Environmental Audit Committee

NEW INQUIRY

Are biofuels sustainable?

Submission by: **Biofuelwatch (http://www.biofuelwatch.org.uk/)**

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1. What are the possible positive and negative social, environmental and economic consequences of biofuels? How might trade-offs between climate benefits and environmental and social impacts be made? Is there a need to develop a new biofuel strategy for the UK or EU, to balance the environmental, social, economic and climate impacts of biofuels?

Biofuelwatch (http://www.biofuelwatch.org.uk/aboutus.php) campaigns against the use of bioenergy from unsustainable sources, i.e biofuels linked to accelerated climate change, deforestation, biodiversity losses, human rights abuses, water & soil degradation, loss of food sovereignty and food security. There are many negative social, environmental and economic consequences of biofuels of which we will go into greater detail within our submission. All of these are covered in the following reports: 'Agrofuels – Towards a reality check in nine key areas'(http://tinyurl.com/233x7n) , "Stop the agrofuel craze!", Special Seedling edition on Agrofuels by GRAIN (http://tinyurl.com/2hkkzp) and 'Agrofuels in Africa – The impacts on land, food and forests" by the African Biodiversity Network (tinyurl.com/yoljmv).

All of our serious concerns relate to agrofuels, largely those produced from large-scale monocultures. Biofuels from true waste, such as biogas from sewage or manure, or the use of waste vegetable oil from transport can provide a sustainable, albeit limited, source of energy. At the same time, we are very concerned that organic matter which is essential for maintaining the health of soils, for biodiversity, and for allowing water-absorption by soil is widely being classed as 'agricultural' or 'forestry waste'. There is evidence that this is already aggravating the impact of drought and crop losses in Hungary. (tinyurl.com/2acb4q). We therefore define agrofuels as:

Agrofuels are biofuels made from crops and trees grown specifically for that purpose on a large-scale, as well as biofuels from agricultural and forest residues that should be returned to the natural cycle because they play an important role in maintaining soil fertility and bio-diversity.

Regarding the term, Agrofuels, it is useful to refer to this description from the Landless Movement of Brazil (MST): *"We can't call this a 'bio-fuels program'. We certainly can't call it a 'bio-diesel program'. Such phrases use the prefix 'bio-' to subtly imply that the energy in question comes from 'life' in general. This is illegitimate and manipulative. We need to find a term in every language that describes the situation more accurately, a term like agro-fuel. This term refers specifically to energy created from plant products grown through agriculture."*

At present, there is no evidence that the large-scale use of agrofuels can help to mitigate climate change. Quite the contrary: There is substantial evidence that agrofuel production is already causing an acceleration of climate change, for two reasons:

Firstly, most agrofuels, including the most types grown in the EU (rapeseed biodiesel, wheat ethanol, maize ethanol and biogas, biodiesel from sunflower oil) are produced from monocultures with the use of fossil-fuel derived fertilisers and pesticides, and with the use of nitrate fertilisers. The Stern Review finds that, globally, the non-carbon dioxide greenhouse gases from agriculture (not including land-use change) account for about 14% of global anthropogenic greenhouse gas emissions. Carbon dioxide emissions from the loss of soil organic carbon and, of course, from land-use change need to be added to this. Agriculture is the main source of anthropogenic nitrous oxide emissions, linked to the use of nitrate fertilisers and also to legume monocultures (biological nitrate fixation). A recent study by Paul Crutzen et al (http://tinyurl.com/ywbft6) suggests that, if the full direct and indirect effects of nitrate fertilisers are considered, common agrofuels such as rapeseed biodiesel and corn ethanol are worse (up to 1.7 and 1.5 times respectively) for the climate than fossil fuel diesel or petrol.

Secondly, agrofuel expansion worldwide is leading to significant land-use change, as more natural land, semi-natural land and biodiverse, low-intensity farmland is converted to agrofuel monocultures. A recent paper by Renton Righelato and Dominick Spracklen , published in Science (tinyurl.com/36eqb5), warns that: Clearance results in the rapid oxidation of carbon stores in the vegetation and soil, creating a large up-front emissions cost that would, in all cases examined here, outweigh the avoided emissions." Large-scale land conversion for agrofuel feedstocks for export is happening in many parts of the global South, including in South-east Asia and South America, where rainforests, natural grasslands and mixed farming systems are being converted to agrofuel plantations. Within the EU, there is concern that the planned abolition of set-asides, as demanded by the biofuel industry, will lead to further soil carbon losses, as well as increasing nitrous oxide emissions through the greater use of nitrate fertilisers. For a further discussion of climate impacts, see below.

Given the strong evidence for large-scale agrofuel monocultures having a negative impact on the climate , on soil and water, on biodiversity and on local communities, we believe that the question of a 'trade-off' does not arise.

We believe that there needs to be detailed independent research into the full-system impact of biofuel production, taking account of all direct and indirect impacts, and that there also needs to be full consultation with the people and communities in the global South who are most directly affected by agrofuel expansion before there can be any credible biofuel strategy for the UK or the EU.

This is why we support a moratorium on EU incentives for agrofuels and agroenergy from large-scale monocultures and would ask that you consider the report compiled by Biofuelwatch, entitled; HOW MEANINGFUL ARE 'GREENHOUSE GAS STANDARDS' FOR BIOFUELS IN A GLOBAL MARKET?, which forms part of the submittal after the references.

2. Should biofuels be regulated to minimise the negative environmental and social impacts, and in what way? How might regulation fit in with international trade agreements and rules? Should there be regulation of the entire carbon cycle of biofuels?

The answer to the first question would be yes, if the answer to the last question was also yes which should not be a question as surely this has to be the only true way forward, then the case has already been made above ([1, 2, 3]) which shows that there is no place for large scale biofuel mono-cultures either to mitigate climate change, or on the other environmental grounds (water resource & quality, soil quality, biodiversity) or social grounds (human rights abuses, workers conditions, pesticide poisoning, food sovereignty and food security).

The RTFO consultation that closed on 17th May of this year continually refers to the fact that regulation on grounds of sustainability is not permitted by WTO rules:

43. As of today, however, there is no internationally agreed definition of a "sustainable biofuel", nor is there any internationally agreed methodology for calculating the precise greenhouse gas savings from biofuels. If, ahead of international standards being developed, the UK Government were to refuse to allow certain biofuels to qualify for the RTFO on sustainability or carbon saving grounds, this may be successfully challenged as a barrier to trade, threatening the continuation of the RTFO.

45. Ahead of this, the Government intends to do everything possible to encourage the use of only the most sustainable biofuels with the lowest carbon intensity, in a way which is compatible with international trade rules.

82. It might also be possible to specify that, from a given date, only those biofuels meeting certain minimum environmental and social standards should qualify for credits under the RTFO. This may depend to some extent on how quickly standards can be agreed in this area. Work is already under way on this in bodies such as the international Round Table on Sustainable Palm Oil production. The European Commission is also planning to develop a certification scheme. It should be noted, however, that until similar standards and practices are developed in other sectors, there will be an ongoing risk that "sustainable" feedstocks are diverted to use as transport fuels, with "unsustainable" feedstocks being used in other sectors (such as food production). Thus, increased demand for "sustainable" biofuel feedstocks might still lead to deforestation and other adverse environmental effects.

Environmental groups
There are numerous environmental groups who are concerned with both measures to reduce greenhouse gas emissions and to ensure the sustainability of any biomass used to produced transport fuels. These groups have been engaged with policy development through the Low Carbon Vehicle Partnership (LowCVP)1. A number of environmental groups have argued that the Government should only support renewable fuels which meet certain minimum environmental standards, but WTO rules currently mean that such a requirement would be subject to challenge.

At the Renewable Energy Association, Bioenergy 2007 Conference there was a very interesting session on transport fuels, chaired by Malcolm Fredrick from Department for Transport. Jessica Chalmers from the Low CVP made the following points:

- 'There is currently not an international agreed methodology for greenhouse gas emissions savings.
- 'The information flow from producers is not transparent and the verification procedure has to be robust and credible.'
- 'WTO rules are complex. There is no case law evidence and we're going to have to try it and see.'
- '…following the Cramer Report, the Netherlands would have instigated mandatory sustainability requirements, but dropped plans, because of the WTO.'

3. How successful are existing international structures, such as the Roundtable on Sustainable Palm Oil, at ensuring that imports of biofuels can be obtained from sustainable sources? To what extent is it currently possible to identify the provenance and production standards of imported biofuels?

There is an important difference to be made between voluntary certification initiatives, such as the Forestry Stewardship Council (FSC), that depend on conscious consumers choosing to pay more for a certified product; and mandatory certification, which is based on setting legally enforced environmental and social

standards. Existing initiatives like FSC, RSPO and RTRS (no criteria yet) have generated substantial criticism from civil society in producer countries, or have suffered from failing participation.

The FSC case gives an example of the lack of effectiveness of such schemes in the global South. FSC is a lot less effective in the South than in North America and Europe. Of all commercial forest area, 58% is certified (by FSC and all other labels together) in Europe, against 2% for Asia and Latin America, and 1% for Africa. This is very important as European agrofuels are increasingly being sourced from timber products – take recent developing agreements between Brazil and Nordic countries for wood pulp biodiesel.[4] A voluntary standard applying to only 2% of forestry offers no credible protection of crucial ecological resources.

The level of credibility failure is evidenced by the recent the Norwegian government declaration, following a ruling by the Norwegian Consumer Ombudsman, recently declared: "The government wants to stop all trade with unsustainably or illegally logged tropical forest products. Today there is no international or national certification that can guarantee in a reliable manner that imported wood is legally and sustainably logged"

The RSPO is not a certification standard and verification procedures have not been agreed. There is no reason to believe it will work, and there is no evidence that the existence of the RSPO has led to an improvement in standards in the industry. There is a serious flaw with the RSPO - carbon emissions from peat drainage are ignored by the RSPO and it therefore does nothing to protect the climate, or encourage sustainability.

We refer you the recent report by Milieudefensie, Lembaga Gemawan and Kontak Rakyat Borneo which looks at the legal, environmental and social practices of the Wilmar Group in Sambas District, Indonesia [5].

The Wilmar Group are one of the largest palm oil companies worldwide and a supplier of bioenergy feedstock. The report reveals that company reporting about their practices bears little resemblance to the reality on the ground, and that, contrary to the company's declarations, illegal land acquisition, burning of land (associated with massive greenhouse gas emissions) and deforestation for new plantations are common procedures. We cannot see how the proposed RTFC verification scheme would do anything to prevent such open abuse of the system, particular where imports from outside Europe are concerned.

The Basel criteria for soy suffer similar lack of credibility and are widely opposed of civil society groups.

The RSPO, RTRS or the Better Sugarcane Initiative do not certify any produce, and none of those stakeholder forums have adopted verification standards. We cannot see how a scheme can be adopted as a benchmark when it has not even been fully agreed and set up. The RTFO credibility is undermined by the proposal that mere membership, together with auditing against principles and criteria should qualify. Membership does not imply adherence to the priniciples and criteria, and no process for independent auditing exists.

The communities in the global South who will be directly affected by the RTFO have not been consulted. Many of those communities and civil society organisations, however, have spoken out very strongly against some of the standards proposed as benchmark standards for the RTFO. The RSPO, for example, has been rejected by the leading NGOs of Papua New Guinea, whilst the RTRS (Basel Criteria) has been strongly opposed by many civil society organisations in South America, who do not agree with the concepts of voluntary sustainability certification of a monoculture industry which is linked not just to deforestation and biodiversity losses, but also to the dispossession of tens of thousands of small farmers, the poisoning of communities, water and soil with pesticides, to soil erosion, water over-extraction, and the loss of food sovereignty, leading to widespread malnutrition in countries such as Argentina and Brazil. Only one organisation which represented small farmers ever joined the RTRS, and they left the Organising Committee in summer 2005, feeling that they could not influence the process.

Under environmental standards, it is stated that conversion of high carbon soils, including peatlands, would not be acceptable. However, this is not one of the principles and criteria of the RSPO. If the RSPO is accepted as a benchmark standard, then biofuels such as palm oil biodiesel from Indonesian and Malaysian peatlands can still be classed as 'sustainable', in contradiction of the standards.

4. At what stage is biofuel technology? Is there enough support for the development of biofuel technology? A UN report found that the climate change benefits of solid biomass fuels outweigh those of liquid biofuels. Are current policies promoting the development and deployment of a range of biofuel technologies? How successful have EU strategies and Directives been in stimulating biofuel usage? Will the 2010 biofuel target be reached? How effective are the Government's fiscal arrangements for biofuels?

This is a mute point, regarding there being enough support for biofuel technology. This question can only be answered after an immediate moratorium on EU incentives for agrofuels and agroenergy from large-scale monocultures including tree plantations and a moratorium on EU imports of such agrofuels. This includes the immediate suspension of all targets, incentives such as tax breaks and subsidies which benefit agrofuels from large-scale monocultures, including financing through carbon trading mechanisms, international development aid or loans from international finance organisations such as the World Bank. This call also responds to the growing number of calls from the global south against agrofuel monocultures, which EU targets are helping to promote. 180 worldwide organisations have called for a moratorium, which is needed to establish the macro impacts of the global market place. Many of these organisations represent the workers of the plantations, the landless, the indigenous communities and subsistence farmers in the global South, who are being adversely affected by EU and UK biofuel policy.[6]

A similar statement was made in January of this year by 250 global organisations and key individuals, who called on the European Parliament, European Commission and European Union for an end to targets for biofuels in Europe.[7]

A moratorium, is now required, because the fledgling biofuel technology has been implemented with a complete bypass of a pre-implantation public policy debate. The issues that are now emerging about agrofuels are those that should have been considered in public debate and policy setting, upstream of any implementation phase. Instead, events have by-passed this stage, and the issues that should have been discussed upstream are now being discussed belatedly in the downstream phase. The above referenced data on the adverse environmental and social aspects of the unregulated biofuels market we feel convincingly demonstrates that a moratorium is now essential to allow scientists and politicians to gain a greater understanding of the true impacts on the social, human rights, land rights, ecological, climate impact, biodiversity and food security.

We would agree with the UN report that found that the climate change benefits of solid biomass fuels outweigh those of liquid biofuels. In fact it is more efficient to use biomass for heat, then CHP, then electricity generation, and finally transport. This descending efficiency hierarchy would suggest that if they aim of government biofuel policy is indeed to mitigate climate change, then land should not be used to grow feedstock’s for vehicles as this is quite clearly the least efficient use of the planets land. The UN Millennium Assessment Report warns of catastrophic impact on all ecosystems of increasing agriculture.[8] A report published in the Proceedings of the National Academy of Sciences[9] using data from the UNs FAO on agricultural production in 161 countries to show that nearly a quarter of the energy processed by land plants is either harvested by humans or lost due to our activities. In south Asia, where oil palm plantations are expanding rapidly to satisfy the EU biofuel directive 63% of plant production is used or destroyed by humans.

The researchers[9] said their analysis shows it will not be possible to produce significant quantities of fuel this way without taking more energy away from natural ecosystems
achieve this level of bioenergy use would almost double the present biomass harvest and generate substantial additional pressure on ecosystems,".

Question 4 goes on to ask about the development, deployment and how successful have EU strategies and Directives been in stimulating biofuel usage. Given that biofuels are the least efficient use of biomass a more pertinent question, would and should be has the EU and national government developed, deployed and stimulated truly renewable energy technologies and a modal shift to a sustainable and integrated transport system. In both cases each sector of our economy would have to be tackled so that not only is efficiency increased, but demand is actually reduced.

All biomass in the heat and electricity sectors would have to be judged on a greenhouse gas emission life cycle against, wind, wave, tidal, geothermal and solar – in particular concentrated solar power. All of these technologies could and should utilise high voltage DC networks to enable the most optimum geographical positioning and economies of scale of infra-structure.

In the transport sector, carbon emissions from the vehicle fleet can be reduced by higher efficiencies and lower carbon emissions; changes in driving practises' eg. regular servicing; car sharing; lower speeds; congestion charging; road charging; taxation of engine capacity; fuel tax escalator. This would be combined with greater investment in public transport and cycle paths. Most long distance freight should be transferred to the railways and canals.

The global percentage total for biofuels is 1% and the UK is presently at 0.6% of the RTFO target. So the question: 'Will the 2010 biofuel target be reached?' should really be what will be the affects on the climate, biodiversity, human rights, water quality and food security if the target of 5% is reached, since all of these issues are already areas of concern at between a tenth and a fifth of this total. Certainly it looks like Europe's bird, insect and mammal life, will be a casualty in the quest to achieve the 2010 target, if the EU set-asides are converted to biofuel production, as looks increasingly likely.

Europe's common farmland birds have declined by nearly 50% since 1980, as a result of intensive agriculture, including the grey partridge, corn bunting, turtle dove, lapwing, whinchat, tree sparrow, skylark and linnet[10] 45% of Europe's butterflies are at risk of extinction and a recent study found 80% declines in bee diversity and 70% declines in the diversity of wild flowers dependent on pollination on hundreds of sites in the UK and Netherlands[11] As the authors of the study warned, the future of pollination and of much of our food supplies may be at risk as pollinators are driven into extinction.

Set-asides were initially introduced for market reasons, but large numbers of our birds, insects and some mammals have come to depend on them for their survival[12]. The EU have just commissioned a study about the environmental benefits of set-asides and a longer-term review was supposed to look at ways of protecting our wildlife with more targeted farming policies. In the meantime, however, plans to scrap all set-asides for the next two seasons have been announced. Millions of birds could be left without food and nesting sites next spring, and there will be little hope of Europe meeting its commitment of halting biodiversity losses by 2010.

5. The EU Strategy for Biofuels claims that biofuels "are a direct substitute for fossil fuels in transport and can readily be integrated into fuel supply systems". What proportion of UK domestic transport and energy generation could be fuelled by UK-produced biofuels? Is it possible for biofuels to entirely replace oil for transport purposes? Is there a role for public procurement or public transport? Will biofuels improve fuel security? How secure are biofuel crops from unexpected events such as drought or disease?

The evidence now shows that biofuels are not "are a direct substitute for fossil fuels in transport and can readily be integrated into fuel supply systems".

The recent paper entitled:
'N_2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels' by:
P. J. Crutzen, A. R. Mosier, K. A. Smith, and W. Winiwarter
Atmos. Chem. Phys. Discuss., 7, 11191-11205, 2007
Abstract Discussion Paper (PDF, 382 KB) Interactive Discussion
brings the default values used in the RTFO consultation on carbon and sustainability reporting under the renewable transport fuel obligation into complete doubt. *In particular, the details of*

- *the Oilseed rape to biodiesel (pp.136 - 142), "Default fuel chain" on page 137, and the "N fertilizer" figures on page 140 in the 'Default value tables', and*
- *the Corn to ethanol (pp.133 - 135), "Default fuel chain" on page 132, and the "N2O emissions from soils" and "N fertilizer" figures on page 136 in the 'Default value tables'.*

The report was highlighted in the Times[13]:
… that rapeseed and maize biofuels are calculated to produce up to 70 per cent and 50 per cent more greenhouse gases respectively than fossil fuels from new calculations of the emissions of nitrous oxide. Scientists, including Nobel prize winner Paul Crutzen, have found that the use of fertilizers in biofuel production released twice as much as nitrous oxide as previously realised. The research team found that 3 to 5 per cent of the nitrogen in fertiliser was converted and emitted. See also: [14]

This paper brings the carbon balance issues around biofuels into further doubt. It is clear also that rape seed oil which accounts for about 80 per cent of the biofuel production in Europe and was previously thought to be less damaging than Palm Oil, can also accelerate climate change as Palm Oil does, and is well documented as doing from associated deforestation and peat destructionion[15]

As regards: '*What proportion of UK domestic transport and energy generation could be fuelled by UK-produced biofuels?'*

The Guardian[16] article calculated that: road transport in the United Kingdom consumes 37.6 million tonnes of petroleum products a year.[17] Based on the most productive oil crop grown in this country – rape seed, the average yield is between 3 and 3.5 tonnes per hectare.[18] One tonne of rapeseed produces 415 kilos of biodiesel.[19] Therefore, every hectare of arable land could provide 1.45 tonnes of transport fuel. These figures do not take into account the latest paper on from Crutzen et al, highlighted above, which explained that rapeseed and maize biofuels are calculated to produce up to 70 per cent and 50 per cent more greenhouse gases respectively than fossil fuels from new calculations of the emissions of nitrous oxide.

In order to operate the existing UK road transport would need 25.9m hectares. There are 5.7m in the United Kingdom.[20] In order to satisfy existing demand, the UK requirement, would exceed four and half times the UKs arable land. Or to answer the question, if none of our land that is used for food and animal feed production was converted to biofuel production (and not taking into account the Crutzen figures) approximately 20% of transport could be met. This would obviously not be allowed to happen as our food security and sovereignty would be non-existent. Already the macro affects of displacing UK rapeseed production from food to biofuels has led to an increased importation of palm oil from Indonesia to account of this displacement practise.

'Is it possible for biofuels to entirely replace oil for transport purposes?'

No. There is simply not enough land on the planet to feed 6.5 billion people, and 800,000 motor vehicles. In 2006, world cereal reserves fell to their lowest level in more than two decades, and FAO has reported a

disturbing food supply situation, with demand surpassing supply both in grains and oilseeds, and has called for closer monitoring of the world food situation

Forecasts for the 2006/07 marketing year confirm a tight supply situation for coarse grains and oilseeds, where production may not be sufficient to satisfy global demand, thus necessitating a sizeable reduction in stocks.[21] In six of the last seven years, humans worldwide consumed more grains and oilseeds than were produced.[22]

The EU is already the world's largest importer of food, and its massive imports of animal feedstuffs (75% of its proteins needs for feed are imported) are the main reason for the existence of its animal and cereal surpluses.[23] In 2005 the EU imported half of its total oilseed requirements, while in 2006 the FAO reported that, "*after two years of exceptional expansion, imports are expected to continue growing strongly because domestic oilseed production is not sufficient to satisfy both, demand for food uses and for biofuel production.*"[24]

The Intergovernmental Panel on Climate Change predicts that rain-dependent agriculture could be cut in half by 2020 as a result of climate change. [25]
In a presentation at the Renewable Energy Association Bioenergy 2007 a slide showed that the University of Leeds has predicted there will be 2,000 million cars on the road and according to the US Energy Information Administration, energy demand will have increased by 50%. The number of cars will have doubled to 2 billion and the number of people on the planet increased by 2 billion when rain fed agriculture could have already halved.

'Is there a role for public procurement or public transport?'
Yes. Other than short journeys that most people can undertake by walking or cycling (a quarter of all car journeys are less than 2 miles[26]) mass public transport can replace the private motor vehicle. In fact this is necessary if the county is to meet reduction targets of 90% by 2030, which are necessary and urgent. This move would be to the use of coaches as developed by Alan Storkey[27], which does not involve the use of biofuels. Please note that National Express (coach service operator), have decided not to use biofuels based upon environmental concerns over carbon savings, based on advice from the University of Surrey.[28]

The cost of motoring has fallen whereas bus and coach fares have risen by 66% in real terms since 1975, and train fares by 70% - the cost of owning and running a car fell in the same period by 11%.[26,]

'Will biofuels improve fuel security?'
This question is presumably asked in light of the present situation in the Middle East and Latin America. The answer must be no, as demand will far out way the amount of fuel that can be grown in the UK for biofuels. The Department for Transport predicts traffic to grow by 26% between 2000 and 2010[29], whereas UK targets are 5% by 2010 and these will actually increase greenhouse gas emissions, due to the macro effects of global distribution of feedstock's.

Reduction in demand will improve fuel security, as will efficiency measures and one simple example: The RTFO report says: "Renewable fuels are one of the few options identified in the transport sector that can achieve cost-effective carbon savings." Throughout the report we are told that the RTFO would be the equivalent, in carbon terms, of taking a million cars off the road. That is 4% of our cars. In 2005 a review from defra [30, 31] reducing carbon emissions, showed that enforcement of the 70 mph speed limit would save 890,000 tonnes of carbon a year or 9/10 of the RTFO. This measure is described as "politically difficult", as is car-sharing and road user charging. The same (restricted) report states that changing speed limits would save 1.7 million tonnes of carbon and car sharing between 0-0.5 million tonnes. This amounts to removing 1.7 million cars from our roads or between 70 and 75% more savings than the RTFO (if the figure of 1 million was correct).

'How secure are biofuel crops from unexpected events such as drought or disease?'

Biofuel crops are no more secure from unexpected events such as drought or disease, or for that matter floods all of which affected so many of our arable crops this summer.[32, 33, 34]

6. What impact would an expansion of UK production of biofuels have on the ability of the UK to produce its own food? How might this impact on greenhouse gas emissions from international trade patterns? What impact might the expansion of biofuels have on international food security and prices?

We hope to have shown above, that the two are mutually exclusive and incompatible. Due to the nature of the free market this will have an adverse effect on greenhouse gas emissions.

What impact might the expansion of biofuels have on international food security and prices?'

In the case of soya, for example, an FAO June 2006 report (presumably not considering recent increase in targets) estimates that the main producing countries (USA, Brazil and Argentina) would need to triple production in order to supply the agrofuel market and that "*a near doubling of the area under cultivation would be probably required,*
even assuming future yields matched the highest yield encountered currently in rain fed cultivation under high input technology in the USA."[35] Taking into account that the USA already uses all the suitable land for soya, and that demand for ethanol and
rising prices in cereals are expected to cause an increase in land devoted to grains in this country at the expense of soya, it seems that the only available 'surplus' is to come from southern producers. The expansion in soya cultivation for export in Brazil and in Argentina has already taken a tremendous toll in these countries. Not only has it spurred deforestation and destroyed valuable ecosystems, driving indigenous peoples and small
farmers from their territories, it has also displaced small farmers and local production oriented towards meeting domestic food needs. As Grupo de Reflexión Rural comments: "*The export model exemplified by soya seriously threatens food sovereignty in Argentina…In recent years, soya has replaced the production of food staples, which are now being imported.*"[36]

The rapid expansion of oil palm plantations in Indonesia, Malaysia and other developing countries, encouraged by expectations of a huge agrofuel
market, is also having devastating impacts not only on the environment but also on local farming economies and food sovereignty. In addition to the expansion of agricultural land, rising agrofuel demand is to be met by an increase in crop yields, with increased inputs in order to maximize production. According to the European Fertilizer Manufacturers Association: *"Over the next ten years… nutrient use for oilseeds will increase by 35% and even by 49% for oilseed rape. This is due to an increase in biodiesel production."* [37] On the other hand, the rapid development of agrofuel markets is encouraging investment in farming operations by the agrofuel industry, already prospecting developing countries for suitable land for energy crops.

Small farmers in these countries will not be able to compete with large-scale, export oriented, intensive productions managed by industry. Many are forced – sometimes through the use of violence – to abandon farming and migrate to cities, adding to the significant fraction of world population already living in precarious situations in urban peripheries, extremely vulnerable to rising food prices. The escalating demand for agrofuels will encourage small farmers to plant energy crops rather than crops cultivated to meet family needs and/or supply local markets. This will increase dependency on purchased inputs and on distant markets that communities are unable to control, and threaten local subsistence and food security. In addition to significant environmental, social and economic damage, intensification of agriculture and the displacement

of small farmers is bound to entail a dramatic loss of local crop varieties and associated knowledge, further undermining local agricultural sustainability and food sovereignty.

7. How might farm viability in both developed and developing countries change with an expansion of biofuels? What implications are there for poverty in developing countries? Should we be concerned about large monopolies forming in the biofuel sector?

Regarding implications on poverty in developing countries, they are myriad and they are already being exhibited: [38, 39, 40, 41, 42]

To benefit local communities, agrofuel production would need to be part of a diverse farming system. But development is focused on large centralized monocultures for economies of scale and a consistent product. The impact of monocultures such as sugar
cane in Brazil, is a clear example of the lack of benefit for the poor and marginalized. This is reinforced by experiences from other countries, including Paraguay and Argentina, Ecuador and Indonesia and South Africa, where communities have reacted to government agrofuel strategies. In Europe, the EC has claimed that agrofuels can provide opportunities for farmers as well as creating jobs and rural regeneration. However EU sources are highly contradictory, especially regarding the number of jobs that will actually be created, not simply replaced or displaced.'

Human rights violations have already resulted from soya, sugarcane and palm monocultures in Latin America and Asia, and these are likely to intensify through the production of agrofuels. Impacts on health arise from deforestation and pesticide spraying. Another major issue involves historical and intense land conflicts, due to monoculture expansion. Production of agrofuel crops may involve violent evictions and murders. Examples are given here from Colombia and Paraguay.[43, 44, 45, 46]

'Should we be concerned about large monopolies forming in the biofuel sector?'

Yes. Isn't the monopolies and mergers commission concerned about large monopolies in any market? Quite clearly the present large companies make life for the plantation workers extremely unpleasant, which is putting it rather delicately. Powerful players are already forming allegiances in the biofuel market. Eg BP and D1 with jatropha in India nad South Africa; BP and British Sugar; Tesco – Cargyle – Greenergy; Northeast Biofuels[47] - including Monsanto, who are seeking to overcome British public concerns about GM food, by introducing GM biofuel feedstock.

There is a very large and powerful lobby forming that includes: Fossil fuel companies, biofuels suppliers and refineries, food manufacturers, farmers, GM & car manufacturers. In Germany the car lobby backed by Ms Merkel is said[48] to have successfully stopped the EC introducing tougher regulations on reducing cars carbon emissions by lobbying for higher EU biofuel targets.

References

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HOW MEANINGFUL ARE 'GREENHOUSE GAS STANDARDS' FOR BIOFUELS IN A GLOBAL MARKET?

This background paper discusses the usefulness of 'greenhouse gas standards', based on life-cycle greenhouse gas assessment in ensuring that biofuels mitigate rather than accelerate global warming. It looks at the importance of non-linear feedbacks which could result from deforestation, which could significantly accelerate ecosystem collapse and climate change; at the importance of indirect or 'displacement' impacts from agrofuel production; and at the remit and limitations of life-cycle greenhouse gas assessments. Finally, we briefly look at the wider debate about the amount of agrofuels which could theoretically be used without accelerating climate change and/or further destroying biodiversity, depleting freshwater supplies and soil.

The term 'biofuels' includes both fuels from true waste and fuels from 'energy crops' which in most cases are grown on monocultures, such as sugar cane, corn, oilseed rape, palm oil and soya. Biofuels from true waste, such as biogas from landfill or manure or waste vegetable oil, are clearly 'climate-friendly', although their role in climate mitigation will be limited. We refer to fuels from 'energy crops' as agrofuels – a term which would also include fuels from organic soil and forest residue, which are essential for maintaining soil fertility and biodiversity. This paper looks at the role of agrofuels only.

Rainforest and peatland destruction and accelerated climate feedbacks:

According to the Stern Review, deforestation is responsible for 18% of global anthropogenic greenhouse gas emissions, however that report does not give estimates for peat and other soil emissions. Figures contained in the in the IPCC's Assessment Report Four suggest that carbon dioxide emissions from global peatland degradation exceed those from deforestation[1]. The destruction of South-east Asia's peatlands for oil palm and timber plantations is the biggest single cause of peatland emissions worldwide.

Rainforest and peatland destruction is thus a major contributor to greenhouse gas emissions, and it also threatens the stability of the global climate in ways not reflected in emissions statistics. One direct impact is the loss carbon sinks: At present, around 25% of anthropogenic carbon emissions are absorbed by the terrestrial biosphere, i.e. by soils and vegetation, and a similar amount is absorbed by the oceans. There is strong evidence that old-growth forests and peatlands continue to sequester large amounts of carbon dioxide from the atmosphere. If those carbon sinks are destroyed, more of our emissions will remain in the atmosphere.

Climate scientists are increasingly concerned that, beyond a certain level of warming, carbon locked up in soils, vegetation and methane hydrates will become increasingly unstable and enter the atmosphere, thus making climate stabilization impossible beyond 1.8 to 2^{o}C global warming from pre-industrial levels. Staying within this level of warming will require very fast and steep emission cuts – even whilst carbon sinks absorb half of our emissions. If we destroy our carbon sinks in the meantime, then we will be faced with the need to cut global carbon emissions by more than half, possibly in less than a decade – something which will be virtually impossible. Climate stabilization and ecosystem protection must go hand in hand.

When fossil fuels are burnt, the emissions are directly proportional to the amount of fossil fuel we burn. This is not the case for deforestation. Natural forests and peatlands are complex ecosystems. The Millennium Ecosystem Assessment, published by the UN in 2005, warned that ecosystem degradation is leading to an increased risk of non-linear, i.e. accelerating, abrupt changes[2]. There are increasing fears that the Amazon forest could be vulnerable to such abrupt changes, namely to large-scale die-back:

The Amazon rainforest 'recycles' 50-80% of the rainfall on which it depends, through a process of evapo-transpiration. Deforestation reduces the amount of evapo-transpiration and therefore has a strong drying effect. Recent scientific evidence shows that conversion to cropland, such as soya, has an even stronger

drying effect that conversion for other land-use[3]. There is strong evidence that, beyond a certain threshold of deforestation, the rainfall cycle over the Amazon may well break down. The Woods Hole Research Institute which has been at the forefront of studying the Amazon carbon cycle, hydrological cycle, and vulnerability to logging and climate change, warns:

"The risk of fire and drought is enhanced by logging, which opens the forests, and by farmers and ranchers who use fire to replace rainforests with crops and pastures. A brutal downward spiral of drought, forest fire, and further drought could expand across much of the Amazon, replacing the species-rich rainforest with savanna like vegetation."[4]

Concerns about a possibly rapid large-scale die-back are supported by evidence that the current Hadley cell airflow, which brings rain to much of South America and as far north as the US Midwest, itself depends on evapo-transpiration in the Amazon[5]: As much as 75% of the water picked up by the trade-winds from the Atlantic Ocean is pumped back into the atmosphere by the forest and finally leaves the Basin and brings rain to the Andes, Central America and the southern US. Rainfall changes over the Amazon have already been observed, which are in line with those models that suggest that deforestation could indeed alter the Hadley cell circulation. This includes strong signs of savannization in a large region from Para to Guyana. There is no evidence that the Amazon has already crossed a threshold and entered into irreversible die-back, but the droughts of 2005 and 2006, unprecedented in living memory, suggest that it may be close to such a threshold, and there are signs that drought may be returning to the southern Amazon in 2007, for the third year running. Forest die-back and conversion into savannah has already been observed in some areas around the drier margins of the rainforest. Some climate models suggest that Amazon die-back could be rapid[6], comparable perhaps to the sudden die-back of vegetation in today's Sahara. Between around 8,000 AD and 3,000 AD, most of the Sahara was covered in forests, grasslands and lakes. Temporary cooling of the North Atlantic reduced vegetation cover at different times, however, the complete vegetation die-back and desertification are understood to have happened abruptly and can only be explained by models which show that vegetation losses eventually disrupted the rainfall on which the region depended. This illustrates the strong links between vegetation and rainfall and the danger of dramatic, non-linear changes once vegetation cover can no longer maintain essential rainfall cycles.

There is a high risk of non-linear events, such as Amazon die-back which could be rapid, irreversible and lead to catastrophic acceleration of global warming as well as major changes in rainfall patterns, which could very rapidly cause global food shortages and large numbers of refugees. Those risks cannot be represented in 'life-cycle' studies done for agrofuels. Given the strong evidence that biofuel targets in the EU, US and elsewhere will threaten to accelerate Amazon destruction, a precautionary climate strategy implies opposing such a high-risk policy.

Indirect impacts of agrofuel production are a major threat to rainforests and other 'carbon sinks' and there are no proposals to address those in 'certification' or 'standards'

Different kinds of 'sustainability standards' are being developed at present: The LowCarbon Vehicle Partnership suggest a mandatory reporting requirement to encourage the biofuel industry to self-regulate, and proposals contained in the recent UK Department for Transport consultation on the Renewable Transport Fuels Obligation.

The Dutch Cramer Commission submitted a detailed report on 'certification' using a variety of criteria, however we have been informed that this is now being translated into policy proposals for 'reporting requirements' only, not into any mandatory standards. The Cramer Commission's 'assessment framework', sets out different criteria, indicators and reports, but it does not look at which policy mechanisms might provide safeguards to ensure that the proposed criteria are met. It acknowledges that "Some of the impacts of biomass production are difficult to assess on the individual company level, and only become apparent on the

regional, national and sometimes even on the supranational level. This is true in particular for the impacts caused by indirect changes in land use and is especially important in the themes Greenhouse gas emissions, Biodiversity and Competition between food and other biomass uses. In determining the sustainability of biomass it is crucial to take these macro-impacts into consideration". The recommendations made in the report are currently being translated into policy proposals for 'reporting requirements' only, not into any mandatory certification or standards.

Finally, the European Commission has recently consulted on proposals to certify biofuels according to life-cycle greenhouse and their direct impact on high-conservation value ecosystems only. Biofuels which do not meet those criteria would not qualify under a new Biofuel Directive; however, the consultation document acknowledges that indirect impacts on land-use cannot be accounted for. There are no social criteria, meaning that feedstock from plantations where people have been evicted, poisoned by pesticides or even murdered could be certified as 'sustainable'.

This paper, however, focusses on the indirect 'macro' impacts from use and production of agrofuels.

1) A 2006 peer-reviewed study by Morton et al.[3],which was press-released by NASA found: "Area deforested for cropland and mean annual soybean price in the year of forest clearing were directly correlated (R^2 = 0.72), suggesting that deforestation rates could return to higher levels seen in 2003-2004 with a rebound of crop prices in international markets." According to this study, Amazon deforestation rates are coupled to the world market price for soya, rather than to changes in government or private sector policies or practices. If agrofuel expansion pushes up the price of soya, then an increase in deforestation rates in the Amazon can be expected.

2) According to a peer-reviewed study by Ricardo Grau et al.[7], published in 2005, soya expansion is the main cause of the high deforestation rates in tropical and subtropical seasonally-dry forests in South America, and that global factors (technological development and international prices) are the main drivers of soybean expansion and thus deforestation in those areas, including the semi-arid Chaco in Argentina. The study suggests that in Argentina government incentives for soybean production have cushioned industry from fluctuations in prices, suggesting that government optimism in the economic benefits of soybean production may be more important in that country.

3) According to the US Foreign Agricultural Service, world soybean prices rose by 13% between December 2006 and April 2007, despite 8% growth in production in Argentina, Brazil and Paraguay combined[8]. According to a report by the Woods Hole Research Institute published during the same month, soy prices are currently rising as a result of increased demand for corn ethanol in the US, sugar cane expansion for ethanol in Brazil, and the growing use of soy oil for biodiesel[9] . Recent figures from the US Department of Agriculture confirm that US farmers are indeed switching from soya to corn as a result of the demand for ethanol[10] – one of the reasons identified elsewhere why soya prices are now rising.

The impact of both soy biodiesel and corn ethanol on soybean prices has been confirmed by various sources, including the US Department of Agriculture[11], and various media sources[12] . The article by Gargi Shah quotes Mr Pradip Desai, Managing Director, Palmtrade Services Pvt Ltd. Saying "edible oil prices were expected to be driven mainly by the movement in prices of crude oil, demand from the consumption markets (India, China and EU) and the bio-diesel economics (sic)". A recent study by the International Food Policy Research Institute predicts that the rapid increase in global agrofuel production increase the prices of oilseeds, including soybeans, rapeseeds, and sunflower seeds by 26 percent by 2010 and 76 percent by 2020[13]

A recent study by the International Food Policy Research Institute predicts that the rapid increase in global agrofuel production pushes up the prices of oilseeds, including soybeans, rapeseeds, and sunflower seeds by 26 percent by 2010 and 76 percent by 2020[13].

4) It is widely accepted that palm oil expansion, and in particular the increase in concessions granted for palm oil, is the leading cause of deforestation in Indonesia and Malaysia. The Indonesian government has acknowledged that new palm oil investment correlates with the price of palm oil. A report by the Food and Agriculture Organisation in late 2006[14] concluded: "The new demand for vegetable oil for biodiesel production has had a major influence on the recent strengthening of prices; and the agrofuel driven surge in the price of rapeseed and its oil has lifted vegetable oil prices in general". The increasing use of European rapeseed oil for biodiesel was identified as a more important cause for rising palm oil prices than imports of palm oil for biodiesel up to 2996. Since late 2005, coinciding with the rapid increase in agrofuel demand, the EU has been a net importer of both rapeseed oil and soy oil, having been an exporter of both until then[15]. This suggests that, so far, the indirect, or displacement, effects of agrofuel use in the EU have had a considerably greater impact on palm oil prices and thus deforestation in South-east Asia than the use of palm oil biodiesel in Europe, let alone the use of palm oil biodiesel from recently deforested land.

5) According to recent findings by Daniel Nepstad of the Woods Hole Research Institute[9], only a relatively small proportion of soya expansion currently happens inside the Amazon rainforest. Far more important is the displacement of other agricultural activities due to soya expansion in neighbouring areas, such as the Cerrado. Dr Philip Fearnside of the Brazilian National Institute for Research in the Amazon confirms in the same article: "Soybean farms cause some forest clearing directly…but they have a much greater impact on deforestation by consuming cleared land, savanna, and transitional forests, thereby pushing ranchers and slash-and-burn farmers ever deeper into the forest frontier. Soybean farming also provides a key economic and political impetus for new highways and infrastructure projects, which accelerate deforestation by other actors." Brazil's National Agro-energy Plan has qualified 200 million hectares of Brazilian territory as 'degraded' and thus suitable for the expansion of agrofuel monocultures. Most of this is biodiverse dry forest or savannah, on which indigenous people and other local communities depend for their livelihoods, or lands used for cattle ranching or small-scale subsistence farming. This will seriously worsen the situation described by Nepstad and Fearnside above.

6) Government support for agrofuels, including agrofuel targets in the EU, affects deforestation not just by pushing up prices. Many companies and Southern governments are drawing up economic development plans and investment strategies based on optimism about future world demand and prices for agrofuels, which is boosted by Northern governments' long-term commitments to create and support a growing agrofuel market. In June 2006, for example, the CEO of Cargill described agrofuels as a 'a bit of a gold rush' in a New York Times article[16] and the President of the Inter-American Development Bank (IDB), Luis Alberto Moreno, has called agrofuels a "transformative opportunity" for Latin America and the Caribbean[17].

This 'market optimism' is being translated into concessions and investment decisions that economic strategies which create 'favourable conditions' for the expansion of monocultures which produce feedstocks for agrofuels. Those decisions, once made, will be difficult to reverse. In Indonesia, for example, palm oil expansion for the global biodiesel market is one of the priorities in the 5-year economic plan, with government plans for the conversion of around 20 million more hectares over the next 20 years[18] . The Asian Development Bank (ADB) has recently committed itself to large-scale investment in agrofuel expansion, including from palm oil, and, in April this year, the Inter-American Development Bank (IDB) announced plans to invest $3 billion in private sector agrofuel projects. The Argentinean government are committed to meeting 10% of Europe's agrofuel demand by 2010, as well as increasing domestic biodiesel use[19], and they have put economic incentives, such as tax breaks and mandatory targets in place to achieve this.

According to an article in the Latin Business Chronicle, the meeting between President Lula and George Bush in March this year encouraged US, European and Japanese investors to draw up new investment plans for sugar cane plantations, mills, road, railway and port projects[20] .

7) The investment decisions and strategies described above are likely to accelerate deforestation and peat drainage not just by encouraging land conversion to agrofuel plantations. Large numbers of refineries are being built and planned, particularly in South-east Asia and Latin America, which require large plantations to remain economically viable. The Indonesian NGO Sawit Watch estimate that a palm oil mill requires 20,000 hectares of land to be viable, yet a biodiesel refinery needs 50,000 hectares[21]. Ecotropica and the Global Nature Fund have warned that ethanol refineries for which the Mato Grosso state government has recently granted planning permission will make large-scale deforestation and drainage in the Pantanal inevitable [22].

Much of the 'strategic' investment by governments and international finance organization, however, will include infrastructure projects, which will fragment and open up many of the world's remaining rainforests, semi-arid forests and natural grasslands to development. The link between road building and forest degradation and destruction is well-established[23]. The Initiative for the Integration of Regional Infrastructure in South America (IIRSA), for example, is a plan by South American governments to greatly increase roads, waterways and ports, partly in order to facilitate imports of soybeans and grains. A total of 335 projects have been identified, and 31 are currently being implemented at a cost of $4.3 billion, co-financed by the Inter-American Development Bank, Fonplata and the United Nations Development Programme. The largest IIRSA project is the Madeira- Mamoré -Beni-Madre de Dios hydroelectric and channelization complex, which would allow for soybean expansion in the Bolivian Amazon and savannah and the Brazilian rainforest, according to the International Rivers Network[24]. The IIRSA is a far-reaching investment programme which will serve a variety of economic interests, not just agrofuel expansion. Paraguayan farmers organizations have, however, pointed out that national agrofuel strategies in countries like Paraguay, the Ethanol Alliance between the US and Brazil, which other Latin American governments are expected to join, proposals made at the First American Congress on Biofuels in May 2007, as well as bilateral agrofuel co-operation between Latin American states and the US and EU depend on many of the large-scale infrastructure projects planned under the IIRSA[25]. Agrofuel expansion thus provides a very strong incentive for road, port, canal developments which are a major threat to Latin America's largest natural ecosystems.

This is reflected in the Brazilian government's Plan for Growth Acceleration (PAC), which was published in January 2007. This includes ambitious infrastructure projects in the Amazon forest. Many of the projects will be financed by Brazilian National Bank for Economic and Social Development (BNDES), and there is a commitment to build 1,150 kilometres of ethanol and biodiesel pipelines for export. Expansion of monoculture plantations for agrofuels, particularly in the Cerrado, forms an important part of the PAC. There are further proposals to devolve environmental protection to states and municipalities which many environmental organsiations fear could water down existing standards[26].

Guyana is another country where rainforests are threatened both directly and indirectly by agrofuel expansion: In April 2007, plans for the first ethanol plants were announced, and there are plans to improve transport links across the border with Brazil and along the Atlantic seabord linked, at least partly, to plans to grow and transport sugar cane for ethanol. It is feared that this could increase settlements, agricultural expansion and port development[27].

8) Another likely 'indirect impact' of agrofuel expansion is the strengthening of political power of corporate interests representing large agri-businesses and biotech companies. This may well be reflected in Brazil's Plan for Growth Acceleration or the Paraguayan and other investment policies and strategies, including those discussed above. In Indonesia, high palm oil prices and government support for biodiesel expansion has greatly strengthened the economic power of companies such as Raja Garuda Mas, Sinar Mas or the Bakrie Group[28]. Many of those business groups have got strong links to government and have increased their political dominance, particularly in Kalimantan and Sumatra, by taking advantage of decentralization. Raja Garuda Mas and Sinar Mas own the logging/timber companies APRIL and APP, notorious for their destruction of most of Sumatra's rainforests. The biodiesel boom is thus strengthening business groups also responsible for rainforest destruction for timber, pulp and paper. It is therefore impossible to distinguish

between rainforest destruction for palm oil or for timber in Indonesia: The government's strategy of granting more concessions to companies for palm oil plantations, together with a virtual lack of law enforcement against those companies is encouraging both rainforest conversion to plantations and illegal logging.

The indirect impacts from agrofuel expansion are in many cases a greater threat to rainforests and other vital carbon sinks than the conversion of those ecosystems to agrofuel plantations. Indirect impacts include the displacement of other forms of agriculture into natural ecosystems as agrofuel plantations are expanded elsewhere, the wider effects of infrastructure projects linked to agrofuel expansion, the strengthening of corporate elites already responsible for deforestation and forest degradation in many Southern countries, and the encouragement of national development strategies and public-private investment decisions which favour monoculture expansion and large-scale infrastructure projects at the expense of rainforests and small-scale sustainable farming. Deforestation rates in many areas are linked to commodity prices, for example for soya and palm oil, which are now being boosted by agrofuel expansion. Furthermore, the 'market optimism' created by biofuel targets in the EU, US and elsewhere is serving as a strong incentive for private investors and governments to provide both the infrastructure and long-term institutional framework for monoculture expansion.

How useful are life-cycle greenhouse gas assessments?

All of the certification/standards/reporting proposals for agrofuels which being discussed at present look at encouraging the use of agrofuels with a 'positive greenhouse gas balance'. Many European NGOs are now calling to restrict public support, granting it only to those agrofuels that achieve at least 50% greenhouse gas reductions. The 'greenhouse gas balance' of agrofuels is established through life-cycle greenhouse gas assessments that should ideally be peer-reviewed though, in reality, very few of them are.

There are no peer-reviewed life-cycle greenhouse gas studies for biodiesel from palm oil, jatropha or soya, and peer-reviewed studies on sugar cane ethanol are limited to those looking at energy gains and fossil fuel displacement, rather than total greenhouse gas balances. One study by Macedo et al, which appears not to be peer-reviewed, looks at the greenhouse gas balance of Brazilian sugar cane, but excludes deforestation and land-use change, despite the fact that sugar cane expansion is linked to land conversion in the Cerrado, the Atlantic Forest and the Pantanal[30].

There are further problems with using the results of life-cycle greenhouse gas assessments as 'benchmark' for agrofuel sustainability. One European study, for example, suggests that scientific uncertainties make it impossible to say whether greenhouse gas savings from rapeseed methyl esther (REM) are 7% or 58%. Neither of those figure includes organic soil carbon losses, nor do the studies consider the indirect impacts of greater use of REM in Europe in pushing up vegetable oil prices, and in particular palm oil prices, globally and thus triggering further palm oil expansion linked to deforestation in countries like Indonesia and Colombia [31].

- Many assessments point to significant uncertainties, particularly with regard to the attribution of by-products, and soil nitrous oxide emissions.
- The largest number of peer-reviewed life-cycle greenhouse gas assessments has been done for US corn ethanol. An evaluation of six different analyses by Alexander Farrell et al, published in Science in January 2006[32] reveals a wide range of methods used and different results reached. The authors conclude that corn ethanol brings small greenhouse gas savings of 13% compared to petrol, but only if soil erosion and land conversion are ignored. This study, in turn has been criticized some scientists[33]. Alexander Farrell and his colleagues said in response to this criticism: "Including incommensurable quantities such as soil erosion and climate change into a single metric requires an arbitrary determination of their relative value." Yet soil erosion implies the loss of soil organic

carbon and a need to use further energy and fertilizer input (with more nitrous oxide emissions) to be able to farm the land. Soil organic carbon losses and climate change are ignored in virtually all life-cycle assessments, further undermining their usefulness as a benchmark for 'sustainability'.

- As mentioned above, soil organic carbon losses are ignored in virtually all life-cycle assessments, even though they can be substantial. One of the regions where soil organic carbon changes linked to agriculture (though not to agrofuel production in particular) has been studied extensively is Argentina's Pampas region. Here, different studies reach very different results for the same climate zone and farming methods, some indicating minor accumulation of soil organic carbon with non-till farming, whilst others show substantial carbon losses. This is likely due to variations in soil composition and different methodologies.

Although there is no universally agreed methodology for life-cycle assessments, few independent researchers working in this field, and very few peer-reviewed studies, agrofuel companies are increasingly commissioning their own assessments. They use a range of methodologies, often ignoring important sources of emissions, or even all greenhouse gas emissions other than those of carbon dioxide. If governments introduce a reporting requirement or standards based on life-cycle greenhouse gas assessment, then they will have to rely on industry-commissioned, non-peer-reviewed studies that by their nature will not provide independent scientific evidence. The only alternative, not proposed or considered by anybody, would be to delay such a requirement, possibly by several years, and to provide government finance to build the capacity for independent scientific research in this field.

Here are two examples of company-commissioned life-cycle assessments:

- Greenergy Biofuels Ltd claim to have been the first UK company to publish figures on carbon savings from the biodiesel they sell. Like other companies, they ignore greenhouse-gas emissions other than carbon dioxide, even though nitrous oxide emissions account for a large proportion of life-cycle emissions from biodiesel. Greenergy commissions the Edinburgh Centre for Carbon Management (ECCM) for studies. Greenergy Biofuels Ltd's office is at the same address as ECCM and Greenergy previously owned a lot of the ECCM shares.
- In June 2006, Neste Oil published a report on life-cycle greenhouse gas savings from their NExBTL biodiesel from rapeseed oil and palm oil, which was undertaken by the German Institute for Energy and Environmental Research (IFEU)[34]. The surprising conclusion of this study was that the best greenhouse gas balance comes from converting natural rainforest to palm oil for biodiesel. Biofuelwatch spoke to the IFEU team responsible for the study and were advised verbally that the result was derived by excluding soil carbon emissions, all emissions linked to peat destruction, all emissions linked to forest fires, and dividing deforestation emissions by 100 (i.e. spreading them over a century), even though the maximum life-time of an oil palm plantation is around 25 years. Calculations for nitrous oxide emissions ignored the IPCC observation, contained in the Third Assessment report, that the application of nitrate fertilisers to one hectare of tropical and phosphorous-limited soil resulted in N2O emissions 10-100 times higher than those from applying the same amount to a hectare of temperate soils.

As discussed above, no methodologies exist which could account for indirect impacts, let alone non-linear feedbacks, when establishing 'greenhouse gas balances'. Accounting for those would indeed be extremely difficult:

a) If Amazon rainforest is converted to soya plantations, a good life-cycle study should calculate how much carbon is lost from each hectare of the new plantation as a result of deforestation. Those figures would be based on the presumption that carbon emissions correlate directly to the area deforested, i.e. that there will be no non-linear feedbacks. As we have seen above, there is a high risk of non-linear feedbacks, yet it is

impossible, to predict exactly where the 'tipping point' for a large-scale die-back of the Amazon might lie. No life-cycle study can account for or attribute the release of perhaps 120 billion tonnes of carbon which could result from land-clearance beyond that unknown 'tipping point.'.

b) In South-east Asia, satellite images have confirmed that most of the annual peat and forest fire hotspots are on plantations, many of them oil palm plantations. The spread and intensity of the fires, however, depends on weather conditions. In theory, a life-cycle assessment could account for carbon emissions from forest fires set to clear land for a agrofuel plantation, though no such assessments have been done as yet. In practice, this will be almost impossible to police or prove, and it would also yield vastly different emission figures linked to chance weather conditions rather than company practice. In reality, vegetation burning and, in most cases, land-conversion and deforestation, are ignored completely in life-cycle assessments.

c) Life-cycle assessments are done on a field basis, and thus cannot account for any of the indirect 'displacement' effects described above. Those effects are difficult to quantify and prove and no methodology for including them exists.

Life-cycle assessments are micro-studies, which look at greenhouse gas balances on a field-basis. They cannot account for the wider impacts of agrofuel production, such as displacement of other agricultural activities or accelerated deforestation linked to infrastructure for the transport of agrofuels. Neither can they account for non-linear feedbacks. There are very few peer-reviewed studies, and methodologies vary widely. Most studies ignore some types of greenhouse gases or sources of emissions, such as soil organic carbon losses and deforestation/land-use change emissions. Scientific uncertainty means that some of the better studies reveal a very wide margin of error, which makes it difficult to use them for any 'certification' or 'reporting' requirements. There is no capacity for independent research to carry out the large number of assessments required by any reporting or certification scheme. This is likely to result in a large number of company-sponsored 'research' projects that will not be independently verified. Most importantly, however, even the best life-cycle greenhouse gas assessment cannot help to prevent agrofuels from accelerating global warming, because it cannot account for indirect impacts/displacement, nor for non-linear climate feedbacks from deforestation, which are amongst the most serious risks to our carbon sinks and thus to the stability of the global climate.

Could sustainable agrofuels play a significant role in future energy supply?

Any major shift from fossil fuel energy to bioenergy will significantly increase human demands on the planet's photosynthetic capacity, and on the biosphere in general. Perhaps the most fundamental question in the agrofuel debate is whether, or in how far, increased use of bioenergy could be possible without further destabilizing ecosystems, depleting the soil and water on which agriculture as well as ecosystems rely, or further disrupting the carbon cycle and thus accelerating climate change. A number of studies suggest that sustainable bioenergy, and agrofuels in particular, could meet a significant proportion of our primary energy demand. All of those studies are based on the assumption that there will be no climate change impacts on agriculture in coming decades – the report by E Smeets et al even states that it is assumed that the climate will not change between now and 2050. All of the studies assume that substantial increases in per hectare yields are feasible, and that further intensification of agriculture is possible without being limited by depletion of water and soil, despite the fact that global grain production has, so far, peaked in 2004 and that per hectare yields of key agrofuel crops are declining in different parts of the world. European oilseed rape per hectare yields, for example, have been falling for four years, with a significant fall in overall output in 2007.

Various studies, including the UN Millennium Ecosystem Assessment Report, show that human pressures on the biosphere and resource use are already highly unsustainable, even without large-scale modern

agroenergy. According to that report, 60% of ecosystem services are degraded and there is an increasing likelihood of non-linear changes in ecosystems which could have severe impacts on human society.

Contrary to the widespread presumption that agrofuels are a source of 'renewable energy', the International Panel on Climate Change states that stable ecosystems must approach zero 'net primary productivity'[36]. This means that, in a stable environment and climate, the amount of carbon fixed by plants is equal to the amount of carbon put back into the atmosphere, partly by the plants themselves and partly by symbiotic soil organism. It means that, over the human time-scale, healthy ecosystems do create energy. This is why scientists such as Tad Patzek, geoengineer at UC Berkley warn that agrofuels will require intensive 'mining' of the biosphere, in which ecosystems, including soils, continue to be stripped off their organic materials, which will have to be continuously replaced by fossil fuels (in the form of fertilizers) to prevent or even delay agricultural collapse[37].

The difference between carbon emissions on the one hand and increases in atmospheric carbon dioxide on the other suggests that, at the global level, net primary productivity has been increasing in recent decades, allowing ecosystems to absorb about 25% of anthropogenic carbon dioxide emissions. Many scientists assume that this is a temporary response to higher carbon dioxide levels ('carbon fertilisation'), which may soon be overwhelmed by increasing stress from heat, drought and extreme weather events. It is not a trend on which we can rely in future.

A recent paper by Helmut Haberl et al[38] finds that humans already use 23.8% of the net primary productivity of the terrestrial biosphere resulting in severe ecosystem degradation and bio-geochemical changes, and that large-scale biomass expansion would greatly increase those pressures. NASA satellite images reveal that most net primary productivity in the more densely populated parts of the world is appropriated by humans[39]. Another paper, by Renton Righelato and Dominick Spracklen[40], finds that meeting the EU and US agrofuel targets will require clearance of natural forests and grasslands, and that "clearance results in the rapid oxidation of carbon stores in the vegetation and soil, creating a large up-front emissions cost that would, in all cases examined here, outweigh the avoided emissions". Ecological restoration, rather than land conversion for agrofuels, would offer a significant potential for reducing global carbon emissions, according to the authors.

A presentation by G Huppes and E van der Voet of the University of Leiden[41], links increases in bioenergy use to reduction in land available for ecosystems and finds that large-scale bioenergy expansion will first reduce and eventually eliminate the space available for ecosystems, and thus for most species on earth.

Scientists at a recent conference of the Stockholm International Water Institute warned that agrofuel production would double the amount of water used by agriculture and lead to land clearance and significant carbon dioxide emissions[42]. Water scarcity is a major threat to human society, to agriculture, and to ecosystems.

Second-generation agrofuels, if they were to become commercially available, would allow humans to turn different types of biomass into liquid transport fuels. This could greatly increase human pressure on the biosphere.

It is important to consider natural limits to the use of bioenergy, which are the negligible amount of 'new energy' created by plants, the scale of human appropriation of the planet's photosynthetic capacity and 'ecosystem services', and the fact that demand for agrofuels is increasing at a time when all of the world's ecosystems are already under strain from resource over-exploitation and climate change. There are intrinsic natural limits to 'sustainable agrofuels', which cannot be overcome by more effective regulation, sustainability safeguards or by new technology. Going beyond those limits

will greatly increase the chances of ecosystem collapse and non-linear events, as highlighted in the UN Millennium Assessment.

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