Fuelling controversy – can biofuels slow the speed of climate change?

The scale of the global challenges posed by climate change has given rise to an industry developing and selling potential solutions. New partnerships between oil and agribusiness companies are supported by many governments. However, the extent to which biofuels can play a beneficial role in replacing fossil fuels and reducing carbon emissions is hotly debated.

New partnerships between oil and agribusiness companies are seen by some as the way forward for developing an alternative energy source to fossil fuels.
JEROEN OERLEMANS | PANOS PICTURES

Good management of the earth's biological systems has become vitally important if we are to reduce greenhouse gas emissions to levels that do not trigger irreversible climate change. Forests, soils and oceans lock up huge quantities of carbon which is released through human activity, such as burning fossil fuels. If levels of carbon emissions are not kept in check, global warming will escalate out of control.

Biofuels have grown in importance in discussions about energy and climate change. Regional instabilities and dwindling oil supplies have sent political leaders and businesses scrambling to secure energy supplies. Attention has turned to alternative forms of fuel that are becoming more economically competitive.

Media toolkit on climate change

This is the first in a series of briefing documents for journalists on climate change. It forms part of the work of the Panos London Environment Programme which works with the media on information and communication surrounding environmental issues, with a particular focus on sustainable agriculture, climate change and natural resource management.

For further information contact **media@panos.org.uk** or visit the Panos London website **www.panos.org.uk/environment** If you use this or any other Panos media resource to cover environment issues, please let us know how and with what results.

In practice, however, many biofuels offer low or negative carbon savings because growing crops and converting them into biofuels is itself energy-intensive. So the benefit of carbon accumulated in the plant during the growing process of photosynthesis can be lost to energy-intensive agriculture and processing. Studies of bioethanol production vary widely in their conclusions around carbon and energy gains or losses.

To stand a chance of being economically viable, biofuels made from high-energy plants that need little processing, such as sugar cane, achieve the best results. High fuel prices and large-scale production make such crops competitive. Tropical plants such as oil palm yield many times more energy than plants such as maize. Developing countries in tropical regions where high-yield crops grow are fast becoming favoured areas of cultivation for feedstock, the raw materials used for biofuels.

Large quantities of feedstock are required to replace even a small fraction of the huge volume of oil used for transport globally. Even with high-yield crops, this needs vast areas of land. The choice is between converting farmland to biofuel cultivation or destroying natural areas to make way for fuel crops. Both of these options are controversial. Conversion of farmland reduces the land available for growing food, while conversion of natural forests reduces natural resources such as wood, water, soil and biodiversity.

Fuel from biomass

Biotechnology research is focusing on ways of increasing the usable percentage of plant biomass. Scientists are working to develop genetically engineered enzymes, yeasts and bacteria that are intended to make it possible to produce biomass ethanol from cellulose plant fibre found in plants, trees and agricultural waste. This would dramatically reduce the cost of producing ethanol because the industry would no longer have to rely on valuable food crops such as corn or soya. However, it would also reduce the quantity of organic matter decomposing into soil, which is known to replace vital soil nutrients and to store carbon.

The Iogen Corporation of Canada is a market leader in enzyme production and the processing of cellulose into ethanol biofuels. The company has built a pilot refinery and hopes to offset the energy lost in the conversion process to a more viable level. On the strength of this it has attracted significant investment interest from Shell, Petro-Canada and investment bank Goldman Sachs.

The biotechnology corporation Syngenta has developed a genetically modified (GM) maize variety, Event 3272, specifically for production of biofuel. In May 2006 it applied for a licence to introduce the variety into South Africa, the US, the European Union (EU) and China. Event 3272 incorporates an enzyme already used in the conversion process for biofuels.

Energy independence

Much of the political appeal of biofuels lies in their potential for reducing dependence on imported fuel supplies, especially for large agricultural producer countries. Brazil is leading the way with domestic production of biofuel from sugar cane, while US President George W Bush called for a shift towards biofuels in his 2005 State of the Union speech. In some countries such as Peru, small-scale local production of biodiesel is helping to support community economies and fuel needs.

Bio-oil bedfellows

Escalating investment is already making biofuel a substantial business arm of the oil industry, which blends biofuel with petrol. This trend looks likely to accelerate as more and more oil and agribusiness companies join hands.

BP, for example, is investing $500 million to set up an Energy Biosciences Institute at a major university, yet to be decided, to develop biofuels. BP has also joined the US Biotechnology Industry Organization (BIO) and has entered into a partnership with biotechnology giant Dupont, initially to produce a petrol additive.

Questions about biofuels

- What is the position of your government on biofuels? Which department, if any, is responsible for their development?
- Is there any research and development or investment in biofuels taking place in your country?
- Are there any biofuel crops being grown in your country? If so, which crops are they and where will they be processed?

In Malaysia, the palm oil industry is operating on a large scale. Vast areas of tropical rainforest have been cleared to make space for plantations, releasing huge amounts of carbon into the atmosphere.
MICHAEL MORGENSEN (TAYACAN) | PANOS PICTURES

The carbon cost of fossil fuel inputs

Modern agribusiness is built on fossil fuels such as oil and gas, which are used for everything from transport to the manufacture of pesticides and fertilisers. High dependence on such external inputs, together with farm practices such as ploughing, make modern agriculture a significant contributor of carbon emissions.

Some research indicates that one litre of fossil fuel will produce nearly two litres of bioethanol. Less hopeful is Professor David Pimintel of Cornell University who found that the conversion of corn into bioethanol required 30 per cent more fossil energy than was yielded by the fuel ultimately produced.[1]

1
Pimentel, D and Patzek, T W (2005), 'Ethanol and biodiesel from crops not worth the energy', *Natural Resources Research*, Vol 14: 1, pp65–76, www.biologynews.net

Demanding the earth?

Pressure on forests

Though the biofuels industry is still in its infancy, the rapid expansion of agricultural land used for feedstock has already had a big impact on natural ecosystems – most notably tropical rainforests. In Malaysia and Indonesia huge fires sparked by palm oil plantation owners have destroyed vast tracts of forest, sending large amounts of carbon into the atmosphere. In 1997–8 alone these fires contributed the equivalent of 40 per cent of all fossil carbon emissions globally. A similar story is unfolding in the Brazilian Amazon where soya cultivation – in part for biofuels – is rapidly eating into the rainforest.

Biofuel plantations in developing countries are increasingly being promoted as trade solutions that mitigate climate change. Through the Kyoto Protocol system of emissions trading, biofuel projects can gain carbon credits that can be internationally traded. However, cases of social and environmental abuse associated with the rapid spread of both conventional and GM commodity crops partly used for biofuels are causing alarm amongst civil society and businesses alike.

For example, illegal clearance of the Amazon rainforest for GM soya cultivation is accelerating and the carbon released into the atmosphere here looks set to more than cancel out any carbon gains of switching to biofuels. Climate scientists warn that disruption of the rainforest belt could cause the breakdown of rainfall patterns crucial to the survival of the rainforest and agriculture in the region. Die-back of the world's remaining forests is a matter of deep concern: climate scientists project that this would release so much carbon that it would tip the atmospheric carbon scales towards irreversible climate change.

In 2006 investigations by Greenpeace into large-scale soya farming financed by US-based commodity multinationals Cargill, ADM and Bunge found that Amazon-grown soya was going into the supply chain of major supermarkets and fast food companies. These retail companies, fearing a consumer backlash, are pushing soya traders to clean up their supply chain. In response, the big commodity traders have pledged not to buy soya in future from areas of cleared rainforest.

Fuelling trade and famine?

For developing countries, a shift towards large-scale, export-led biofuel crop production could increase the volume of export trade and associated benefits such as employment. It could also mean that water and nutrients necessary for securing domestic food supplies may instead be exported to affluent countries in the form of biofuels.

Not all types of biofuel displace food crops. Like other countries in the Southern Africa region, Malawi is currently establishing jatropha tree plantations for the production of biodiesel. Heralded for providing multiple local uses and resilience to drought, these trees are replacing areas previously used for tobacco cultivation.

The demands for both food and fuel in Malawi are undeniable. In 2005 half the population relied on food aid, due to drought, and most of the population continue to use fuelwood for energy, placing pressure on dwindling forests. The jatropha oil harvested will not meet local demand as it is destined for export to Europe for conversion into biodiesel. Displacing food crops with fuel crops is a sensitive issue, particularly in areas where food is scarce – although many biofuel crops also supply by-products used for animal feed.

Motivating the market

The biofuels market is not being stimulated only by rises in the price of fuel, which can make it less attractive financially to grow food commodities. Supportive political policies, in part motivated by the need to stem climate change, are being implemented, with rules and incentives. For example the EU has set a target of meeting 5.75 per cent of its transport fuel needs from biofuels by 2010 and is due to set a higher target soon. It also supports its growers with subsidies and provides tax breaks on biofuels.

Reaching the limits

Figures from the Organisation for Economic Co-operation and Development (OECD) show that Europe would need to convert more than 70 per cent of its farmland to raise the proportion of biofuel used in its road transport to 10 per cent. This limits the extent to which Europe can displace petroleum with regionally grown biofuels. Instead, imports from developing countries are already providing much of the raw materials and these are projected to increase. Nevertheless, Jeff Schafer, a proponent of biodiesel, estimates that if high-yield biofuel crops were grown on all the farmland on earth, they would still only meet 20 per cent of current crude oil energy demands (see www.ecoworld.com).

The US has set a target of increasing its annual production of biofuels from 2 billion gallons currently to 5 billion gallons by 2012. This compares with US petrol consumption of 129 billion gallons in 2000 projected to rise to 165 billion by 2012. The US also provides tax breaks on bioethanol, and subsidies for ethanol refineries have caused a construction boom. Efficient conversion is only one element in meeting targets, as a large part of the increase is intended from yet greater intensification of corn farming to produce higher yields.

The US National Corn Growers Association (NCGA), chief industry advocate of bioethanol from corn, calculates that 82.5 per cent of all the energy used in bioethanol production comes from fossil fuels. It says: 'Using coal and natural gas feedstocks for ethanol plants is a more efficient way to convert coal and natural gas to transportation fuel'. So the cycle of production still remains largely locked into the fossil fuel-based carbon economy.

Questions about the impact of biofuels

- Who controls biofuel production in your country?
- Is there a place for small-scale, local community-based projects to produce biofuels?
- Has export-focused agriculture had an impact on food security in your country?
- What restrictions are there on expanding the area of farmland under cultivation?
- Are there examples in your country of biofuel production having an impact on people's livelihoods and welfare?
- Where there are climate change and biofuel projects, how was the process of consultation with communities and local organisations carried out?

Biodiesel power in the Amazon

Practical Action – an international non-governmental organisation – and the National Agrarian University of La Molina have formed a partnership to evaluate the potential for biodiesels in the Peruvian Amazon. Since 2003 they have explored ways to improve access to local sources of clean energy for isolated communities, through the development and promotion of sustainable systems of producing biodiesel from native plants. The majority of the two million inhabitants of the Peruvian jungle rely heavily on biomass and diesel to fulfil their energy needs. Diesel is expensive and spills can pollute the rivers.

As an initial step, the project tested different indigenous oily plant species for their yield and consumption qualities for conversion to biodiesel. Simple, affordable technology has been developed for low-cost, small-scale production of biodiesel which is intended to serve communities of around 50 families.

The project is already encouraging oil recycling. In addition, the university's laboratories are being used to convert discarded oils from the university canteen into biodiesel to power the campus bus.

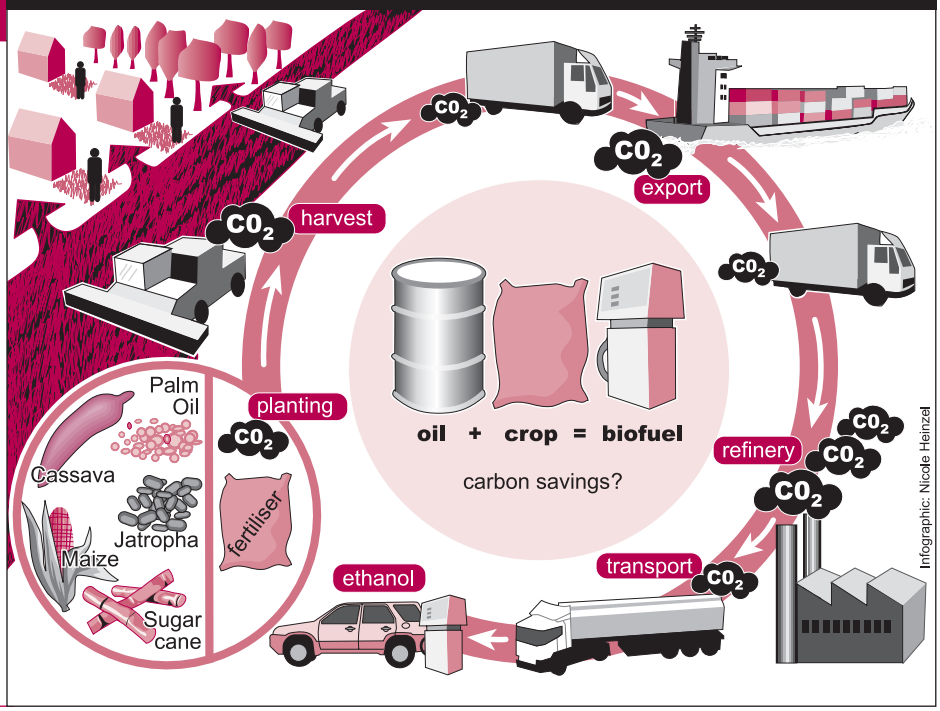
Soluciones Prácticas/ITDG
www.solucionespracticas.org.pe
www.practicalaction.org

Diesel spillage from boats can pollute the Amazon and diesel is expensive. Inhabitants of the Peruvian jungle rely on biomass and biodiesel for their energy needs.
ALVARO LEIVA | PANOS PICTURES

Export trade – what carbon footprint?

The further that produce needs to travel to reach its destination, the greater the carbon cost in transport, refrigeration, packaging and distribution. The most costly mode of transport is air freight – and many developed countries now rely on imports of fresh produce from developing countries by air to fulfil demand for seasonal vegetables all year round. One organic farmer in Zambia told Panos that half of his total production costs went on air freight to supply two UK supermarkets with green beans, mange-tout and baby corn.

The cycle of energy consumed in ethanol production



Genetic engineering and biofuels

Genetic engineering is used at many stages in the production of biofuels. GM feedstock such as soya and maize is widespread, and GM trees are being promoted because they fix carbon from the atmosphere and could provide a ready supply of feedstock. GM enzymes, bacteria and yeasts are used in the conversion process. But there are major worries at the international policy level, particularly amongst countries party to the UN Biosafety Protocol and the UN Convention on Biological Diversity about the impact of GM organisms on the environment and on human health.

Fixing the future, or releasing the genie?

Research into GM trees ranges across a number of areas, from disease resistance in fruit and nut trees to the characteristics of wood fibre. For example, biofuels based on tree cellulose, though still under development, are a big future hope in this sector.

In the context of the Kyoto climate negotiations, trees act as 'carbon sinks'. The faster 'sinks' can sequester or fix carbon, the quicker they can earn lucrative carbon credits. Hence there is a substantial financial incentive to engineer GM traits such as faster growth rates.

In both the production of biofuels and paper, lignin (the 'glue' that holds the tree together) is an unwanted by-product that hampers production. By reducing lignin in GM trees, industrial processing would be shifted back from the factory to the growing tree.

Conventional tree plantations, such as eucalyptus, have been shown to deplete local water tables, encourage forest fires, cause salination and reduce forest biodiversity. Establishing plantations also has implications for land ownership and the rights and access of local people to the land.

GM trees, which are currently grown commercially only in China, are designed for plantations. They also come with a host of additional issues that have implications for human health, natural forests and agriculture. For example, the risk of genetic pollution from tree pollen – which cannot be contained and which travels great distances – was recognised in the 2006 UN Convention on Biological Diversity.

GM crops are normally tested for several generations to assess their environmental and health risks. However, because of their long life-cycle, this has not happened with trees, despite concerns that their genetic complexity requires close scrutiny to detect unforeseen effects.

Questions about genetic engineering

- Does your country allow commercial release or testing of genetically engineered crops?
- Has your government put in place biosafety measures such as laws and border controls to track the movements of genetically modified organisms?
- Has there been any public discussion about GM crops and, if so, which issues do people consider most important?

International news pegs

- The annual Summit of the Kyoto Protocol (of the UN Framework Convention on Climate Change)
- The annual Summit of the Biosafety Protocol
- National projects under the Kyoto Protocol's Clean Development Mechanism or other voluntary carbon offset projects

Global or local trade?

While it is widely recognised that biofuels will never be a complete replacement for petrol, the rapidly increasing momentum behind the industry could see biofuel becoming a major global transport fuel within the next ten years. Some see the industry benefiting impoverished areas of the world, others have grave misgivings about the knock-on impact of land use change to biofuels.

A key factor influencing the impact of biofuels is whether the industry develops around trade which aims to fulfil the fuel demand in rich countries or whether biofuels are used locally to solve local energy needs.

Glossary

Agribusiness
A generic term that refers to the various businesses involved in food production, including farming, seed supply, agrichemicals, farm machinery, wholesale and distribution, processing, marketing, and retail sales

Biomass
Plants, including trees, used directly to produce heat for cooking, processing and heating

Biofuels
Generally produced from crops grown to produce liquid fuel, mainly for vehicles. There are two kinds:

Biodiesel
from crops which produce oil, eg soya, palm oil, jatropha, oilseed rape and sunflowers. Oil from these is mixed with alcohol or sometimes used in its pure form

Bioethanol
starch from crops such as corn, soya and cassava, is converted into sugars by commercial enzymes enhanced by biotechnology. Alternatively, sugar crops are used. The sugars are then acted upon by specific varieties of yeast to produce ethanol in a process called fermentation

Carbon footprint
A measure of the amount of carbon dioxide emitted through the combustion of fossil fuels. Often expressed as tons of carbon dioxide or tons of carbon emitted, usually on a yearly basis. Measured for many things such as individuals, a business, a process or the cost of transport

Clean Development Mechanism
An arrangement under the Kyoto Protocol allowing industrialised countries with a commitment to reducing greenhouse gases to invest in emission reducing projects in developing countries as an alternative to more costly emission reductions in their own countries

Feedstock
The raw material required for an industrial process. Biofuels use plants and biomass as feedstock

Greenhouse gases
Gases that build up in the atmosphere which contribute to global warming. The most widespread is carbon dioxide, although others such as methane and nitrous oxide, while found in smaller concentrations, have a greater warming effect

Useful websites and more information

General

www.renewableenergyaccess.com/rea/home – Renewable Energy Access news portal

www.ecoworld.com – EcoWorld is an internet-based publishing company

www.euractiv.com/en/energy/biofuels-transport/article-152282 – European energy information

Civil society

www.cures-network.org – Citizens united for renewable energy and sustainability (CURES), *Towards a Southern African NGO position on biofuels*

www.journeytoforever.org/biofuel.html – Journey to Forever is a pioneering expedition by a small, mobile NGO

http://priceofoil.org – Oil Change International campaigns to expose the true costs of oil and to facilitate the transition towards clean energy

www.biofuelwatch.org.uk – Biofuelwatch campaigns for regulation to ensure that only sustainably sourced biofuels can be sold in the EU

www.natbrasil.org.br – *Agribusiness and biofuels: an explosive mixture*, Friends of the Earth Brazil, 2006

www.worldwatch.org – Independent research for an environmentally sustainable and socially just society, *Biofuels for Transportation* (2006)

www.greenpeace.org – *Eating up the Amazon* (2006)

Industry, government and institutional bodies

www.ncga.com – The National Corn Growers Association (NCGA) is a US federation of state organisations, corn boards, councils and commissions that develops programmes and policies at state and national levels to help advance the interests of corn producers

www.biodiesel.org – National Biodiesel Board (US)

www.abengoabioenergy.com – Abengoa Bioenergía is the first producer of fuel bioethanol in Europe

www.d1plc.com – D1 Oils Plc is a UK-based global producer of biodiesel

Publications

Larry Lohmann (ed), (2006) 'Carbon Trading: A Critical Conversation on Climate Change, Privatisation and Power', *Development Dialogue* 48, pp1–359. Available free for download at www.dhf.uu.se

Albert Sasson, *Industrial and Environmental Biotechnology: Current Achievements, Prospects and Perceptions*, (UNU-IAS, Yokohama, 2005): www.ias.unu.edu/binaries2/Ind_Envbiotech.pdf

EU directive 2003/30/EC, 8 May 2003, on the promotion of the use of biofuels or other renewable fuels for transport: http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_123/l_12320030517en00420046.pdf

European Commission, 'An EU Strategy for Biofuels' (2006): http://europa.eu.int/eur-lex/lex/LexUriServ/site/en/com/2006/com2006_0034en01.pdf

Takavarasha, Dr T et al (2005), *Feasibility study for the production and use of biofuel in the SADC region*, SADC

A full bibliography of resources can be found on the Panos London website **www.panos.org.uk**

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