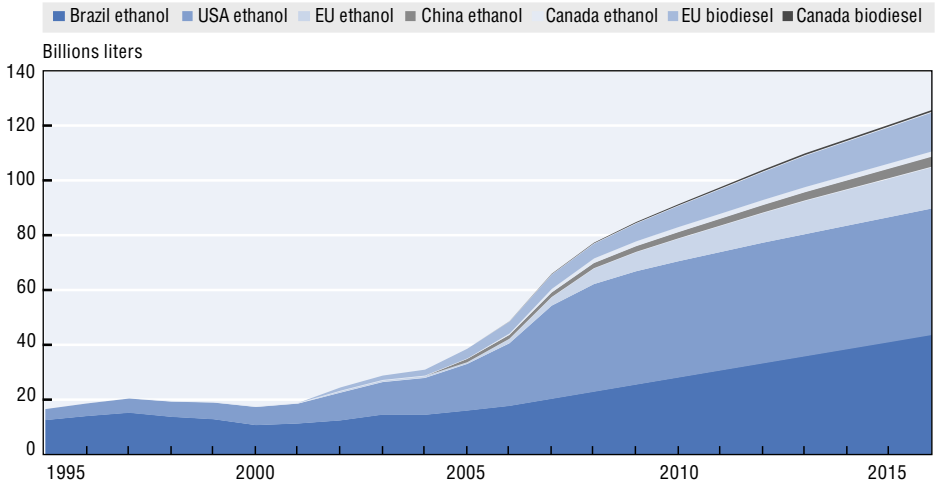
The production of biofuels is growing rapidly in many countries. In OECD countries, this growth is most evident in the United States, the European Union and Canada. Outside the OECD area, the main producer by far is Brazil, but production is also increasing – albeit from a very low base – in China, as well as in a number of other countries in South and East Asia (see Figure 1).

Public and private interest in the area of biofuels is also stronger than it has ever been, for a number of reasons.

First, continued rapid economic expansion in Asia has led to increased oil demand and, combined with limited expansion in oil refinery capacity worldwide, has driven up energy prices. At the same time, the notion is increasingly taking hold that fossil fuel supplies are finite and that other forms of energy need to be

Figure 1.

BIOFUEL PRODUCTION IN SELECTED COUNTRIES – PROJECTIONS TO 2016



Source: OECD-FAO Agricultural Outlook 2007-2016.

developed. Bioenergy is one of the alternatives and its development is seen as enhancing energy security in oil importing countries.

Second, with growing evidence of global climate change, it is becoming increasingly urgent to develop sources of energy that have lower greenhouse gas emissions than fossil sources. Bioenergy is seen by many as a "clean" form of energy: the amount of CO_2 released when it is burned is generally equivalent to the amount of CO_2 captured during the growth of the crop that produced it.

Third, with current technologies, biofuels are mostly produced from crops such as sugar, cereals, and oilseeds. Demand for these crops is thus likely to grow in line with the expected increase in demand for biofuels. Consequently, prices of these crops are expected to remain above their average values that prevailed during the past decade with positive impacts on overall farm income levels and possibly beneficial spin-offs for many rural communities (see Figure 2).

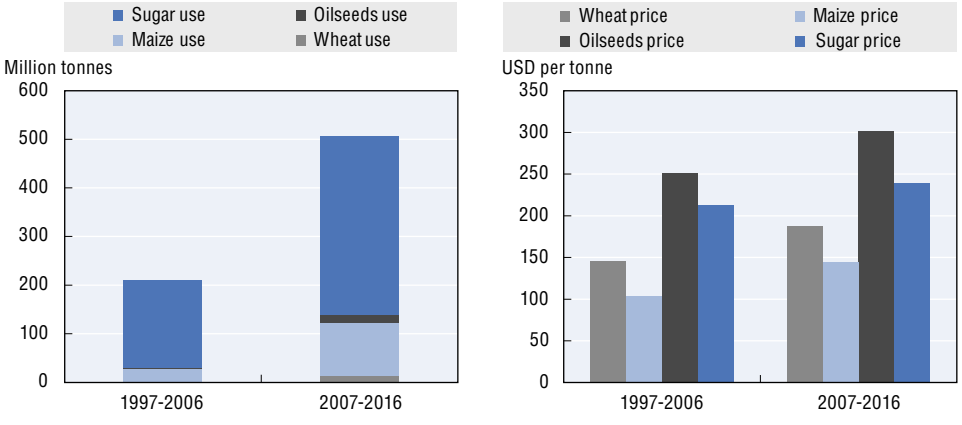
Fourth, bioenergy production is seen as a potential driver for economic growth in developing countries. In some countries, biofuel production could reduce dependence on imported fossil energy. Also, farmers in these countries could benefit from the expected higher crop prices, which could help raise rural incomes and aid poverty reduction. ■

How are governments promoting biofuels?

Depending on the country, the choice of crop and how it is grown, the technology used to turn it into energy and the type of biofuel produced, production costs vary considerably. Biofuel production in OECD countries is currently supported to the tune of USD 13 to 15 billion per year (OECD/ITF, 2007). At the moment, Brazil is the only major country producing biofuel from crops on an economically viable basis. Still, there is government support in Brazil: biofuels are exempted from the oil fuel excise tax and biofuel producers are exempted from a social tax on revenues. These subsidies totalled USD 1 billion in 2006. In addition, Brazil has had blending requirements for many years. Biofuel production could be economically viable in some less developed countries with a favourable climate and low-cost inputs, but there is no significant output from these countries at the moment.

Figure 2.

BIOFUEL PRODUCTION: CROP USE AND PRICES



Source: OECD-FAO Agricultural Outlook 2007-2016.

Production costs for ethanol have ranged in recent years from USD 0.35-0.50 per litre of gasoline equivalent (GE) if produced from sugar cane, and from USD 0.45 to more than USD 1 per litre of GE for grain- or sugar beet-based fuels (the energy content of ethanol is about one third lower than that of gasoline). For biodiesel, the cheapest source is animal fats, with total production costs at around USD 0.40-0.55 per litre of diesel equivalent (DE), while biodiesel based on vegetable oil is produced for about USD 0.70-1.00 per litre of DE. The costs for "second generation" technologies, such as ethanol produced from ligno-cellulosic material from plants or synthetic biodiesel currently range between USD 0.80-1.10 per litre of GE and DE.

These costs for biofuels compare to gasoline and diesel prices – net of taxes – of between USD 0.35 and USD 0.60 per litre in recent years. Consequently, at crude oil prices of about USD 60 per barrel, public support is required in the order of USD 0.15-0.55 per litre of GE or DE in most OECD countries to make biofuel production based on agricultural crops profitable. With crude oil prices having recently reached levels around USD 90 per barrel, net gasoline and diesel prices have increased to above USD 0.70 per litre, but as crop prices have increased sharply at the same time, the basic economics of biofuel production have not changed significantly.

The most commonly used government policies to stimulate biofuel production are financial incentives, such as tax credits or concessions, and import quotas and tariffs; to enhance their use, quantitative blending requirements of ethanol and bio-diesel with fossil fuels are often introduced. These measures represent the bulk of the support, which is further provided through a variety of other measures that affect virtually all stages of the supply chain.

As summarised in Table 1, biofuels production is stimulated through specific and general support programmes. For instance, the costs of converting and distributing biofuels are reduced through capital grants, loan guarantees, subsidised loans, income tax concessions and excise and value-added tax exemptions. Also, import tariffs and other trade restrictions effectively limit competition from internationally competitive sources, thereby further stimulating domestic production of biofuels. Finally, biofuel use is stimulated through

Table 1.

BASIC CHARACTERISTICS OF BIOFUEL POLICIES

		Economic agent or activity affected directly by the policy			
		Biomass production	Biofuel production	Biofuel use	Biofuel trade
Form of policy	Quantitative requirements			• Blending obligation	• Import quota
	Qualitative requirements	• Land set-aside obligations with permission to produce energy crops	• Fuel standards (*e.g.* oxygen content)		• Fuel standards
	Financial incentive	• Energy crop payment • General agricultural support measures	• Investment aid / tax credits for production plants • Loan subsidies • Public research in conversion processes	• Fuel tax concessions • Sales tax concessions for biofuel compatible vehicles • Public research in engine development	• Import tariffs

requirements for petrol stations to sell certain amounts of renewable fuels, mandatory blending requirements, and subsidies on the purchase of biofuel-compatible equipment, such as flex-fuel vehicles. ■

Can biofuels live up to public expectations?

Much is expected of biofuels by many governments around the world. But at present, biofuels can only make a modest potential contribution to addressing public expectations, for a number of reasons.

First, the potential for biofuels to replace fossil energy is relatively small and the scope to improve energy security in this way is limited. The crops used in present-day biofuel production have a very low energy density compared with fossil energy sources. In other words, large amounts of agricultural land would be needed to replace a moderate amount of fossil energy. So biofuel production will be limited by the amount of land available. This partly explains the International Energy Agency's (IEA) estimate that by 2030 biofuels may account for only 4% to 7% of road transport fuels. According to the IEA, the amount of arable land needed for biofuels to meet just 4% of the world's transport demand in 2030 is equal to more than that of France and Spain (IEA, 2006). The energy security argument also has to be seen in a context of highly variable crop prices which could have important impacts on the profitability of biofuel production from one year to another.

Second, assessing the environmental impact of biofuel production in the northern hemisphere is not as simple as is often suggested. Life cycle analyses (LCAs) that take into account the entire production chain suggest that there is potential for fossil energy savings through the use of first-generation biofuels. However, these savings are relatively limited and vary between different situations in different locations. For ethanol based on cereals and sugar beet, fossil energy used for its production, including for crop production, transport and conversion would represent 60 to 80% of the energy contained in the final fuel. For biodiesel from animal fats and vegetable oils, the fossil energy needed still represents up to 50% of the final fuel energy. In contrast, the fossil energy used for producing ethanol based on sugar cane account for only 10% or less of the energy in the final product. While GHG emissions from feedstock production vary importantly with farm practice and soil type, savings in GHG emissions are lower for cereal and beet-based ethanol than for cane-based ethanol and biodiesel.

In addition to the limited scope for savings in energy and GHG emissions from most first-generation biofuels, there may also be increased environmental pressures. As growing demand from increased biofuel production raises prices for cereals, oilseeds and sugar, this may result in fragile land being brought back into production or currently forested land being cleared. This is already becoming an issue in certain countries in South-East Asia where the expansion of palm oil plantations largely comes at the expense of existing forest area and biodiversity. Also, increased demand for biofuels may lead to an increase in more intensive and single-cropping practices, reducing water levels and damaging soil quality, and bringing increased quantities of pesticides and fertilizers into the environment.

Against a background of uncertain environmental impacts and considering that the contributions of first-generation technologies to energy savings and GHG abatement are relatively modest in most cases, the costs for achieving any goals

governments might have to reduce CO_2 emissions through the increased use of biofuels are high. It is estimated that the costs per ton of CO_2 that is saved through the production and use of biofuels are in the order of USD 500 (about EUR 350), and even higher in many cases. This compares to prices for emission rights in the European Emission Trading Scheme (ETS) peaking at around EUR 30 per ton in March 2006, and currently hovering around EUR 24 per ton for 2008 futures (Cozijnsen, 2007).

Third, the results will be mixed for farmers. Crop farmers will certainly benefit from the higher prices coming from increased demand for biofuels. But with contemporary technologies and current public support policies these are mostly cereal and oilseed producers in OECD countries. Livestock producers, whether inside or outside the OECD area, who use the same cereals and oilseeds as animal feed do not benefit from this support. Hence, they will face higher costs and reduced incomes despite lower protein feed prices due to the additional supply of feed by-products from biofuel production. Also, the industrial demand for biofuels crops may be less price sensitive than traditional food and feed demand, which would add to price instability in world cereal markets.

Many OECD countries, while promoting biofuel production and use, also support fossil fuel use in agriculture – to the tune of some USD 8.6 billion, or about EUR 6 billion, a year. In addition to the high public cost, such measures are inconsistent with apparent environmental and energy diversification goals. Nevertheless, biofuels subsidies are much higher per litre (as high as 50% of the total cost of production) when compared to subsidies for fossil fuels which are in the order of less than 5% of the consumer price.

Fourth, food consumers will face higher prices resulting from increased raw commodity prices. In most OECD countries where costs of agricultural raw materials are only a small part in the final costs of food in the shops and where food represents only a small share of total expenditures, this issue should not be over-emphasised. But for poorer consumers in many developing countries, even a modest price increase could make the difference between being able to buy food or not.

Finally, the main ethanol and biodiesel producing countries in the OECD have implemented measures to limit imports of biofuels. At present, tariffs on ethanol imports are EUR 0.192 per litre in the European Union and 2.5% of the import value plus USD 0.143 cents per litre in the United States. Other countries also apply tariffs on ethanol imports as well as on biodiesel trade. Such border measures distort markets: they raise energy prices for consumers in OECD countries and limit the opportunities for development of potentially more competitive producers outside the OECD area. Given the larger potential for energy and GHG savings from biofuels produced in the southern hemisphere, such trade measures are also inconsistent with the objective of reducing fossil energy use and GHG emissions. ■

Where do we go from here – how can policies help?

It is clear that there is strong public interest in biofuels and that policies as well as markets will influence their development. The appropriate choice of policy measures will differ across countries – there is no “one size fits all” solution. Governments seldom have all the information they need to make fully informed policy decisions, and this is also true in the area of biofuels. Even so, and while

further research is being undertaken, a number of *preliminary* recommendations can be made that are based on accepted principles of good policy formulation (OECD, 2002).

- ***Focus efforts on policies to encourage reduced energy demand and GHG emissions.*** Measures such as more fuel efficient vehicles offer large potential benefits and would be more cost efficient than replacing fossil fuels with biofuels (OECD/ITF, 2007). Also, taxes on the carbon content of all fuels would be more cost effective than subsidies or targets for biofuel use as they would directly target CO_2 emissions.
- ***Encourage investment in research and development to accelerate the introduction of "second generation" biofuels and biorefineries that are able to produce a range of products, including but not restricted to biofuels.*** Such investments offer more promise than trade barriers and support for domestic production.
- ***Explore a range of alternative sources of energy, including bioenergy***, that can be used to generate heat and power more efficiently and cheaply than through the conversion of feedstock to biofuels.
- ***Provide for freer trade in both biofuels and their raw materials.*** This would provide an important incentive to improve the economic efficiency of biofuel markets.
- Where governments consider that support for production of biofuel from first generation feedstocks is warranted, ***any such support needs to be linked to performance and desired outcomes,*** such as a specific reduction in greenhouse gas emissions.

These recommendations are preliminary and are of a general nature. Specific actions need to be considered in light of the diverse conditions and objectives in different countries. In addition, further insights on the range of issues outlined above could contribute to more fully informed policy decisions in the future. The OECD and the IEA are currently undertaking additional analyses and will provide a detailed economic assessment of biofuels and related policies in mid-2008. ■

For further information

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For further reading

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