GreenFacts
Facts on Health and the Environment

Scientific Facts on

Liquid Biofuels for Transport

Prospects, risks and opportunities

Source document:
FAO (2008)

Summary & Details:
GreenFacts

Context - Serious questions are being raised about the environmental impacts of producing liquid biofuels for transport, the costs of policies to promote them and their possible unintended consequences.

Even though production of biofuels such as ethanol and biodiesel is growing rapidly, their contribution to total transport fuel consumption in the coming decades will remain limited. In contrast, the effects of increased biofuel production on global agricultural markets, the environment and on food security are already significant and are stirring controversy.

What could be the future role of biofuels for agriculture, food security and climate change?

This Digest is a faithful summary of the leading scientific consensus report produced in 2008 by the Food & Agriculture Organization (FAO):
"The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities"

The full Digest is available at: https://www.greenfacts.org/en/biofuels/

This PDF Document is the Level 1 of a GreenFacts Digest. GreenFacts Digests are published in several languages as questions and answers, in a copyrighted user-friendly Three-Level Structure of increasing detail:

- Each question is answered in Level 1 with a short summary.
- These answers are developed in more detail in Level 2.
- Level 3 consists of the Source document, the internationally recognised scientific consensus report which is faithfully summarised in Level 2 and further in Level 1.

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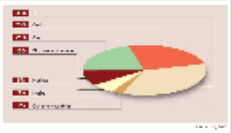
1. What are biofuels?

1.1 Defined broadly, biofuels are fuels derived from biomass – any matter derived from plants or animals. Biomass has traditionally been used as fuel for energy production in the form of wood, charcoal or animal waste. A basic distinction is made between unprocessed primary biofuels, such as fuelwood, and processed secondary biofuels The latter include liquid biofuels, such as ethanol and biodiesel, which have increasingly been used for transport in the last few years.

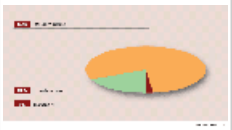

Sugar cane is one of the feedstocks for making biofuels
Credit: Rufino Uribe

1.2 Ethanol and biodiesel are the most widely used liquid biofuels. Ethanol can be produced through fermentation and distillation from any raw material containing significant amounts of sugar (e.g sugar cane or sugar beet) or starch (e.g maize, wheat or cassava).

Biodiesel is produced by chemically combining vegetable oil or animal fat with an alcohol. It can be produced for instance from rapeseed, soybean, palm, or coconut oils.


World primary energy demand per Source
[see Annex 1, p. 8]

1.3 Current liquid biofuels, referred to as "first generation biofuels" only use sugar, starch or oil and thus a fraction of the energy contained in the plant material. However, most plant matter is composed of cellulose and lignin. For greater efficiency, "second-generation biofuel" technologies are being developed to make use of these components.


Use of biomass for energy
[see Annex 4, p. 10]

There are significant technical hurdles still to clear to make production of lignocellulosic ethanol commercially competitive, but once these processes become economically viable, they could use waste products from agriculture and forestry, municipal waste, as well as new crops such as fast growing trees or grasses.

1.4 Large-scale production of biofuels from crops requires large land areas, so liquid biofuels can only replace fossil fuels to a very limited extent. Current production is equivalent to less than one percent of world transport fuel demand.


See also our Digest on Forest & Energy [see https://www.greenfacts.org/en/forests-energy/index.htm]

Projections foresee an increase in the share of the world's fertile land used to grow plants for liquid biofuel production from 1% in 2004 to around 4% in 2030. With this cultivated area and first generation biofuel technologies 5% of road transport fuel demand could be met This could double if second-generation biofuel technologies become commercially available.

2. What are the economic and policy factors influencing biofuel development?

2.1 Prices for liquid biofuels and for the crops needed to produce them are partly driven by fossil fuel prices. Government support schemes also play a key role as most biofuels are not generally competitive without subsidies, even when crude oil prices are high.

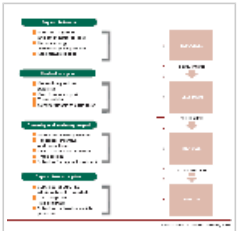
The crop and energy markets are closely linked, since agriculture both supplies and uses energy. Agricultural crops compete with each other for land and water and farmers will sell their produce to markets regardless of end use, be it for biofuel production or food use.

When the market value of a biofuel crop is high, prices for other agricultural crops that also need land and water will tend to rise too.

2.2 The main drivers of government support for biofuels are concerns about energy security and climate change as well as a political will to support the farm sector.

2.3 Common policy instruments include:

- mandatory blending of a percentage of biofuels with regular diesel or gasoline,
- subsidies for distribution and use of biofuels,
- tariffs on imported biofuels to protect domestic producers,
- tax incentives on the sale of biofuels as well as
- increased support for research and development.



Support provided at different points in the biofuel supply chain [see Annex 5, p. 11]

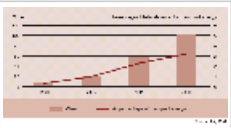
2.4 Many of the above instruments have been introduced in OECD countries at a cost of up to one US$ per litre. They have tended to introduce new distortions to agricultural markets.

Agricultural and forestry policies have had a strong influence on the bioenergy industry. Agricultural subsidies and price support affects both production levels and prices of feedstocks for first generation biofuels. Agricultural policies have also shaped world trade patterns for agricultural products including bioenergy feedstocks.

2.5 The raw material accounts for the largest share of total biofuel costs. Over the past few years, prices of raw materials for biofuel production have been highest when crude oil prices were high. Biofuel policies themselves have contributed to increased demand for agricultural products and thus increased prices. However, high crude oil prices and government subsidies also enable biofuel producers to pay higher prices while still remaining profitable.

3. How are biofuel markets and production evolving?

3.1 Food prices generally declined during the 40 years up to 2002, if inflation is taken into account. Since then they have risen sharply, with vegetable oil and cereal prices showing large increases.



Trends in Consumption of transport biofuels [see Annex 3, p. 9]

These high prices are partly the result of rising demand from developing countries and for biofuel production. There have also been poor harvests in some countries at a time when reserve stocks are at a relatively low level.

3.2 Biofuel demand and supply are expected to continue their rapid increase. And although the share of liquid biofuels in overall transport fuel supply will remain very limited, the projected increase in production of crops for making biofuels is substantial relative to the projected increase in total agricultural production.

Increased biofuel production could come from using more cropland for biofuel production and from improved yields. However, if grasslands or forests are brought into agricultural production for this purpose, this would have environmental consequences.

For ethanol, Brazil and the USA are expected to remain the largest producers but strong production growth is foreseen in China, India, Thailand and several African countries. Biodiesel production is dominated by the EU but a significant growth is expected in Brazil, Indonesia and Malaysia.

3.3 The biofuels policies in place in the EU and the USA, have distorted national and international agricultural markets. This results in high costs for the taxpayers in developed countries and discrimination against producers in developing countries. As a consequence, production does not necessarily occur at the most economically and environmentally suitable locations or with the most efficient technologies.

Coordination of biofuel policy at international level is needed to correct global agricultural policy failure and improve allocation of resources.

4. What are the environmental impacts of biofuel production?

See also our Digest on Biodiversity [see https://www.greenfacts.org/en/global-biodiversity-outlook/index.htm]

4.1 The overall performance of different biofuels in reducing fossil energy use and greenhouse gas emissions varies widely when considering the entire life cycle from production through transport to use. The net balance depends on the type of feedstock, the production process and the amount of fossil energy needed.

4.2 Increased biofuels production will be achieved through improved land productivity and through expansion of cultivated area, using existing cropland as well as less-productive land. However, it is more likely that biofuels will intensify the pressure on the fertile lands where higher returns can be achieved.

When forests or grasslands are converted to farmland, be it to produce biofuel feedstocks or to produce other crops displaced by feedstock production, carbon stored in the soil is released into the atmosphere. The effects can be so great that they negate the benefits of biofuels, and lead to a net increase in greenhouse gas emissions when replacing fossil fuels.

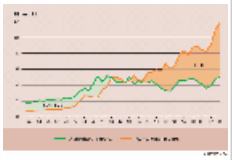
4.3 When crops for biofuel production require irrigation it exerts pressure on local water resources. In addition, water quality can be affected by soil erosion and runoff containing fertilisers and pesticides.

4.4 Changes in land-use and intensification of agricultural production may harm soils. The impacts depend on the way the land is farmed. Various techniques and the use of certain plant species can reduce adverse impacts or even improve soil quality.

4.5 Biofuel production can affect biodiversity. For instance habitat is lost when natural landscapes are converted into energy-crop plantations or peatlands are drained. In some instances, however, biofuel crops can have a positive impact, for instance when they are used to restore degraded lands.

4.6 In order to ensure an environmentally sustainable biofuel production, it is important that good agricultural practices be observed, and measures to ensure sustainability should be applied consistently to all crops. Moreover national policies will need to recognise the international consequences of biofuel development.

5. How will biofuel production affect food security and poverty?


Agricultural trade balance of least-developed countries
[see Annex 2, p. 9]

5.1 Food prices have risen sharply in the past few years, especially for cereals and vegetable oils, in part because they are used both for food and biofuel production. In addition, higher transport costs increased the costs of imported food. While some countries will benefit from higher food prices, the food bill is expected to increase for the least-developed countries which are net food importers.

Higher food prices will affect all households, but the impacts will be greatest for poor families may that spend half their income or more on food. The effect of a price increase will be significant for the estimated 850 million people around the world who are undernourished, most of whom are net buyers of food, both in urban and rural areas.

5.2 In the longer term, biofuel production could revitalize the agriculture sector and alleviate poverty by raising rural incomes. But government support for improved infrastructure, institutions and services remains essential, for instance to improve farmers' access to credit. Government support is also required to protect the most vulnerable.

5.3 While production of crops for biofuel production may offer opportunities for farmers in developing countries, it may also lead to greater competition for land. Those most at risk are small farmers and especially women, who usually do not own the land that they farm. Strong government commitment is needed to improve agricultural productivity and assure equal opportunities and access to both land and markets.

6. How could biofuel policies be improved?


See also our Digest on Climate change [see https://www.greenfacts.org/en/climate-change-ar4/index.htm]

6.1 The positive contribution of biofuels towards energy security and greenhouse gas emission reductions is increasingly being challenged. Their unintended impacts on market prices and food-security have frequently been overlooked in policy discussions. Uncertainties regarding the economic viability of biofuels remain, because of the influence of oil and crop price fluctuations, as well as future policy and technical developments. Biofuels are influenced by a wide range of policies, and a coordinated approach is needed to consider overall benefits and risks.

6.2 Biofuel policies should:

- protect those who are poor and have insecure food supplies.
- create conditions where poorer countries and small farmers can take advantage of future market opportunities.
- ensure that biofuels are effective in reducing greenhouse gas emissions, while protecting land and water resources.
- reduce and avoid distortions in biofuel and agricultural markets.
- be developed with appropriate international coordination.

6.3 Subsidies and mandatory blending have created an artificially rapid growth in biofuel production, exacerbating some negative impacts. Existing policies have had a limited effect in achieving energy security and climate change mitigation and therefore need to be reviewed.

Government incentives and support for biofuels have been largely guided by national or regional interests rather than a more global perspective. There is a need for an appropriate

international forum to agree on sustainability criteria to achieve environmental objectives without creating trade barriers.

7. Conclusions

7.1 Poor people's food security in urban and rural areas is under immediate threat from higher food prices partly induced by increased biofuel production. Well designed and targeted safety nets are needed to support their access to food.

7.2 In the longer run, higher food prices could stimulate agricultural development, but measures will be needed to ensure that benefits reach small farmers and marginalized people including women.

7.3 Some biofuels may reduce greenhouse gas emissions when replacing fossil fuels, but the net effects on climate change depend on where and from what raw materials they are produced. Carbon emissions from land-use change when forest or pasture is converted to cropland can largely negate the greenhouse gas savings obtained by using biofuels for transport.

7.4 Expanded biofuel production may threaten land and water resources and biodiversity. Appropriate policy measures are required to minimize possible negative effects.

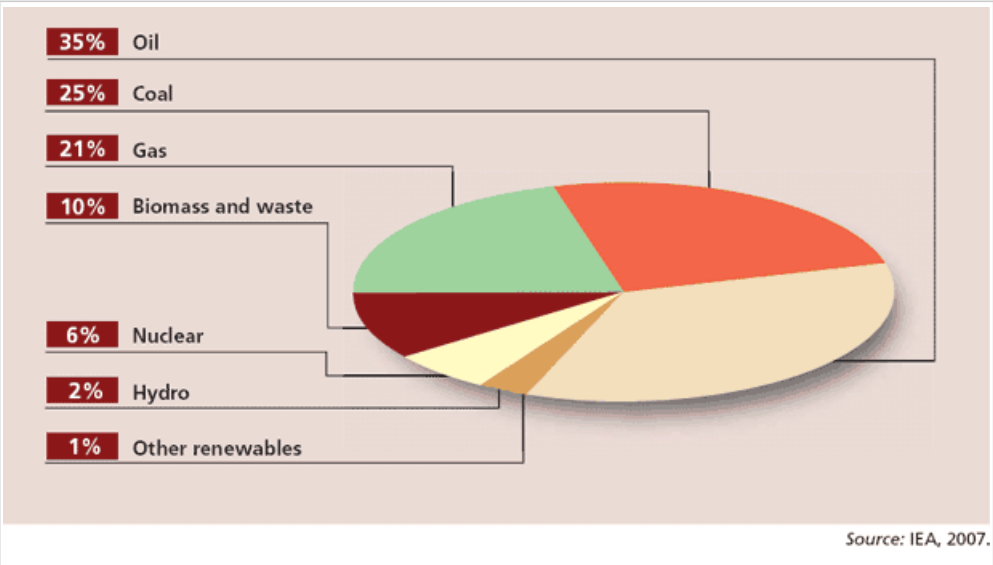
7.5 Some countries with abundant natural resources and appropriate infrastructure and institutions may be able to develop an economically viable biofuel sector. However, liquid biofuels will only be able to make a limited contribution to the global supply of transport fuels. "Second generation biofuels" made from cellulose and lignin would expand the range of opportunities.

Biofuel growth has thus far been driven primarily by policies rather than market forces. Policies must be reviewed to avoid negative impacts and promote sustainable biofuel production.

Annex

Annex 1:

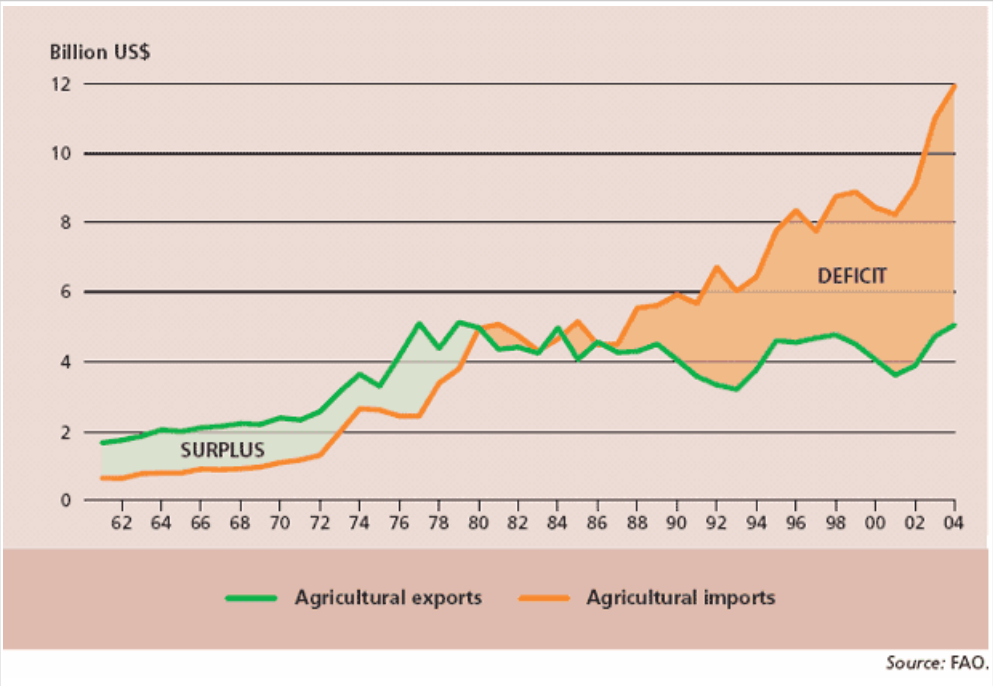
Figure 1: World primary energy demand by source, 2005



Source: FAO, The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities (2008) [see http://www.fao.org/docrep/011/i0100e/i0100e00.htm],
Chapter 1, Introduction and key messages, p.3

Annex 2:

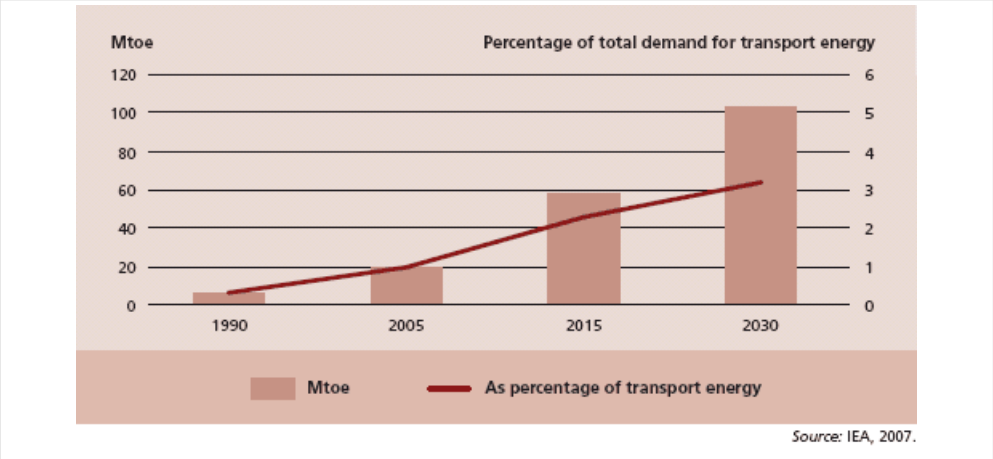
Figure 27: Agricultural trade balance of least-developed countries



Source: FAO, The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities (2008) [see http://www.fao.org/docrep/011/i0100e/i0100e00.htm], Chapter 6, p.73

Annex 3:

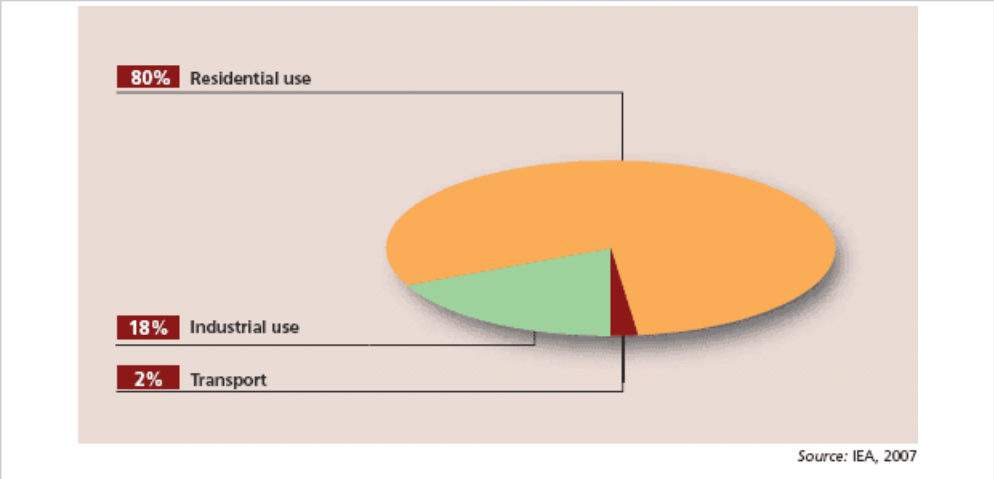
Figure 3: Trends in consumption of transport biofuels



Source: FAO, The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities (2008) [see http://www.fao.org/docrep/011/i0100e/i0100e00.htm], Chapter 1, Introduction and key messages, p.6

Annex 4:

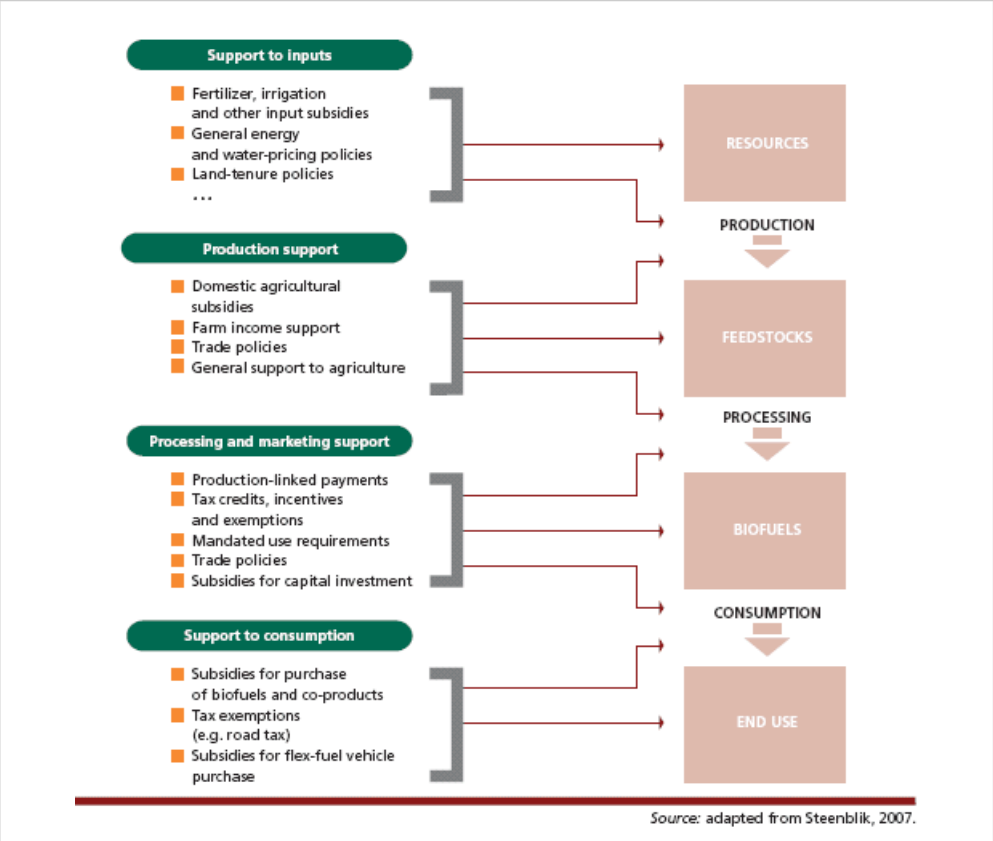
Figure 5: Uses of biomass for energy



Source: FAO, The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities (2008) [see http://www.fao.org/docrep/011/i0100e/i0100e00.htm], Chapter 2, p.11

Annex 5:

Figure 8: Support provided at different points in the biofuel supply chain



Source: FAO, The State of Food and Agriculture, Biofuels: Prospects, Risks and Opportunities (2008) [see http://www.fao.org/docrep/011/i0100e/i0100e00.htm],
Chapter 3, Section policy measures affecting biofuel development, p.28