GREENPEACE

Policy on BIOENERGY

FINAL

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1. Background

Human induced climate change is predominantly caused by the release of greenhouse gases (GHG) to the atmosphere from the burning of fossil fuels. Renewable energy is part of the solution to climate change and bioenergy is a renewable energy source (i.e. the energy is from the sun and can be replenished).

Currently, bioenergy supplies about 10% of total global primary energy[1], primarily traditional biomass usage (e.g. firewood) in developing countries. However, modern uses of biomass (e.g. to generate electricity) are increasing, especially in developed countries, due to concerns over climate change, high oil prices, and energy security.

There are concerns regarding the environmental and social impacts of an increase in biomass use. In particular, the impacts of a projected large increase of using biomass as biofuels for transport (as opposed to stationary applications) are complex and controversial. Judgments are confounded by newly emerging issues, a lack of information, and uncertainties over claims of technological advances. Hence, this policy does contain some uncertainties, which reflect the current state of knowledge.

The resources and potential for climate and biodiversity-friendly biomass applications vary widely in different parts of the world. Nevertheless, this policy document offers criteria applicable globally upon which to assess individual bioenergy projects.

A list of definitions is given at the end of the document

2. Greenpeace Bioenergy Policy

Greenpeace believes that bioenergy is part of the solution to combat climate change. However, bioenergy is not a silver bullet for unsustainable energy usage and must be used in conjunction with other measures, both political and social, to reduce energy consumption and increase energy use efficiency.

Greenpeace supports the use of biomass produced in a sustainable way for decentralized stationary heat and electricity generators (e.g. cogeneration and biogas). Greenpeace believes that some biofuels derived from crops can make a contribution to reducing GHG

[1] UNDP 2004. World Energy Assessment Overview Update, p.28
http://www.undp.org/energy/weaover2004.htm

emissions from transport, but these are limited to those with considerable positive energy and carbon balance (e.g. sugarcane ethanol); that are grown within the framework of sustainable agriculture; that do not cause, either directly or indirectly, destruction of intact ecosystems and that do not hinder the ability of any nation, in particular developing nations, to achieve food security and sovereignty.

Greenpeace encourages the development of “second generation” technologies to produce biofuels (i.e. cellulosic ethanol) from sustainable agricultural and forestry wastes. The use of such wastes would avoid destruction of diverse or valuable ecosystems, and would not provoke land-use conflicts.

Production and use of bioenergy should not widen social inequities, especially between developing and developed countries. Local needs should take priority over global trade. Trade in bioenergy must not result in negative social and environmental impacts, nor undermine food security and sovereignty.

3. Criteria for assessing bioenergy production technologies

Following are criteria, applicable globally, upon which individual bioenergy projects can be assessed. Bioenergy production technologies must be analysed from a complete life cycle perspective to ensure that:

1. **bioenergy is used in conjunction with other measures to reduce GHG emissions,** including those to increase energy use efficiency and reduce energy consumption. They should be used to complement and balance the energy supply in a clean renewable energy system, based on solar, wind, small hydro, geothermal, wave and tidal power.
2. **the energy balance of any bioenergy project is considerably positive** (i.e. the end product generates considerably more energy than it required for its production). At present, it is not possible to put a number on what energy savings would be “considerable”, but the energy saving must be readily demonstrable.
3. **bioenergy maximises the reduction of greenhouse gas emissions** in a way that it is effective in combating climate change.
4. **biomass from natural ecosystems is sustainably harvested.** Biomass (e.g. wood) from natural ecosystems (e.g. forests) must be harvested sustainably.
5. **social conflicts are avoided, in particular, those caused by trade.** Production and use of bioenergy should not widen social inequities, especially between developing and developed countries. Local needs should take priority over global trade. Trade in bioenergy must not result in negative social and environmental impacts, nor undermine food security or sovereignty.
6. **crops and plantations for bioenergy are produced within the framework of sustainable agriculture**. Any crops or plantations grown either for stationary biomass applications or for processing into biofuels must be produced within the framework of sustainable agriculture in order to avoid negative environmental and social impacts.

Greenpeace’s sustainable agriculture framework requires that cultivation of bioenergy crops:

- does not cause conversion of intact ecosystems.

Cultivation of bioenergy crops must not cause direct or indirect destruction of intact, diverse and/or valuable ecosystems (e.g. forests that are carbon stores and have high biodiversity).

Bioenergy production systems should maximize agro-systems that promote biodiversity and minimize competition with food crops. Instead on concentrating bioenergy production from monocultures of food crops, bioenergy could be produced from integrated agro-systems, e.g. growing trees for biomass, but also wind protection/erosion control.

- does not hinder food security or sovereignty.

Bioenergy crops have land use implications. Available agricultural land is a finite resource and demand for bioenergy crops would inevitably lead to increased competition for land between food and non-food uses. Bioenergy crops should not compete with food crops in areas or countries where agriculture land is needed to ensure food security. Nor should biomass undermine food sovereignty. This competition is easier to balance if production is primarily for domestic (local or national) consumption.

- bioenergy technologies do not involve releases of GE organisms to the environment

Greenpeace opposes the deliberate environmental release of any genetically engineered (GE) organism, regardless of its intended use. The claim that GE plants for bioenergy would increase yields and make bioenergy production and use more efficient does not justify the deliberate releases of GE crops to the environment. The use of enzymes from GE bacteria or fungi in secure, contained facilities to digest cellulose or lignin (for ethanol production as biofuel) does not entail a deliberate release to the environment. However, there are serious concerns regarding the presence of any GE micro-organisms in by-products and waste products from biofuel production (e.g. fermentation processes for cellulosic ethanol), and how these would be disposed of without releases of GE organisms to the environment.

- minimises use of agrochemicals

Sustainable agriculture minimises the use of agrochemicals (fertiliser, pesticides, and herbicides) because they are harmful for humans and the environment. Additionally, synthetic nitrogen-based fertilisers contribute to climate change by the emission of the GHG N_2O.

- does not use invasive species

The expansion and development of new bioenergy crops should not introduce any invasive species. Where there is doubt, the precautionary principle should be used.

- promotes conservation of water and soil fertility

The production of biofuel crops should maintain soil fertility; avoid soil erosion; promote conservation of water resources and have minimal impacts on water quality, nutrient and mineral balances.

4. Which biofuels fulfil our criteria?

See also “Types of biofuels” for further information

Corn-based and other grain ethanol cannot generally produce significant quantities of fuel per area of land and therefore fail our criteria for an acceptable biofuel. In the U.S., where most corn-ethanol is produced, the cultivation is not within the framework of sustainable agriculture.

Biodiesel produced from palm oil and soy is unacceptable when they are closely linked to deforestation, as they currently are in the Amazon and SE Asia.

Sugar cane ethanol has resulted in GHG savings in Brazil but has also entailed considerable negative environmental and social impacts. Sugar cane (or any other biomass crop with a significant positive energy balance and reduction in GHG) would have to be produced within the framework of sustainable agriculture avoiding social conflict to fulfil our criteria.

The efficient production of ethanol from sustainable agriculture and forestry wastes ("cellulosic" ethanol) has potential to provide biofuels without the land-use implications associated with ethanol produced from grain crops. Greenpeace encourages the development of such "second generation" technologies.

Reminder: bioenergy must always be used in conjunction with other measures to mitigate climate change including those to increase energy use efficiency and reduce energy consumption.

5. Incineration of municipal waste is not an acceptable fuel source

Greenpeace opposes the incineration of municipal wastes to produce energy. Currently, the calorific value of municipal waste is largely supplied by plastics (non-renewable fossil resources) or to a lesser extent paper and wood, which can all readily be recycled. In addition, municipal solid waste incinerators emit persistent, toxic and bio-accumulative chemicals, such as the chlorinated dioxins, to atmosphere during normal operation.

Incinerators generate large quantities of bottom ash and fly ash. Fly ash in particular can be highly contaminated and must be managed as a hazardous waste. Municipal waste incineration cannot, therefore, be considered as the basis of a sustainable waste management strategy, or as a clean renewable energy source.

6. Detailed information on types of biofuels

Biofuel Crops

Biofuels can be produced from many crops. At present, attention is focused on producing ethanol (alcohol) and biodiesel from a few food crops:

- Crops for ethanol production: corn (maize), sugar cane, sugar beet and wheat (plus, in the future, agricultural wastes, grass and wood for "cellulosic" or "lignocellulosic" ethanol).
- Crops for biodiesel production: rapeseed (canola), oilseed trees (*Jatropha*), soy, and oil palm.

<u>Ethanol derived from biomass</u>

Corn Based Ethanol: The current method of deriving ethanol from corn (maize) does not show promise. There is debate over the energy balance[2], with some studies showing positive and others negative energy balances. This is largely due to the way energy

[2] Shapouri, H., Duffield, J., Mcaloon, A.J. 2004. The 2001 Net Energy Balance of Corn-Ethanol. Proceedings of the Conference on Agriculture As a Producer and Consumer of Energy, Arlington, VA., June 24-25.
Farrell, A.E., Plevin, R.J., Turner, B.T., Jones, A.D., O'Hare, M., Kammen, D.M. 2006 Ethanol can contribute to energy and environmental goals. Science 311: 506-508.

balance is calculated. Corn-derived ethanol booming in the U.S. and is being considered as a source of fuel in China. The agricultural practices used to grow corn in the U.S. are unsustainable, highly dependent on fertiliser, pesticides and much is GE corn. Some argue in the U.S. that corn derived ethanol is a useful transitional fuel to cellulose based ethanol, but ethanol production from corn will never meet the policy goals currently being promoted in the U.S.

Wheat (grain) based ethanol: Grain ethanol production plants are being planned in some European countries. There are concerns that grain-based ethanol could compete directly compete with food.

Sugar Cane Ethanol: The Brazilian ethanol program has received a tremendous amount of attention. Ethanol from sugar cane has a considerable positive energy balance and has resulted in a significant decrease in greenhouse gas (GHG) emissions in Brazil. However, there are currently considerable negative environmental and social impacts of growing sugar cane in Brazil[3], although it's possible this could change in the future. If Brazil follows up on its plan to substantially increase ethanol production, existing concerns regarding agricultural practices and labour could increase. There is also concern that increased sugar cane production in Brazil could, directly or indirectly, push the agricultural frontier into the Cerrado, Amazon or Atlantic forests. Hence, sugar cane would have to be produced within the framework of sustainable agriculture avoiding social conflict and not entailing conversion of intact ecosystems to be acceptable to Greenpeace.

Sugar beet Ethanol: Sugar beet ethanol has not received the same amount of attention as sugar cane ethanol. However, in the EU, considerable agricultural surpluses of sugar beet exist and there are plans to use these to produce bio-butanol (similar to bio-ethanol)[4]. There is considerable negative environmental impact of growing sugar beet in temperate European countries.

Biofuels from agricultural and forestry wastes

Cellulosic Ethanol: Cellulosic (or lignocellulosic) ethanol is ethanol derived from the cell walls of plants or woody material and can utilise grass, agricultural or forestry wastes. A recent survey confirmed that energy and GHG savings are the best for cellulosic ethanol, compared to ethanol derived from corn or sugar cane[5]. A major effort is underway to produce cellulosic ethanol by second generation technologies which would be more efficient[6]. In addition, ethanol derived from wastes does not have land-use implications associated it, as compared with ethanol produced from grain crops. In the future, crop wastes could become a major source of cellulose-based ethanol.

Gas and (non ethanol) liquid fuels*:* Production of synthetic gas from almost any type of wet biomass is growing. It uses the same type of process used to produce liquid and gaseous fuels from coal. The synthetic gas can be used directly as fuel, or almost any type of liquid fuel can be derived from it – most often biodiesel. This new generation of technologies shows promise and could prove to be part of the solution to climatic change.

Dias de Oliveira, M.E., Vaughan, B.E. & Rykiel, Jr. E.J. 2005. Ethanol as fuel: energy, carbon dioxide balances, and ecological footprint. Bioscience 55: 593-602.

[3] Dias de Oliveira, M.E., Vaughan, B.E. & Rykiel, Jr. E.J. 2005. Ethanol as fuel: energy, carbon dioxide balances, and ecological footprint. Bioscience 55: 593-602.

[4] http://business.guardian.co.uk/story/0,,1802200,00.html

[5] Farrell, A.E., Plevin, R.J., Turner, B.T., Jones, A.D., O'Hare, M., Kammen, D.M. 2006 Ethanol can contribute to energy and environmental goals. Science 311: 506-508.

[6] Gray, K.A., Zhao, L. & Emptage, M. 2006. Bioethanol. Current Opinion in Chemical Biology 10: 141-146.

The likely near-term outcome is that cellulosic agricultural and forestry waste (wheat straw, corn stalks etc.) will be used.

Crops for Biodiesel

The debate on the extent to which biodiesel from crops can practically be used in transportation centres on conversion rates and the acreage necessary to substitute for gasoline products. It is possible that technology will develop to increase efficiency of biodiesel, but at present these are not efficient enough for large scale usage.

The projected large increase in the use of biodiesel could create problems regarding land-use. These land use concerns are particularly worrying where they concern global trade: with developed nations, such as the EU, aiming to import biodiesel from developing nations. They are worrying because the agricultural practices are largely unregulated at source.

Soy and Palm Oil: Soy in the Amazon and other parts of South America (e.g. Argentina) and palm oil in Asia Pacific are rapidly expanding. For example, soy in Brazil, Argentina and Paraguay and palm oil in Indonesia and Malaysia have become major drivers of deforestation[7] and, at least in Brazil[8], created modern-day slave labour and affected indigenous lands. Deforestation emits carbon previously stored in trees to the atmosphere, and therefore contributes to climatic change.

Soy expansion is currently driven by global demand for protein. However, in the future, global demand for biofuel may be a major driver for both palm oil and soy as well as for a number of other cash crops.

For both palm oil in Indonesia and soy in Brazil, round tables have been set up to discuss "sustainability" criteria for their expansion with the agro-industry. However, these are not strong enough and too vague to be an effective safeguard for biodiversity. Greenpeace does not participate in these round tables because our goal and position is to oppose any expansion of soy, palm oil and other cash crops into forests and other natural ecosystems as a key threat to terrestrial biodiversity. Soya or palm oil production that does not entail deforestation is likely to be feasible only on a small scale for local use.

Biodiesel from vegetable oil: With obvious limitations in scale, waste cooking or vegetable oil can be converted to biodiesel (by a simple chemical reaction that removes glycerine) and then used in regular diesel vehicle engines. All waste vegetable oil could be recycled to use as biodiesel. Besides, vegetable oil can be use directly (without chemical modification) in vehicle engines that have been modified, but these systems seem to be still experimental and less energetically efficient.

Energy costs and environmental effects of transportation of fuels: In general, the energy cost transportation of biofuels appears to be small in comparison to production costs. However, the transportation of cargo and trucks will have environmental impacts, as emissions of GHG from fuel combustion.

7. Definitions

- **Biomass** in energy production and industry means mass derived from biological

[7] Pearce, F. 2005. Forests paying the price for bio-fuels. New Scientist 19th November 2005.
Greenpeace 2006. Eating up the Amazon. http://www.greenpeace.org/international/press/reports/eating-up-the-amazon

[8] Greenpeace 2006. Eating up the Amazon. http://www.greenpeace.org/international/press/reports/eating-up-the-amazon

material, usually plants. It covers a very wide range of plant sources, including those that are used for fuel directly (e.g. fuelwood), and those that are processed into biofuels (maize, soy, sugarcane, *Jatropha*, etc.). It could also be used to include animal and human biological wastes but, although important local sources of energy in many parts of the world, they are not considered here because they are not currently used for energy generation on a large scale (see also municipal wastes above).

- **Biofuels** means liquid and gaseous fuels derived from biological material. These are mainly intended for the replacement of gasoline or diesel in transport.
- **Bioenergy** is the collective term given to energy derived from biomass.
- **Energy balance** is the difference between the energy value generated by an energy source and the energy inputs (fossils or otherwise) used to producing that energy source. For example, the energy balance of a given biofuel would be the outputs (energy generated when combusted and energy equivalents of by-products (glycerol and soybean meal, for example) minus the inputs needed for its production (agriculture and biorefinery inputs, for example).

- **Types of bioenergy**

Bioenergy is derived from biomass. Biomass can either be used in stationary applications and for transport as biofuels.

Stationary applications: Biomass can be used directly or indirectly to generate heat and electricity through "cogeneration", "biogas" and "biomass-to-liquid" in decentralised systems to complement other renewable energy sources.

Transport applications: Biofuels used in transport represent a less direct solution to help reduce emission of GHG than biomass in stationary applications because biomass needs to be transformed to a liquid or gas form, which requires additional energy.

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