Position on Bioenergy

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By: Wolfgang Richert

Greenpeace believes that in order to prevent dangerous climate change we need to keep the global mean temperature rise (since pre-industrial times) as far below 2 degrees Celsius as possible. In order to do that we need a revolution in the way we use and produce energy. We need to bring deforestation to an end and make our agricultural system sustainable. Bioenergy can play a role in our energy revolution, though its role should be limited as any use of bioenergy needs to be sustainable and result in significant reductions in greenhouse gas emissions. Bioenergy support measures should be used in conjunction with other measures to reduce climate change, including increasing efficiency and reducing energy consumption.

There are two main types of bioenergy:[1]

- Biomass used to produce electricity and/or heat
- Biofuels, also referred to as agrofuels, used as a transport fuel

Biomass used to produce electricity and/or heat is considered to be the most effective use of bioenergy because use can be made of more efficient cogeneration practices and there is no need for additional conversion to liquid.

Biofuels for transport are increasingly being supported by many governments in developed countries as well as by some developing countries, mainly Brazil. However, emerging research points to uncertainties around the level of emission savings that can result from switching to biofuels. In many cases emission savings seem to be either very low or lead to a net increase in emissions compared to the use of fossil fuels. It is clear that much bigger gains can be made by reducing transport levels and by investing in fuel efficiency than by promoting biofuels.

Furthermore, the production of biofuels puts pressure on agricultural land leading directly or indirectly to the destruction of natural ecosystems, such as tropical forests. Deforestation emits carbon previously stored in trees and soils into the atmosphere, therefore contributing to climate change.

The agricultural production of biofuels can result in a number of unsustainable practices. For example it can endanger food security and the livelihoods of the world's poor as well as leading to the cultivation of genetically engineered (GE) crops. Currently, governments in Europe and the US heavily subsidise biofuels for the transport sector and have set mandatory targets without any policies in place to address the knock-on environmental and social consequences.

We need:

- Policies from governments and other stakeholders which ensure that all sources of bioenergy result in a genuine reduction in greenhouse gas emissions of at least 60% compared to the existing use of fossil fuels.[2] In addition, such fuels must meet strict sustainability criteria such as (see section 2 for complete list):
    - Their production must not result in the direct or indirect conversion or degradation of natural forests or other natural ecosystems
    - They must be produced using sustainable agricultural production methods
    - They should pose no threat to food security, particularly in developing countries

[1] See also 'Definitions'.
[2] This demand (+60% GHG balance) is based on current available information. The reason for this figure is that (1) scientific uncertainties exist around a number of elements of the calculation that requires a relatively high margin; (2) agriculture for energy crops puts pressure on available agriculture land that is a limited resource itself. Different crops and plantations have different efficiency. Only the most efficient ones should make use of arable land. See also Annex 1.

- A new mechanism, implemented by governments, to accurately assess and address the indirect conversion or degradation of natural forests or other natural ecosystems, because crops or plantations that cause this indirect impact must not be supported by governments, and thus must be excluded from any governmental support measures

Therefore:

- Greenpeace supports the use of biomass in stationary applications when the raw material is produced under strict sustainability criteria, as mentioned above, and further defined below in section 2. For example, agricultural and forestry residue use, preferably regional and in cogeneration power plants. The local production of biogas from residues or manure is another example of a potentially efficient (small-scale) application that can help energy supply in remote or rural areas

- Greenpeace opposes most current mainstream sources for biofuels, as they do not meet sustainability criteria. In the case of maize, rapeseed and soy the GHG reduction is not considerable and sometimes even negative, and these crops are predominantly produced using unsustainable farming practices. In the case of palm oil no sufficient standards are in place to ensure it will not contribute directly or indirectly to forest destruction

- Biofuels for transport can only play a minor role in reducing climate emissions. The transport sector must instead focus their efforts on improving efficiency by using lighter and smaller cars with more efficient engines and reducing demand for transport

- Currently sugar cane is the only mainstream biofuel that can deliver a reduction in GHG emissions of more than 60%.[3] However, sugar cane is no panacea because it can lead to direct or indirect land-use change (e.g. deforestation) and is produced using unsustainable agriculture practices. There are further promising developments in the use of cellulosic agriculture and forest residues in second generation biofuels (although the quantities of residual materials available will be finite) and the use of algae cultivated in closed systems to produce biofuel. Both technologies require further research and development

- There should be no governmental support by way of subsidies, tax redemptions or mandatory targets for any biomass or biofuel without guarantee that strict sustainability criteria are fulfilled

- Setting targets for biofuels such as the EU 10% proposal are premature and must be dropped until it can be established that sufficient volumes can be produced in accordance with defined sustainability criteria

[3] See for example: Scharlemann, J.P.W. & Laurance, W.F. 2008. How green are biofuels? Science 319: 43-44.

1. Introduction and Definitions

Currently, bioenergy supplies about 10% of total global primary energy. This is mainly traditional biomass usage (e.g. firewood) in developing countries.[4] However, industrial uses of biomass are increasing, especially in developed countries, due to concerns over climate change, high oil prices, energy security as well as to provide a new source of income for farmers. An increasing number of developing countries support the growing and exporting of crops for energy . At this moment there is no proof that large-scale agriculture for the export of energy crops is economically, socially or environmentally sustainable.

Greenpeace supports bioenergy projects that fulfil strict sustainability criteria, more fully described in the following chapter. Unfortunately, governments, especially in industrialised countries, have started to introduce support measures without any sustainability standards. Meanwhile, more and more studies[5] show that many bioenergy projects are not sustainable. In particular, the production of agricultural crops for biofuels is problematic. One of the main problems is that there is no proof that the production and use of biofuel or biomass leads to a reduction of greenhouse gases. In addition, the degradation or conversion of natural forests or other natural ecosystems not only destroys biodiversity but also leads to high emissions of CO_2[6]. Finally, biofuels encourage unsustainable agriculture practices such as the use of GE crops as well as competing with food production that threatens food security in poor countries. Furthermore, the expansion of industrialised farming can threaten the livelihoods of local communities, for example because of lack of employment in the plantations, lack of processing jobs or weak labour circumstances. In many Southern countries the threat to land rights for local communities such as indigenous peoples is also an important issue.

As the OECD notes[7], despite the mounting evidence, governments are failing to address these environmental and socio-economic concerns – "The current policy response to the environmental consequences of biofuel production is to develop criteria designed to ensure a sustainable production of biofuels. However, biofuel mandates are still targeting ambitious market shares without an in-depth understanding of what a sustainable production level is and from where these biofuels could be supplied. There is a serious risk that biofuel quotas for demand are higher than potential sustainable supply, creating a strong incentive to 'cheat' the system."

Greenpeace calls on all stakeholders to distinguish between sustainable and unsustainable bioenergy and to develop sustainable bioenergy only. Specifically, Greenpeace calls on governments to develop strong control mechanisms to guarantee that all bioenergy projects, biomass and biofuels, that are supported by their own instruments are produced in a sustainable manner. No subsidies and tax redemptions should be given and no mandatory feed-in targets implemented without independent and transparent proof that strict criteria for sustainability as defined in section two are met.

Definitions

- **Agriculture or crop residue** is any vegetative material remaining in the field or discarded after harvest. Examples are husk from rice or maize, stalk from maize or cassava and bagasse from sugar cane
- **Bioenergy** is the collective term given to energy derived from biological material. It covers a very wide range of plant sources, including those that are used for fuel directly, and those that are processed into biofuels. It could

[4] UNDP 2004. World Energy Assessment Overview Update, p.28: http://www.undp.org/energy/weaover2004.htm.
[5] FAO World agriculture: towards 2030/2050. Prospects for food, nutrition, agriculture and major commodity groups. Global Perspective Studies Unit. FAO. June 2006.
Crutzen, P.J. et al.: N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels, August 2007.
Scharlemann, J.P.W. & Laurance, W.F. 2008. How green are biofuels? Science 319: 43-44.
Zah, R. et al. 2007. Oekobilanzen von Energieprodukten, Oekologische Bewertung von Biotreibstoffen. Schlussbericht/Final Report. Switzerland, May 2007.
Greenpeace 2007. How the palm oil industry is cooking the climate, www.greenpeace.org/international.
Fargione, J. et al. 2008. Land clearing and the biofuel carbon debt, www.sciencexpress.org, 7 February 2008.
Searchinger, T. et al. 2008. Use of U.S. croplands for biofuels increases greenhouse gasses through emissions from land use change, www.sciencexpress.org, 7 February 2008.
[6] Already deforestation is responsible for about one-fifth of global GHG emissions.
[7] OECD September 2007: Round Table on Sustainable Development. Biofuels: Is the cure worse than the disease? By R. Doornbosch and R. Steenblik.

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 part of this definition and not considered in this position paper because they are not currently used for energy generation on a large scale (see also 'municipal wastes' in section 3)

- **Biofuels** are in this document defined as liquid or gaseous fuels derived from biological material that is intended for the replacement of gasoline or diesel in transport applications
- **Biogas** is a gas, rich in methane, which is produced by the fermentation of animal dung, human sewage, crops or crop residues in an airtight container. It is used as a fuel to heat stoves, lamps, run small machines and to generate electricity. Plans also exist to use it in transport. The residues of biogas can be used as a low-grade organic fertilizer.
- **Biomass** is in this document defined as mass derived from biological material, usually plants, that are intended for the replacement of fossil fuel in stationary application for the production of electricity and/or heat
- **First generation biofuels** commonly refers to the current mainstream biofuels in the transport sector. They are made from food crops. They are harvested for their starch, sugar or oil content and processed into liquid fuels using fairly simple technologies. Ethanol is produced from fermentation of sugar or grain crops, and biodiesel is a chemically altered form of plant oil
- **Forest residues** are fibrous by-products of harvesting, manufacturing, extractive, or woodcutting processes. This includes logging residues that consist of bark, branches, leaves, lops, tops, damaged or unwanted stemwood. It also includes mill residue wood: hogged bark, trim slabs, planer shavings, sawdust, sander dust and pulverized scraps from sawmills, millworks and secondary wood products industries
- **Fossil fuel reference**: To estimate the percentage GHG reduction achieved by a particular bioenergy production chain, its performance must be properly compared with a reference, fossil chain. The fossil fuel reference is the chain that should be displaced by the biomass or biofuel chain. For biofuels, a transport chain means a well to wheel approach. For bioelectricity this is the chain until the electricity consumer. The reference fossil fuel chain involves the following GHG emissions: (1) emissions from mining/extraction, (2) emissions from transport of coal, gas, oil or electricity and (3) emissions from conversion to petrol, electricity or heat
- **Greenhouse Gas (GHG) balance** is the percentage of GHG emission reduction achieved by a particular biomass or biofuel production chain properly compared with a reference, the directly comparable fossil chain. For electricity from biomass this is the fossil chain until the electricity consumer. For biofuels for transport this means a 'well to wheel' approach
- **Invasive species** are non-native species that threaten ecosystems, habitats or species
- **Precautionary principle** is a principle adopted by the UN Conference on the Environment and Development (1992) that in order to protect the environment, a precautionary approach should be widely applied, meaning that where there are threats of serious or irreversible damage to the environment, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation
- **Second generation technologies** are not well defined but usually refer to the conversion of cellulose-rich fibres into liquid fuels. All plants contain cellulose and lignin. These are complex carbohydrates (molecules based on sugar). Lignocellulosic ethanol is made by using enzymes to free the sugar molecules from cellulose. These sugars can then be fermented to produce ethanol in a similar way to first generation bioethanol production. The by-product of this process is lignin. Lignin can be burned as a fuel to produce heat or power.

2. Greenpeace Criteria for Sustainability

First of all, governments must take a broad approach when designing policies regarding bioenergy or before implementing supportive measures for biomass or biofuels. This includes the following:

- Bioenergy support measures should be used in conjunction with other measures to reduce GHG emissions, including those to increase energy use efficiency and reduce energy consumption. Bioenergy should complement and balance the energy supply in a clean renewable energy system, based on solar, wind, small hydro, geothermal, wave and tidal power
- In the context of the *food vs. fuel* debate, governments should take into account the direct and indirect social impacts of bioenergy production and ensure that additional profits due to rising commodity prices remunerate first and foremost small farmers and not increase food insecurity

Below are **globally applicable criteria** on which individual biomass production and individual bioenergy projects should be assessed. The complete life cycle of bioenergy production technologies must be analysed to ensure that:

1. **Any bioenergy project has a positive GHG balance of at least 60%.** The calculation of the GHG balance must be made over the whole production chain. This automatically favours the most efficient biomass application, such as electricity and heat production as opposed to transport. The GHG balance must also include the greenhouse gas emissions from indirect conversion of natural ecosystems[8]
2. **Crops and plantations for bioenergy must not cause direct or indirect destruction or conversion of natural forests or other natural or valuable ecosystems** (e.g. forests, which are important carbon stores and have high biodiversity)[9]
3. **Biomass from natural ecosystems is sourced in an environmentally responsible and socially just manner**, such as those sources certified by the Forest Stewardship Council (FSC). Additional criteria for the use of wood and wood residues from forests must be applied.[10] Also grass from grasslands must be harvested sustainably[11]
4. **Social conflicts are avoided and food security, livelihoods and land rights are not undermined.** Production and use of bioenergy should not widen social inequalities, especially between developing and developed countries. Local needs should take priority over global trade and production. In addition, international trade in biomass or biofuels must not result in negative social impacts, nor undermine food security. Land use conflicts are avoided and indigenous peoples and local communities have the right to free and prior informed consent for the use of their land
5. **No deliberate release of genetically engineered (GE) organisms to the environment**. Any bioenergy crops, including trees, must not be GE
6. **Crops and plantations for bioenergy promotes biodiversity on plantation level**, which means that they must not concentrate on monoculture plant and tree plantations
7. **Sustainable agricultural practices are applied** that do not pollute the biosphere by accumulation of agrochemicals like synthetic fertilizer, pesticides, and herbicides in the soil, water or air. The use of these agrochemicals is minimised, which means that they are only used when there is no biological or organic alternative and only in the most-efficient and non-polluting way
8. **Plantations promote conservation of water and soil fertility**. The production of bioenergy crops should maintain soil fertility; avoid soil erosion, promote conservation of water resources and have minimal impacts on water availability, quality, nutrient and mineral balances
9. **The expansion and development of new bioenergy crops should not introduce any invasive species**. Where there is doubt, the precautionary principle should be applied

[8] For more details see Annex 1.
[9] For more details see Annex 2.
[10] Unfortunately, none of the existing forest management standards has developed criteria for the assessment of residue use, which makes assessment of the sourcing intransparent.
[11] International standards to assess sustainability of harvesting grass from grasslands do not exist. Local and regional circumstances are crucial. The decision making process must be transparent and stakeholders must be involved.

3. Which Sources for Bioenergy Fulfil the Criteria for Sustainability?

The objective of this section is to show how Greenpeace assesses the sustainability of bioenergy projects and the raw material for bioenergy production. The following are Greenpeace analyses of the most important mainstream biomass or biofuel developments.

Biofuel Crops

Biofuels can be produced from many crops.

- Crops for ethanol production: corn (maize), sugar cane, sugar beet and wheat (plus, in the future, agricultural residues, grass and wood for "cellulosic" or "lignocellulosic" ethanol)
- Crops for biodiesel production: rapeseed (canola), oilseed trees (yatropha), soy, and oil palm (plus, in the future, second-generation biodiesel (e.g. biomass to liquid technologies), which may be based on vegetable oils or residues

Ethanol Derived from Agriculture Crops

Corn based ethanol: The current method of deriving ethanol from corn (maize) does not fulfil sustainability criteria. There is debate over the energy balance, with some studies showing positive and others negative GHG balances. However, none show a positive GHG balance above 60%.[12] Corn-derived ethanol is booming in the U.S. and is being considered as a source of fuel in China. The agricultural methods used to grow corn in the U.S. are unsustainable because they are highly dependent on fertiliser, pesticides and much is genetically engineered (GE) corn. Some argue that in the U.S. corn derived ethanol is a useful transitional fuel to cellulose-based ethanol, but ethanol production from corn will never meet the criteria for sustainability.

Wheat (grain) based ethanol: Grain ethanol production plants are being planned in some European countries. This application has a low GHG efficiency and is putting pressure on the use of arable land for food production and therefore doesn't fulfil Greenpeace criteria.

Sugar cane ethanol: The Brazilian ethanol program has received a tremendous amount of attention. Ethanol from sugar cane has resulted in a significant decrease in GHG emissions in Brazil. However, there are currently considerable negative environmental and social impacts associated with growing sugar cane[13], although it's possible this could change in the future. Greenpeace experience in Brazil shows that sugar cane expansion, directly or indirectly, could lead to the conversion of natural ecosystems because it pushes the agricultural frontier into the Cerrado, Amazon and Atlantic forests.[14] Another concern is the release of CO_2 and the fumes as result of burning land and residues. The fumes are also extremely unhealthy for the workers in the fields. In addition there are negative social consequences, such as poor labour circumstances (low salary and high pressure on output in relation to hard labour) and a lack of respect for the land rights of local communities. If Brazil follows up on its plan to substantially increase ethanol production, existing concerns regarding the impact on ecosystems, agricultural practices and social conflicts will only increase.

Data from other countries show that the positive GHG balance from sugar cane in Brazil depends upon specific circumstances. First of all, in Brazil most of the husbandry is undertaken by human labour, not by energy-consuming machines. Secondly, it is important that the sugar cane residues, the so-called 'bagasse', are used for energy production, as it can be a good energy source. Thirdly, if the soil is not highly fertile, sugar cane requires high inputs of fertilizers. This all has an impact on the GHG balance. And finally, sugar cane needs a large amount

[12] 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.
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.
[13] 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.
[14] 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.
Scharlemann J.P. W. & Laurance, W.F. 2008. How Green Are Biofuels? 319 43-44.

of water. If this water is not available then irrigation is needed. This can lead to competition for water with other agricultural crops threatening local food security.

In other words, sugar cane is not a silver bullet and would have to be produced within the framework of sustainable agriculture and avoid social conflict. Existing sugar cane production, in the right circumstances, can play a role in reducing GHG emissions.

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). Sugar beet in temperate European countries is a mainstream product with the same environmental impacts as other agricultural products from non-organic farming, but there are no issues of conversion of intact ecosystems nor does it cause negative social impacts. The GHG balance of sugar beet is not high and does not meet Greenpeace's 60% demand.

Biofuels from Agricultural and Forestry Residues

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. It is also known as a second-generation biofuel. Recent data confirm that the GHG balance is positive compared to first generation ethanol.[15] In addition, ethanol derived from (genuine) residues does not have additional land-use implications associated with it, as compared with ethanol produced from grain crops. In the future, crop residues could become a major source of cellulose-based ethanol. Therefore, Greenpeace encourages the research and development of such second-generation technologies.

Having said this, it must be said that also the second-generation technologies are not a silver bullet. While the use of residues is efficient and makes sense, the specific 'production' of this by-product can change the equation entirely. For example, if one uses more fertilizers to produce more residues what will the GHG balance be? Is the use of fertilizers for the production of grass for second-generation production climate-efficient? In other words, the availability of residues is limited.

Furthermore, this technology can result in the use of GE microorganisms that convert biomass into ethanol. This is a biohazard (see GE organisms above). What will the companies creating the cellulosic ethanol do with the residues? How will they make sure that no contamination of the environment takes place?

Gas and (non ethanol) liquid fuels*:* Production of synthetic gas from almost any type of wet biomass is increasing. 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 climate change if cellulosic agricultural and forestry residues are used.

Crops for Biodiesel

It is possible that technology will develop to increase efficiency of biodiesel, but at present they are not efficient enough for large-scale usage.

The projected increase in the use of biodiesel and their inefficiency regarding GHG reductions will most likely create problems regarding land-use. Therefore strong control mechanisms are needed to ensure that environmentally damaging practices aren't 'greenwashed'.

Soy: Global demand for soy is mainly driven by the global demand for meat, with soy used as an ingredient in animal feed. This demand has historically driven deforestation in the Amazon, and is currently driving deforestation in other South American countries such as Argentina. The GHG balance of soy falls far short of any sustainability criteria. This coupled with the pressure on forested areas likely from a significant expansion of demand for soy in biofuel, means that soy is not a suitable source for biofuels.

Palm oil: Although palm oil's GHG balance as a source for bioenergy is better than many other raw materials, there are no sufficient standards in place to ensure its production is not directly or indirectly contributing to GHG

[15] See for example:
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.
Schmer, M.R., Vogel, K.P., Mitchell, R.B. & Perrin, R.K. 2008. Net energy of cellulosic ethanol from switchgrass. Proceedings of the National Academy of Sciences 105: 464-469.

emissions through deforestation or peatland clearance. For example, the Roundtable on Sustainable Palm Oil (RSPO) scheme does not exclude companies engaged in deforestation from being members. In addition, the RSPO scheme doesn't require segregation of palm oil that meets RSPO criteria from palm oil coming from deforestation or peatland clearance. Until such time that such assurance can be made, palm oil coming from companies engaged in deforestation and peatland clearance should be rejected.

Rapeseed: There is some evidence that standard rapeseed production in Europe is based on unsustainable farming practices, considering the particularly high amounts of fertilizers and pesticides used in rapeseed fields.[16] At this moment data also show that crops such as rapeseed produced in for example Europe have a GHG balance of far less than 60%.

Biodiesel from waste vegetable oil: With obvious limitations in scale, waste vegetable oil from cooking can be converted to biodiesel by a simple chemical process and then used in regular diesel vehicle engines. All waste vegetable oil could be recycled to use as biodiesel with relatively low environmental impact and a relatively high efficiency regarding GHG emission savings.[17] Vegetable oil can also be used directly (without chemical modification) in some vehicle engines. The environmental impacts from the crop production are equal to those described under 'Crops for Biodiesel'.

Biodiesel from algae: The production of biodiesel from cultured algae is at an early stage of development but has promising aspects. This method is attractive because the amount of land needed to produce the biodiesel is relatively small and it does not require arable land. Furthermore, it does not require scarce drinking water because algae grow on salt water from the ocean. Some algae species produce considerable amounts of natural oils, making them good candidates for creating biodiesel. Algae culture should take place in closed, land-based facilities (i.e. where algae and nutrients cannot enter natural aquatic systems). Algae production must not interfere with natural ecosystems (e.g. adding nutrients to an open aquatic system, such as the sea, to induce algal growth would not be acceptable).

Biomass for Electricity and/or Heat

In Developing Countries

Traditional biomass/biogas: Traditional use of biomass (e.g. firewood and dung) in developing countries is an important energy source in many remote or rural areas, especially in the least developed countries. This usage is not really part of the focus of Greenpeace's position, however, simple technologies could help improve this practice. If the same raw material is used in modern ovens instead of open burning, the energy efficiency increases rapidly and it is healthier because fumes can be channelled away from people. Another option is small-scale production of biogas for electricity or heat. The residues of biogas production can be used as a low-grade organic-matter fertilizer. Also, replacing diesel from fossil fuel in electricity generators by locally produced biodiesel is an energy option in remote areas. If these technologies are applied on a small scale and directly by rural people it serves them best, can lead to poverty alleviation and the risk of large scale conversion of ecosystems can be reduced.

In Industrialized Countries

Lignocellulosic or oil-rich biomass: The use of lignocellulosic or oil-rich biomass to produce electricity and/or heat in industrialized countries is more efficient than the production of biofuels and shows good GHG emission reductions.

The main sustainability issue with these projects is the availability of the raw material. Wood pellets are already becoming a major biomass in industrialized countries and in North America. Good data is missing but as prices go up it is obvious that demand exceeds production. Whether this will lead to more unsustainable wood production and conversion of forests into plantations in Europe is not known, but it is likely to happen if sustainability criteria for biomass are not introduced quickly. Ecological limits for the use of forest residues need to be developed and used.

[16] Sattler, C., Kachele, H. & Verch, G. 2007. Assessing the intensity of pesticide use in agriculture. Agriculture, Ecosystems and Environment 119: 299-304.
Crutzen, P.J., Mosier, A.R., Smith, K.A. & Winiwarter, W. 2007. N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels. Atmospheric Chemistry and Physics Discussions 7: 11191-11205.
[17] Scharlemann, J.P.W. & Laurance, W.F. 2008. How green are biofuels? Science 319: 43-44.

Palm oil: As explained in the previous section, Greenpeace does not believe that sufficient standards are in place to ensure that palm oil producers are not directly or indirectly contributing to GHG emissions from deforestation or peatland clearance. Until such time those assurances can be made, palm oil coming from companies engaged in deforestation and peatland clearance should not be used for biomass.

Biogas: Is used as a fuel to heat stoves, lamps, run small machines and to generate electricity. The residues of biogas production can be used as a low-grade fertilizer made from organic matter. Because they come from renewable resources and are largely waste products, they have potential for future use. This picture changes if not only genuine residues are used but the whole crop is planted and used for the biogas production. This is a recent development in Germany, for example.[18] Greenpeace does not have an assessment of these projects but clearly prefers the use of residues.

Municipal waste: Greenpeace opposes the incineration of municipal wastes to produce energy. Currently, the calorific value of municipal waste is largely supplied by plastics or to a lesser extent paper and wood, which should be recycled. In addition, municipal solid waste incinerators emit persistent, toxic and bio-accumulative chemicals, such as the chlorinated dioxins.

Incinerators generate large quantities of bottom ash and fly ash. Fly ash in particular can contaminate the local and regional environment and must be managed as a hazardous waste. Municipal waste incineration cannot, therefore, be considered as a clean renewable energy source.

For further information please contact:

Wolfgang Richert

Policy Advisor Bioenergy

Greenpeace International

Email: wolfgang.richert@greenpeace.org

Tel: +31(0)20 718 2129

Mob: +31(0)615 093 586

[18] See for example at: http://www.ask-eu.de/default.asp?ShowNews=3403; www.biogas.de; www.br-online.de; http://www.tll.de/ainfo/pdf/biog0703.pdf.

Annex 1: The GHG Balance and the Calculation Tool

As defined in criterion 1 in section 2 of this document, Greenpeace's position is that **any bioenergy production chain must lead to at least 60% GHG reductions** compared to the reference fossil fuel chain. The basis for this position is twofold and is based upon currently available information:

- Important scientific uncertainties exist around a number of elements of the calculation. If the objective is to have a 'considerable positive GHG balance' the margin must be bigger than the uncertainties. Until now these uncertainties have not been scientifically reviewed
- Agriculture for energy crops puts pressure on available agriculture land that is a limited resource itself. Different crops and plantations have different energy yields per hectare. Only the most efficient crops should make use of arable land

Furthermore, it is crucial to choose a correct methodology to calculate the GHG balance. Many different methodologies exist for calculating the GHG reductions achieved in biomass-based electricity, heat and fuel chains. As yet, governments have not taken responsibility for developing a clear and joint methodology of how to calculate reductions. This leaves the floor open to stakeholders that have an interest in developing methodologies.

Greenpeace demands that an independent, international body develops a transparent and globally applicable methodology for the calculation of GHG reductions, preferably the IPCC or UNEP.

The *Dutch/Anglo system*[19] provides a reasonable, readily available basis for a GHG calculation tool. Greenpeace uses this system as reference for further debate but a number of key issues still need to be decided upon. In order to have confidence in this system the following must happen:

- **Displacement (leakage) effects[20] must be included in the calculation.** Inclusion of indirect impacts will negatively impact the outcome of the calculation for almost all biofuels[21]

- **The initial GHG emissions from land-use change must be distributed over a timeline of no longer than the first 10 years.** Three main reasons exist for this criterion. First, in order to prevent dangerous climate change we need to use instruments that lead to a direct decrease of GHG emissions instead of leading to initial additional emissions. Second, management can simply not be guaranteed over a longer period. Third, using a timeline of many decades makes the GHG emissions from land use change ridiculously small, while they are in fact a substantial part of current climate change

- **Make full traceability of bioenergy sources mandatory.** Buying without knowing the origin must be excluded or strongly punished with a negative factor in the calculation

- It is important to integrate the use of nitrogen fertilizer application in any calculation. This is not the case in all calculation tools

- **Emissions due to reference residue use** - as there is a high level of uncertainty with calculating the energy value from the use of residue and the risk of *double counting,* it is important to develop a transparent calculator to incorporate these elements into the calculation

- Clearly to create a fossil fuel energy reference we must find an acceptable average across the full range of fossil sources – fossil fuel from the Middle East to low-grade Canadian tar sands. The choice of a credible reference is key to calculating the net GHG impact of bioenergy

- The majority of (conservative) default values should be given in order to prevent endless discussion about technical details

[19] This methodology has been prepared for the Dutch government (by the Cramer Commission, set up to establish criteria for, inter alia, GHG calculations). In addition, this methodology has been discussed with the UK Ministry of Transport and other independent organizations (Low CVP, IFEU, ISPRA and the German FNR).
[20] For explanation see Annex 2.
[21] Fargione, J. et al. 2008. Land clearing and the biofuel carbon debt, www.sciencexpress.org, 7 February 2008. Searchinger, T. et al. 2008. Use of U.S. croplands for biofuels increases greenhouse gasses through emissions from land use change, www.sciencexpress.org, 7 February 2008.

Annex 2: The Indirect Impacts must be Included in the Criteria

Along with the GHG balance, one of the most important criteria is that no direct or indirect degradation of natural forests, high conservation value forests (HCVF) or any other natural ecosystems, such as wet- and grasslands, is acceptable.

Some existing and proposed standards exclude biofuels that cause the direct conversion of natural forests and/or natural ecosystems and include the GHG emissions of direct land use change in the GHG calculation. None, however, address the indirect impacts of shifting existing arable areas to biofuel production, in turn leading to pressures on forests and other natural eco-systems.

Therefore, the inclusion of direct land use change will not be enough. The indirect impact on forest conversion (displacement effect) will be the 'cutting edge' of the debate on criteria and control mechanisms and must be taken into account.

The expansion of sugar cane in Brazil is not sustainable if it pushes other sectors into the Amazon or into other natural ecosystems. Producing sugar cane in the Amazon, for example, is not efficient. The problem arises when sugar cane is planted on land outside of the Amazon that is currently used for cattle ranching or soy production. These two production systems can 'move on' and push the agricultural frontier further into natural ecosystems. This is the displacement effect of the expansion of this sector on forests. This effect has two major implications. First, it can only be measured at macro-level. Secondly, even if part of the expansion of the sector is done in accordance with sustainability standards the problems is not solved. In this specific case any extra demand can still drive displacement, as it is the expansion itself that can cause the problem.

Another example is Indonesian palm oil. Rapidly growing demand for palm oil is leading to wide scale deforestation as well as peatland drainage and clearance. Without strong governance and an effective moratorium on further conversion of forest and peatlands, it is highly likely forest and peatland conversion for palm oil in Indonesia will continue. It is even foreseeable that companies engaged in destructive activities will be able to sell 'sustainable' palm oil to Europe - and get subsidized to do so- while continuing to expand their operations into forested areas.

These situations will never be tackled by a standard that is based on an assessment at the plantation level because these examples show that in the case of some specific crop-country combinations the expansion of the sector itself is the problem. This means that a new instrument must be developed to evaluate indirect threats on macro level even if it is not always able to define this as rigorously as other elements of the sustainability standard.

We need the political will to exclude crops if the threat of indirect impacts exists. On a governmental level, a new body of independent experts needs to be set up which can assess whether certain products or crop-country combinations have wider negative environmental and/or social impacts. This body should have the mandate to ensure that these products or crop-country combinations are directly excluded from any subsidies, tax exemptions and (mandatory) targets.