The Challenge of Sustainable Bioenergy: Balancing climate protection, biodiversity and development policy

A Discussion Paper

Gerald Knauf and Jürgen Maier (German NGO Forum Environment & Development)
Nikki Skuce (OneSky - Canada)
Annie Sugrue (CURES Southern Africa)[1]

As oil prices continue to rise and with climate change mitigation high on the agenda, targets and strategies for bioenergy are gaining momentum. Bioenergy will likely and inevitably play an important role in the future energy mix as we transition from a fossil-fuel economy to an energy-efficient, renewables-based energy system. While governments are making commitments, parts of civil society are raising alarm bells. Rapid expansion of biofuels without adequate concern to risks and side-effects can indeed create many serious problems. However, the current debate seems dominated by extreme viewpoints – from those seeing it as panacea for energy security to others seeing it as potentially causing a global famine and environmental mega-disaster. This paper looks at some of the major concerns and opportunities of bioenergy, and makes innovative recommendations for policies to harness this potential whilst minimizing the downsides.

Introduction: Bioenergy is more than biofuels

The increased use of biomass provides diverse opportunities from a climate and development perspective. If this increase is going to be compatible with environmentally and politically sustainable development, then the conflicting and sometimes contradictory interests must be reconciled. This requires intensive dialogue, negotiations and a participatory process which includes all relevant players on a national and international level. Only then can we ensure a corresponding political framework.

- ⇨ When the discussion of bioenergy revolves primarily around high oil prices and the scarcity of the resource oil, there is a danger of reducing bioenergy to a buffer for increased energy consumption in order to stabilize oil prices or to prevent supply interruptions. This cannot be the role of bioenergy. **If bioenergy is perceived solely as an additional energy source for increasing energy consumption, new and sometimes grave problems will be created without addressing the decisive problem of climate change.** Currently, particularly in the transport sector, energy consumption is still increasing steadily.
- ⇨ Climate change caused by fossil fuel combustion and the finite supply and increased scarcity of fossil energy sources are the two key reasons why humanity will in a few decades – sooner or later - be forced to phase out fossil fuels and convert to renewable energy sources. Even if coal and oil supplies were sufficient for many centuries to come – we could not afford to burn them anyway since that would destroy the climate system of the planet. The recent IPCC reports clearly show: we have underestimated the urgency of the problem, the transition to a renewable energy future is a race against time. This means: **There is no alternative to a massive expansion of biomass utilization.** Without it, there is no way to meet the current and future expanding energy demand, even taking into consideration all potential for increased efficiency. Almost two billion people are still waiting for initial access to modern

[1] These are the personal opinions of the authors.

energy services. That day will never come with a focus on fossil energies and centralized energy systems, as it has been the development strategy of most governments and multilateral development institutions so far.

- ⇨ At the same time, the current focus on liquid biofuels such as bioethanol and biodiesel is a rather inefficient use for biomass. The greenhouse gas and energy balances for these liquid biofuels are in most cases disappointingly low and the negative side effects high. We need an open global debate about the most efficient use of biomass, in particular regarding these questions:
  - do we need biomass to replace petroleum in the transport sector or do we focus on the best use of biomass in the whole energy mix and to reduce CO_2 emissions;
  - what is the best mix of policies to reduce the petroleum dependence of the transport sector, in particular setting up efficient public transport systems, including, but not limited to, the use of bioenergy.

- ⇨ Although, from a sustainability point of view, regional markets are preferable, there is a fast growing world market for biomass as an energy source. Some regions are much better suited for the cultivation of bioenergy crops than others and the biomass and bioenergy materials in most cases can easily be stored and transported. **For many developing countries, the export of bioenergy sources is a business opportunity that will be seized.** Increasing demand will ensure a steady supply. Since there are regional differences in production costs, bioenergy sources are already being traded internationally. As long as the raw materials for bioenergy are cheaper in some countries than in others, they will be bought there despite transportation costs (both environmental and monetary). **If the EU, for instance, is to fulfill its political goals, in 2020 it will already be a net-importer of bioenergy for electricity, heating and fuel. Japan and China are similarly poised to import substantial amounts of biofuels in the near future.**

- ⇨ The risks and side effects of this foreseeable development are of great importance for the ecosystems in the areas of production. **Bioenergy production is – in principle - in competition with food production and with crops grown for material uses**. Although worldwide enough food is produced to feed everyone, over 800 million people go hungry because they cannot afford to buy food. Meanwhile, the rich (in industrial and developing nations) have the buying power to make sure sizeable amounts of land are used to cultivate animal feed, and they buy it "processed" as meat and dairy products. This situation is transferable to bioenergy crops. When the cultivation of bioenergy crops is increasing, it will not be sufficient to simply demand that bioenergy crops must not displace food crops. If the cultivation of bioenergy crops is more lucrative for the farmer than the cultivation of food crops, which cannot be ruled out as fossil fuel prices continue to rise, farmers will cultivate them anyway. There is now increasingly a link between fossil fuel prices on the world markets with food prices. If proper policies are not put into place, then the poor may be left to compete for food not only with the livestock for the meat and dairy consumption of the rich, but also with the automobiles of the rich.

- ⇨ The global consumption of wood has, in many regions, already exceeded a sustainable level. Increasingly, wood comes not from natural forests, but from industrial wood plantations planted with only a few, usually foreign, fast-growing tree varieties. The ecological and social consequences of these plantations are usually devastating. An example is the sinking groundwater levels due to eucalyptus' great demand for water. The energy supply for the majority world continues to be biomass and few programs for replanting or improving efficiencies in wood stoves exist. **If the growing demand for bioenergy increases the consumption of wood even further, the same mechanisms which make the exploitation of natural forests and wood monoculture lucrative today will continue to operate, if there are no political regulations in place.** Natural forests as well as small-scale farms and woodlots will be lost and pushed aside by large-scale logging and monoculture plantations.

In this volatile area of contradictory claims and interests, criteria and regulatory instruments for the global expansion of bioenergy, which allow for an ecologically and socially sustainable use of bioenergy, must be found.

Strong and harmonised international sustainability standards for bioenergy must be developed. Such standards can help to promote energy efficiency, ensure environmental and social sustainability, and support efforts to promote capacity building and compliance. More and more countries and intergovernmental institutions support this idea in principle. Another question is where such standards should be developed. This is ultimately a secondary question, as long as all stakeholders are satisfied that their views and their input into the process is taken into account.

Climate and Energy

Alternative energy and emission scenarios aiming at phasing out nuclear and fossil energies have consistently put their emphasis on two pillars: massive expansion of energy efficiency and of renewable energies. The two most recently released studies are from Greenpeace/EREC (European Renewable Energy Council)[2] and from the German Government's Advisory Council on Global Change (WBGU)[3]. Their scenarios projecting future energy are based on the need to cut global CO_2 emissions (in the former study by 50% by 2050, in the latter halting increases by 2020 in line with the recent IPCC reports). At the same time they assume the same global primary energy consumption as today, 50% from fossil (which in looking at the new IPCC scenarios is almost irresponsibly high). Both scenarios call for a massive energy efficiency revolution and massive increases in renewable energy. The Greenpeace/EREC scenario sees a tenfold increase of global bioenergy use for electricity production by 2050, 60% from energy crops. The WBGU study calls for an increase of bioenergy for electricity production from 1.5% globally to 30% by 2025, wind from 1% to 20% by 2025. The message is clear: there is considerably less time than previously thought to phase out fossil fuels, and expand renewables (including bioenergy). Even more massive damage to ecosystems and developing countries will result from climate change than what can be expected from any bioenergy development. While appropriate policies to ensure sustainability are needed for bioenergy development, there is an urgent need to act now to speed up the global energy revolution away from fossil fuels.

The sustainable use of biomass presupposes a neutral greenhouse gas emissions balance (i.e. carbon dioxide released from its combustion will be 'captured' by plants grown in the next productive cycle). This does not apply to bioenergy sources generated by massive input of fossil fuel sources (fertilizers, processing, transport, etc.). The sustainability of an energy source can, in the end, only be determined by a life-cycle assessment of the entire production and utilization chain of each energy source[4]. For climate benefit, there also needs to be net energy gains from producing biofuels which should be no less than 1:3.

As soon as climate protection, and this means the reduction of fossil fuel combustion, is recognized as a key driver for the utilization of bioenergy, priority must be given to those forms of biomass which reduce the highest amounts of CO_2 emissions and are the most energy efficient. Since OECD governments are still not yet pursuing sufficiently ambitious climate protection policies, CO_2 emission prices remain too low, so that economic incentives to avoid maximum CO_2 emissions with biomass from local sources are inadequate. Processed into liquid fuels, bioenergy as indicated in life-cycle assessments is 5 to 10 times less energy efficient than biogas, wood or woody biomass. The preconditions for the optimal climate-friendly use of biomass are calculable: gradually increasing CO_2 emission prices by ambitious emissions reduction targets (= shrinking emissions budgets in cap-and-trade systems). Without such a market mechanism, only complex regulatory mechanisms can guarantee that the utilization of biomass will result in the highest greenhouse gas reduction possible.

In the immediate future this means that, in most countries, the use of biomass should be concentrated in the electricity and heating sector where it achieve its maximum GHG substitution potential by replacing coal, the most greenhouse gas intensive fossil fuel.

In the electricity and heat sector, agricultural residues and biomass waste as well as unprocessed biomass from the forestry and agricultural sectors are the inputs that are most suitable. Biomass, in contrast to the intermittently available renewable energy sources such as wind and sun, is available at all times. **Therefore its use as a standard base load energy source, particularly in combination with wind and sun, should be encouraged politically.**

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[2] Energy (r)evolution: http://www.greenpeace.org/international/campaigns/climate-change/solutions

3 New impetus for climate policy: making the most of Germany's dual presidency: http://www.wbgu.de/wbgu_pp2007_engl.html

[4] In addition to fossil fuel inputs, the overall balance of GHG emissions from bioenergy supply also depends on the effective use of by-products from bioenergy conversion, (e.g. oil cake, glycerin, bagasse) and processing, which could offset at least some of the GHG emissions from bioenergy cultivation. The conversion of forested, pasture or savannah-type land to (annual) bioenergy crops cultivation could cause higher GHG emissions from released soil carbon and cleared biomass than is fixed by the cultivation of energy crops. This leads to a change in carbon stocks which needs to be considered in the overall GHG balance. ("Sustainability Standards for Bioenergy", WWF-Germany, 2006).

In contrast, the transport sector depends strongly on oil, usually imported. Energy security concerns here tend to override climate protection as the key driver for bioenergy development. Therefore, the petroleum and automobile industries put particular emphasis on using biomass for the production of liquid fuels. However, due to processing and refining, these biomass utilizations end up having lower reductions in CO_2 emissions.

Ambitious biofuels targets have been agreed in major automobile markets. In the US, a goal of 35 billion gallons of biofuels, replacing approximately one-fifth of oil-based transport fuels, is proposed by 2017. Current production is just 4.2 billion gallons. The EU biofuels directive demands that 5.75% of European fuel come from biomass by 2010, increasing to 10% by 2020.

Bioethanol is the most widely used biofuel for transport and accounts for more than 94 percent of global biofuel production. About 60 percent of bioethanol comes from sugarcane and 40 percent from other crops. Brazil is the largest bioethanol exporter, supplying about half of the global market. Other traditional sugar exporters including Guatemala, El Salvador, Pakistan, South Africa and Swaziland are also looking at opportunities derived from bioethanol production and trade.

If bioethanol is used, then economically and environmentally inefficient producers should not be shielded from international competition. Brazilian bioethanol is much more competitive than bioethanol from corn/maize made in the US, for instance, and its energy and greenhouse gas balance is much better. In the long run, it does not make sense to use protectionist measures to shield such expensive American or European bioethanol from competition from developing countries.

Biodiesel plays a prominent role particularly on the German market, where bioethanol is insignificant. Germany is market leader in biodiesel, which is available nation-wide at currently about 1,900 gas stations. With sales at approximately 1.5 million tons, biodiesel currently supplies more than 4% of the demand for diesel. The planned increase to 2 million tons would allow biodiesel to cover approximately 6% of the current demand. Currently Germany has about 750,000 ha for biodiesel production; the land available for biodiesel production cannot however be extended to more than 1 million hectares[5]. On the contrary, the currently available land is already largely used up and half of the current biodiesel production is already based on foreign raw materials (mostly from France and increasingly from the US). International trade in biodiesel is only beginning, and already there are massive complaints about subsidized US biodiesel exports: for every percent plant oil, the US governments pays one cent subsidy, i.e. for a 99% plant oil - 1% fossil diesel mix, this amounts to a whopping 99ct subsidy per gallon. There is already a global market for oils and fats characterized by high growth rates and high demand. The demand for biodiesel on the world market will most likely further increase the pressure on these markets and, for example, support the establishment of more palm oil and soy plantations with all their negative ecological effects. The global expansion of biodiesel therefore should be subject to critical analysis. Particular attention should be paid to the fact that biodiesel produced on arable land has a comparably low yield per hectare and therefore should only be discussed as a very temporary solution until the next generation of fuels is readily available, or for heavy vehicles that rely on diesel.

Another question is whether plant oils have to be refined into diesel at all. Vehicles can also run on pure plant oil. The energy (and agricultural) balance of pure plant oil from perennial plants such as jatropha on marginal land is much better, in particular when used for rural electrification in diesel generators.

However, both bioethanol and biodiesel are not the best options. There is no need to put the emphasis on (liquid) biofuels to reduce emissions and oil dependence in the transport sector.

More important is a modal shift in the transport sector. The removal of the many counterproductive subsidies for aviation and road transport is a prerequisite for a reduction of absolute transport demand by discouraging excessively dispersed production cycles and settlement patterns. All countries need clear political commitments for the expansion of modern and attractive public transport systems, including massive expansion of railways for both passenger and freight transport. Strict fuel efficiency criteria and policies to take gas-guzzlers off the market, increasingly implemented in places such as California and China must be put on the political agenda. In the EU it should be examined whether reduction of CO_2 emissions in the transport sector could better be achieved through integration of the transport sector into the EU emissions trading system and future regional emissions trading systems.

[5] Institut für Energetik&Umwelt/Fraunhofer-Institut/Wuppertal-Institut: Analyse und Bewertung der Nutzungsmöglichkeiten von Biomasse, Wuppertal/Leipzig 2005, p.6

Regardless: The automobile-centered transportation system dominant today is energy-inefficient and cannot be extended to the whole world. It is not possible to produce the enormous amount of fuel needed for this transport system in a sustainable manner. It should be pointed out that the much-criticized EU biofuels target of 10% by 2020 can also be achieved by reducing the consumption of fossil fuels in the transport sector and thus automatically increasing the share of biofuels without actually increasing their absolute amount. It would be a promising option for biofuel critics to push for this option rather than try (with little chances for success) to get the biofuel target revoked.

Taking all that into account, there will still be a need for biofuels for motorized vehicles. However, this does not mean that these biofuels have to be ethanol or biodiesel. More and more studies[6] show that biogas is more efficient than bioethanol produced from sugar cane (Brazil) and even more than bioethanol from maize or sugar beets. Biogas (biomethane) is even more impressive as a fuel when net energy yields per hectare are compared. The gross biofuel yield from one hectare of agricultural land is 4977 litres of fuel equivalent for biogas, 4179 for ethanol from Brazilian sugarcane, 4054 for ethanol from sugar beet, 3907 for BtL, and a lousy 1660 for bioethanol from corn and 1408 for biodiesel from rapeseed. The picture is even more pronounced when you look at the net energy balance, i.e. when you take into account the amount of energy necessary to obtain the energy stored in bioenergy. Today biogas from silage maize, Sudan grass and other productive energy plants already produce a net energy yield of 42,000 to 62,000 kWh per hectare. In contrast BTL (biomass–to-liquid, so-called second-generation liquid biofuels) can only produce around 33,600 kWh. The energy-intensive process of distilling bioethanol from whatever source produces generally an even less impressive net energy yield, depending on the kind of energy input. In terms of CO_2 saving costs, biogas is the most favourable of all biofuels.

In addition, second-generation biofuels are produced by transforming biomass in a high-temperature (energy-intensive) chemical-industrial process into liquid fuels. This does not allow for the recycling of plant materials as fertilizers, thus requiring chemical fertilizers with a corresponding additional energy input. The residues from second-generation biofuels are essentially industrial waste. In contrast, biogas production takes carbon out of the agricultural cycle and the residues with all the nutrients can be recycled to the agricultural system. In principle biogas production is compatible with organic agriculture.

Compared to bioethanol and biodiesel as well as to the »second-generation« liquid biofuels, biogas is more efficient. The biofuel of choice should therefore be biomethane/biogas. The EU should aim to fulfil its biofuels quota primarily with biogas. An interesting idea recently launched by the biogas sector is to create a pan-European biogas production scheme along the international natural gas pipelines and feed biomethane (purified biogas) into these pipelines. This is clearly an attractive option, since the best use of biogas (such as CHP) can not always guaranteed at the site of production.

Efficient technology to use biogas for transport is already available worldwide since biomethane is physically identical with natural gas. Today there are more than 6 million bio/CNG vehicles already operating globally.

Biogas production is also an interesting component for sanitation systems. Coupling sanitation systems with biogas production can provide the necessary water for biogas production (important in arid regions) and make an attractive link between energy and sanitation.

However, biogas as fuel has not been too popular among policymakers around the world, except for Austria. While this is partly due to a lack of information, biogas is more than just a technical question what fuel is best. Ít can have enormous economic and political consequences, because in principle the shift to biogas takes the powerful oil companies completely out of fuel production and perhaps even out of fuel distribution, if the biomethane is fed directly into existing natural gas pipelines. It is also not the optimal choice of automobile companies who have all invested into other options. The biogas option would mean a dramatically increased role of farmers and natural gas companies, at the expense of the oil companies – a side effect that not too many people will regret.

There is also a more indirect role for biomass in the energy sector. Biomass can also be utilized as an energy saving material. Substituting energy-intensive materials such as cement, steel, aluminum or plastic with wood in one-story buildings, electricity poles, etc. could save substantial amounts of CO_2 emissions (globally up to 1.5%). Biomass can also be used to produce plastic materials. Currently the market share of bioplastics is negligible, in Germany 5000 tons a year compared to 18.5m tons petroleum-based plastics.

[6] Calculations by the German Renewable Energy Association (BEE); Presentation by Josef Plank, Austrian Chamber of Agriculture at the Conference »Sustainable Bioenergy- Challenges and Opportunities« 12-13 Oct 2006, Bonn, see www.forumue.de/bioenergy; Institut für Energetik&Umwelt/Fraunhofer-Institut/Wuppertal-Institut: Analyse und Bewertung der Nutzungsmöglichkeiten von Biomasse, Wuppertal/Leipzig 2005 etc.

Petroleum-based plastics are still much cheaper than bioplastics, but that is changing slowly. The best option to minimize competition between energy and material use is a »utilization cascade« - biomass would first be used as wood, then bioplastics and so forth before being transformed into biogas. Plants used for such material applications – wood for building materials and fibrous plants such as hemp for bioplastics - are quite different crops than the crops grown for energy purposes only. There is still a lot of research to do to find the optimal plant combinations for such a sequence of material and energy applications.

While bioenergy is needed to decrease reliance on fossil fuels, adaptation strategies will also be needed as climate change impacts on agriculture production. Warming temperatures from 1981 to 2002 cut the combined production of wheat, corn, barley and other crops by 40 million tonnes per year, according to a peer-reviewed study by the Carnegie Institute[7]. Average global yields for several of the crops suffered from warmer temperatures, with yields dropping by about 3 to 5 percent for every 1 degree Fahrenheit increase.

Recommendations:

1. Adopt ambitious strategies to phase out fossil fuels to ensure GHG emissions peak before 2015 and keep the global temperature rise below 2°C. Focus on the massive expansion of renewables and energy efficiency. Develop the right policy support mechanisms and investment opportunities for this transition to a sustainable energy future.
2. Understand that the environmental effects of bioenergy requires a careful analysis of impacts across their whole life-cycle - from planting and production to the end-of-tailpipe - in order to pinpoint support for the most efficient and sustainable biomass production.
3. In the medium term, the use of biomass should, at least in the industrialized countries, be concentrated in the electricity and heating markets where the best energy balance and the highest CO_2 reduction has been proven and where greenhouse gas intensive coal can be substituted. Political support should be concentrated on the decentralized use of biomass in combined heat and power (CHP), in particular in a renewable mix of sun, wind and biomass to produce reliable baseload electricity, in order to overcome the problem of intermittency of wind and solar electricity.
4. Despite the strategic necessity of sector specific targets for renewable energies, a conservative approach should be used with the bioenergy sector. Too ambitious biofuel targets without ecological considerations could lead to counter-productive results in sector development. Therefore, specific bioenergy sector targets should be set with caution, followed by an approach that includes a strategic impact assessment on the target setting.
5. In the transport sector, there should be a clear focus in most countries on biogas technologies, building vehicle fleets and setting up networks of filling stations and biogas plants as an alternative to fossil fuels and as a means of contributing toward decentralized energy systems and reaching rural regions (in particular in the developing world).

Forestry

The most important bioenergy source by far is wood. In Europe, wood is used primarily in material applications. The percentage of wood felled for fuel within the EU is slightly more than 10%, whereas in the developing countries this share lies closer to 80%. Wood fuel is used almost exclusively locally, often outside of the monetary economy, and is traded internationally at a small rate.

World trade in wood as a bioenergy source is restricted due to wood's relatively low energy density. Wood pellets have the best energy density. Pellets are a by-product of the wood processing industry, can be made on the same premises and are thus a source of supplemental income. With increasing demand and rising energy prices, it is a safe assumption that raw wood or wood chips will become a viable export option, over and above the marketing of waste products. It must not, however, be forgotten that products are already imported which have been produced with wood energy, i.e. raw iron from Brazil.

[7] NEW YORK - Global warming has cut about US$5 billion worth of the world's most commonly grown grains over 20 years, according to a new study. Planet Earth Reuter, US: March 19, 2007.

Forests are not only suppliers of raw materials for competing purposes. Forests are ecosystems and a life support system not only of many animals and plants, but also of people. Rainforests in particular play a key role in regulating the earth's climate and are under threat in many parts of the world.

International use of energy competes with local use. There is reason to believe that in rural areas of the South, forests with public access will increasingly become commercialized and that the surplus wood from these forests will no longer be available to meet traditional needs for local communities. The consequence would be more poverty, hitting women hardest who often have less access to money and are traditionally responsible for the care of the family, including finding fuel wood.

Global wood consumption, for paper, firewood, construction materials and other uses, is already too high and is only made possible by overexploitation in most forest-rich countries. In these countries, forests are receding at an unabated rate. Additional demand from bioenergy could lead to increased efficiency in the use of the natural resource wood, i.e. the appreciation in value of recycled paper. On the other hand, rising wood prices could also create a rising incentive to clear-cut forests. The growing need for land for the cultivation of bioenergy crops has the risk of increasing the destruction of forests and must be controlled accordingly.

The conversion of natural forests into wood plantations with fast growing, usually foreign tree varieties such as eucalyptus, is a well-known problem for the production of cellulose. Plantations have nothing in common with the original function of the forest ecosystem and can cause enormous ecological damage through, for example, sinking groundwater levels and a drastic reduction of biodiversity.

Rising paper consumption already accounts for a fifth of global wood production. Germany, with a per capita consumption of 225 kilos is, with the USA and Japan, one of the world leaders in paper consumption, whereas China has a per capita consumption of only 20 kilos. Today's world average of 55 kilos per person a year is hardly reconcilable with a sustainable consumption level. Wood plantations in Southeast Asia already compete directly with food growers for water and land. The increased use of wood as a bioenergy source also competes with other wood products such as paper.

Recommendations:

1. Human claims to the utilization of wood must in no way ignore or compromise the preservation of the forest as an ecosystem, particularly not in remaining primary forests.
2. The conversion of fallow lands to wood plantations must be thoroughly evaluated from an ecological perspective. It must be taken into account how and when the land came to be fallow, and the soil and climate conditions of the area. The creation of incentives to degrade areas for the lucrative cultivation of bioenergy must be prevented.
3. Bioenergy must not increase logging in valuable conservation-worthy forests.
4. The increased use of bioenergy from wood should be concentrated on wood by-products from other applications to prevent overexploitation.
5. The conversion of natural forests into wood plantations with fast growing, usually foreign tree varieties, such as eucalyptus, must be strictly prohibited.
6. The use of biomass should not reduce the percentage of dead wood in the forests.
7. Measures must be taken to reduce the consumption of paper in the industrial countries and increase the use of cascading utilization systems (i.e. use as an energy source after multiple recycling).
8. Increased funding and programs for reforestation and fuel-efficient wood stoves are needed in developing countries.

Agriculture and poverty alleviation

There is a great diversity of crops which can be used for energy production. Biogas can essentially be produced from any kind of biomass. Even if you opt for liquid fuels, they can be obtained from oily seeds, starch and sugar crops and from many different cultivation systems and technologies (i.e. agroforestry systems, perennial plants or combination cultivation). In developing standards and preferences, regional variances exist but sustainable bioenergy production should look at prioritizing waste materials, perennial

crops with multiple uses, and look at the farming technique used. This contrasts with the current focus on liquid biofuels for transportation.

One of the biggest debates around bioenergy sector development is the concern over food security with fuel crops replacing food crops. Maize, soybeans, sugarcane and other crops can serve as biofuel feedstock, as animal feeds, or as food for human consumption. As energy prices increase, producers exploring multiple markets may respond by shifting existing output of maize or soy from food to fuel use. Or they may shift production from food to non-food plants (e.g. jatropha). In both cases, increased prices and reduced supplies may have adverse effects on the poor and hungry, particularly in net food-importing countries. Recent increases in ethanol production from corn in the US led to a 400% rise in the price of tortillas in Mexico, the staple food for the poor. Whether corn in Mexico or palm oil in West Africa, local production for staple foods and policies to mitigate spikes in international prices for energy crops are required to ensure food security.

However, it is important to point out that the problem did not start with bioenergy but with forced agricultural market liberalization and the integration of agriculture into global markets. The questions to ask are: why have countries become net-food importing countries and why have they lost their food sovereignty. Only ten years ago, before NAFTA, there was no US corn on the Mexican market. Cheap subsidized US corn exports destroyed the livelihood of many Mexican farmers. The small-scale agriculture sector in many developing countries has been destroyed or negatively impacted from the dumping of subsidized agricultural products from European countries and the US. Small-scale farmers were and continue to be driven out of business, leading in turn to migration of rural communities into urban areas. The dumping rates for some agricultural products from the EU to developing countries includes wheat 29%, milk 42%, sugar 56%, poultry 26%, and rice 26%[8]. If bioenergy development in the EU and US leads to reduced surpluses and less agricultural exports to developing countries, then this is certainly good news for farmers in developing countries.

It is not necessarily good news for poor people who are not farmers but have to buy their food. Agriculture exports from the EU and US have kept world market prices of a number of crops, such as maize, artificially low. When they are removed, prices for these crops will go up. In parts of the world such as Southern Africa this is exacerbated by droughts and climate change. Countries that import food are faced with price increases resulting from higher demand for certain crops.[9] At the same, food production in these countries becomes economically more viable and attractive.

If managed well, bioenergy could promote something akin to an agricultural "renaissance" in some developing countries where bioenergy can be produced profitably and stimulate rural economic growth. Bioenergy can create jobs and protect incomes and livelihoods if it is decentralized and processed regionally, so that the added value stays in the region. Decentralized production of bioenergy holds a lot of potential, particularly in the case of raw materials such as Jatropha, castor oil plants and biogas, which can be converted into energy through simple technologies that can be easily installed on-site, and, as in the case with Jatropha, can be grown on marginal lands or through intercropping. The amount of arable land that is currently left idle because farm prices are too low and that would come back into production with substantial increases of farm prices can only be guessed, but it should not be underestimated.

The opposing model is a focus on liquid biofuels for export, which usually requires large areas for monocultures and a much higher grade of technology. Experiences with cash crops (including feedstock) in developing countries show that highly technical industrial cultivation methods need comparably large cultivation areas. In this case the land required will most probably be controlled by large land-owners or companies[10]. Large production units can also create jobs, but they usually simultaneously displace existing structures and thus create conflicts with access to land and water as well as the requirements of diversified agriculture driven by family businesses, cooperatives and rural communities aiming at supplying food and income for the local population; in other words: greater social inequities and poverty. The greater the commercial interest becomes, the greater the pressure from large-scale industry will be - akin to soy

[8] Oxfam 2005

[9] Annie Sugrue and Richard Douthwaite, “Biofuel production and the threat to South African food security”, *Wahenga brief #11,* April 2007, www.wahenga.net

[10] Currently two companies – Cargill and Archel Daniels Midlan (ADM) – control about 65 percent of the global grain trade.

cultivation in Brazil[11]. This could be the same in the case of bioenergy, since production is linked to the land and there is no "free" land. However, while we can probably make sure by political regulation that bioenergy development will not increase social problems in developing countries with a large cash-crop sector, it would at the same time be unrealistic to expect bioenergy production to match higher standards than the rest of the country's agriculture.

Consequently, the way in which the transition towards more bioenergy production is managed will have profound implications for efforts to meet the poor's basic needs, advance their freedoms, secure their human rights to food and water, and to achieve international targets such as the Millennium Development Goals.

The Brazilian initiative of a special program for small farm biodiesel production shows that large farmers and agribusiness need not be the only ones who profit from the production and export of biofuels. The participation of small farmers is secured by a social seal which links production support to social criteria.

The cultivation and export of bioenergy sources must not jeopardize a country's food supply. Governments must set the regulatory political framework necessary to prevent this and ensure food sovereignty and adopt the "Right to food" approach with its voluntary set of guiding principles into the bioenergy sector. The right is defined by the International Covenant on Economic, Social and Cultural Rights as follows: "Right to adequate food is a human right, inherent in all people, «to have regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of people to which the consumer belongs, and which ensures a physical and mental, individual and collective fulfilling and dignified life free of fear.»[12]

Apart from the social problems of large-scale agriculture, there are also serious environmental problems. A focus on cash crops for export often means that sooner or later high-yield varieties with a corresponding need for soil, irrigation, fertilizers and pesticides will be planted, often subsidized. Under these conditions, positive energy and greenhouse gas balances are difficult to attain and there will be negative environmental effects, e.g. on biodiversity. The use of genetically modified organisms in the production of industrial bioenergy raises many unresolved questions about risks (mostly environmental) and side effects (mostly health). The technology involved is also linked to the centralized control of a few large companies over seeds and plant varieties. Obviously the GMO lobby tries to use the bioenergy debate to get a foothold, since in most parts of the world people simply refuse to eat GMO food. So maybe they want to burn GMO plants? However even from a purely economic point of view this makes little sense, conventional breeding is cheaper and has been considerably more efficient at producing the plant properties required for bioenergy. GMOs are not primarily dangerous because of what they do in your stomach but because of what they do to the natural environment while growing. The bi-products of GMO bioenergy of course will be eaten by animals, such as in the case of DDGs (dried distillers grains with solubles) from maize and soy protein.

The deciding factors for utilizing biomass potential are related to land use and land availability. Apart from population growth, degradation of agricultural land (eg. salinization or desertification), climate change and the fertility of the land, the availability of fallow land and the food preferences of the population are key factors. Agriculture is not as simple as growing crops for direct human food consumption. Several crops are used as feed crops or to process into food additives (such as corn and soy), or the land is used for the livestock itself. The eating habits of the residents of most industrial countries as well as the rapidly increasing number of affluent people in developing countries, dominated by meat and milk products, requires two to three times as much land as a moderate diet (and three to four times as much as a vegetarian diet). In other words, sooner or later the question will arise whether agricultural land not required for the production of crops for direct human consumption is to be used either for energy crops or for meat production, as it is the dominant case today. But there is a limit to combined usage. The potential is enormous: 85% of the agricultural land in Germany is needed for the production of meat and meat

[11] When the prohibition of carcass meal in Europe for animal feed (due to mad cow disease) caused a spiked increase in demand for protein, the Brazilian soy market became a targeted supplier. The consequences were a large-scale expansion of soy cultivation into the Brazilian Amazon forest.

[12] This definition entails all normative elements explained in detail in General Comment 12 of the ICESCR. In 2004, after two years of discussion and negotiation in the working group, the FAO Council adopted by consensus the Voluntary Guidelines to Support the Progressive Realization of the Right to Adequate Food in the Context of National Food Security. The Voluntary Guidelines are not legally binding but draw upon international law and provide guidance on the implementation of existing obligations. They are directed towards States Parties to the International Covenant on Economic, Social and Cultural Rights and to States that still have to ratify it. But they are also intended for stakeholders working towards a better implementation of the right to food at national level.

products. Imported animal feed requires large amounts of land abroad. For instance, the more than 3m tons of soy that Germany annually imports from Brazil require about 1.2m hectares of land in Brazil. Brazil exports annually about 33m tons of soy. The conflict »food versus bioenergy« gets an entirely different dimension when you take animal feed for the overconsumption of meat by the rich out of the equation. Brazil's agricultural area is about 263m hectares, and this includes 197m hectares grazing lands for cattle. 18.5m hectares are used for soybean cultivation, mostly for animal feed. [13]

In looking at the broader picture, averting the collapse of the climate by transforming the global energy system is definitely more important than sustaining the excessive meat (and dairy) consumption habits of Europeans, Americans and more and more affluent people in other countries. Therefore policies to guarantee food security should focus on reducing the demand for meat (or at least meat produced from imported animal feed), to free up potentially enormous existing agricultural land for bioenergy crops, since it is here where land use is most dispensable. Options could be regulatory restrictions for intensive animal husbandry, taxation of feedstuff etc.

The situation in Africa is clearly different. Arable land is scarce and mainly used not for cash crops for export but to actually feed the population, while cattle are grazing mainly on marginal grasslands. Governments must make sure that the production of enough food for the people gets clear priority. Bioenergy plants like Jatropha curcas, the moringa tree and the indigenous plums in this region are suitable for marginal and degraded land and in this case do not compete with food production, and in addition they have a beneficial effect through stabilising degraded soil.

Another important issue is water availability. Many regions of the world are water scarce, and this will get worse with climate change. If biofuel crops are grown for export with irrigation on arable land they will potentially not only compete with food but also for water, and that would be a development disaster. Agriculture already uses more than 50% of all available water in many developing countries. It is imperative that among the diversity of bioenergy crops those are selected that do not need irrigation. It may well be that the limiting factor for bioenergy turns out not to be the availability of land, but the availability of water.

Recommendations:

1. Support and protect small farmers and their structures, eg. cooperatives. Increased biofuel production should not contribute to further concentration of land ownership and land access into fewer hands.
2. Create incentives for diverse, low-intensity, bioenergy crop cultivation, with minimal use of fertilizers and pesticides and the use of low-energy forms of agriculture such as no-till practices
3. From an environmental point of view, it is crucial to support innovative and sustainable cultivation systems and technologies (i.e. the introduction of agroforestry systems, perennial plants or combination cultivation).
4. Identify and reward synergies between ecology and economy, and give preference to local production for local consumption.
5. Genetically Modified Organisms must not be used for biomass.
6. Environmental assessments of expanded production of energy crops should be a key element of domestic biofuel strategies.
7. Transform lands currently used for animal feed production for export into bioenergy production.
8. Since the share of degraded land could, in principle, be used for bioenergy farming systems is increasing globally, making use of this land for bioenergy production represents a theoretical potential of 25% of global primary energy use. In order to reduce conflicts about land, the development of environmentally and socially sound options for making use of such land should be a priority for sustainable bioenergy production.
9. Land-tenure conflicts must be avoided. This requires clearly defined, documented and legally established tenure use rights. Poor people should not be excluded from the land. Customary land use rights and disputes should be identified. In countries where land reform and land redistribution is on the political

[13] Tofu for vegetarians is irrelevant in this list, the dairy products consumed by vegetarians however really do matter. It is helpful to point out that a diet of less meat is also more healthy.

agenda, bioenergy should be designed in a way to be compatible with this objective, rather than block it.

Trade

The cultivation of bioenergy crops and the production of bioethanol in developing countries do not automatically mean that they will be exported. After all, most developing countries must themselves import expensive oil on the world market. The Brazilian bioethanol program began with the substitution of imported oil. The USA, the second largest ethanol producer, produces exclusively for the domestic market. What is true for liquid biofuels is even more true for different bioenergy uses where liquid biofuels play only a secondary role.

If the focus in bioenergy is
- on local consumption of bioenergy from a variety of crops, agriculture waste and agroforestry
- on the production of electricity and heat (CHP)
- and on biogas as transportation fuel

then international trade will be minimal. Biogas may still end up in international natural gas pipelines, and woodchips may be traded internationally. However, the large global markets that are currently associated with bioethanol and biodiesel will not result.

Until there is a shift to this focus, an international market in liquid biofuels will continue. As markets for bioenergy grow, so does their international trade, and with it there is more and more support for harmonisation of standards and additional trade liberalisation. Addressing these issues will require co-operation at both the domestic and international levels. Getting the best from bioenergy will require the right combination of markets, incentives and institutions at the local, national and international levels. Getting domestic policies right and ensuring trade rules are supportive is therefore an urgent priority.

As governments try to ensure the sustainability of biomass utilization, it is important to ensure that sujch policies are not undercut by imports. The importing nations must have the option for differential treatment of imported bioethanol or wood in order to avoid the negative environmental and social consequences of large-scale bioenergy export, and to be able to provide better market conditions for sustainable bioenergy sources. In contrast to food and luxury foods, it is highly questionable that consumers are willing to pay more for “fair trade” or “organic” gasoline. Voluntary standards are helpful in food and wood trade, but mandatory standards are needed for biofuels. Whether better market conditions for bioenergy, identical for all consumers, can be achieved by means of the classification of certified ethanol as an environmental commodity (likely vulnerable to legal challenges) or by means of changes (long demanded by NGOs) in WTO agreements (allowing product distinction by process and production methods /PPMs) remains to be seen.

However, the usual agricultural protectionism must not be continued in bioenergy markets. Currently the US and EU have imposed tariffs to try to protect their domestic bioethanol producers from developing country imports, in particular Brazil. From an environmental point of view this is questionable. If it makes ecologic and economic sense to utilize biomass in Europe primarily for electricity and heating, and as long as biogas is not readily available, then there is no reason why the demand for liquid fuel should not be filled by imports or the regulations changed accordingly (mandatory use of biomass without specifying use as a fuel).

The WTO agenda calls for the elimination of all tariff and non-tariff trade barriers in the paper and wood sector by 2010. In light of the practice of overexploitation in most forested countries, this objective has been labeled by NGOs as the “Global Free Logging Convention”.

For the EU, fuel and fuel additions such as ethanol as well as wood and wood products come into consideration as biomass imports. Particularly wood raises considerable questions about overexploitation and sustainable methods of production. Systems of certification can include criteria which stipulate sustainable production methods.

The ideal approach would be an agreement between the major bioenergy producer and consumer countries about mandatory sustainability criteria which then would be enforced by national legislation. Such criteria should be agreed by all concerned players in a participatory process, including governments, industry, farmers, and NGOs. Some of the criteria are, for example: greenhouse gas balance, energy balance, sustainable agriculture, biodiversity impact, the distribution of added value, job creation and social impact, and no protectionism. It should be noted that developing countries have at least as much to gain from such an agreement, since the current biofuel production methods in the industrial nations (bioethanol in the US,

biodiesel in the EU) are much lower in terms of greenhouse gas and energy balance, than Brazilian sugarcane ethanol. The participating nations would exclude unsustainable bioenergy or bioenergy-related products from their markets, and as long as this applies both to domestic as well as foreign producers they should be able to find ways and means to make this WTO-compatible.

It is also questionable to attach environmental regulations to the imports of commodities or products of commodities such as sugar cane, soy and palm oil for energy uses and another set of regulations (most likely none at all) if they are used for animal feed, margarine, soap, cosmetic products, etc. The non-energetic use of these crops is currently quantitatively far more important than the energetic use, though there is a lot more discussion about their use for energy purposes. If sustainable production of these commodities is the objective, a comprehensive regulatory approach for every commodity is necessary.

In designing biofuel policies, policy-makers have a range of available tools. These include taxes and subsidies, information measures (e.g. labelling) and border measures such as tariffs and quotas, as well as simply setting mandatory targets for biofuel use. Policy-makers can promote *supply* of biofuels by supporting research, production and distribution through, for example, low-cost loans, subsidies and tax incentives. They can promote *demand* for biofuels by encouraging substitution by consumers away from traditional fuels through, for example, fuel tax exemptions, government procurement policies and biofuel use targets. A third focus is the development of technical regulations, standards and certification for biofuels and other new energy products. These are required to inform consumers, and to provide incentives for biofuel production that are environmentally and socially sustainable.

The development of new policies also provides policy-makers with an opportunity to correct existing policy and market failures that skew energy and agricultural markets and may undermine biofuel development. Perverse energy subsidies and externalised costs, for instance, depress petroleum prices and retard the adoption of energy alternatives. Agricultural policies, too, skew the price of some agricultural commodities versus others, encouraging farmers to invest in economically or environmentally unsound feedstock.

It also remains to be seen how big this global market will actually be. In May 2007 the Brazilian sugarcane growers association pointed out that the domestic demand for ethanol is so high that less than 20 percent of its production can be exported. However even if only a fraction is traded internationally, this small global market may have a key impact on prices. For many countries it makes no sense to export bioenergy when the energy needs of the domestic market are not covered.

Recommendations:

1. Develop a multilateral agreement on mandatory criteria for sustainable bioenergy
2. Any discussion of bioenergy should be framed not merely in commercial terms, but in light of the paramount considerations of energy security, development and environmental sustainability.
3. First priority must be given to local renewable energy sources, improved energy efficiency and energy conservation. The import and/or export of bioenergy should follow only to compensate for regional deficiencies.
4. In using biomass directly for domestic energy needs, priority should be given to developing regional value-added chains, mostly in developing countries.
5. Under no circumstances should there be a reduction of tariff and non-tariff trade barriers in the paper and wood sector as discussed in the WTO. The regulation of wood as a bioenergy source cannot be separated from the regulation of wood and wood products such as paper.

In the case of wood, we recommend the further development of the FSC seal (Forest Stewardship Council). Such seals are voluntary measures that are only successful when certification brings an additional economic advantage. In this case, there must be a distinction made between wood for wood products and wood for bioenergy. For the consumer, an FSC certified garden chair has a clear surplus value, whereas the acceptance of a higher price for fuel is certain to be more difficult to gain.

Conclusion

The world faces the daunting task of phasing out fossil fuels, because they are a threat to the climate system, are becoming scarce and expensive, and simultaneously the 1.6 billion people without access to

modern energy services require such access. While bioenergy has always played a critical role in the world's energy mix, its role in the future will be a lot more prominent than now. Any credible energy scenario for the coming decades depends on the massive expansion of both energy efficiency as well as a broad mix of renewable energies, including bioenergy. Bioenergy poses large opportunities, but can also have very serious risks and side-effects if managed poorly. Policies and standards are required now to ensure the sustainable development of this energy source.

The major concerns in the bioenergy debate center around food security, deforestation and loss of biodiversity, greater trade imbalances and concentrated international market power structures. The major benefits around bioenergy include greater energy security, decreases in GHGs, increased access to energy, rural development and poverty alleviation. In order to ensure that the benefits outweigh the risks, the major players must lose no time to develop and agree on some mandatory standards, taking into account economic, social and environmental considerations. This will likely only be achieved by developing a multi-stakeholder process that engages civil society. Many of the actors involved in this debate, including governments, NGOs, farmers and industry can benefit from such an agreement – if only by creating a secure investment climate.

Given the regional variances of climates, agriculture, food security and energy needs, regional standards should be developed and refined. Ideally, each level (international, regional, national and local) should introduce sustainability standards for biomass by means of regulations that are consistent with the other levels. The international agreement provides the framework and sets the core standards for environmental, social and economic criteria for the different sectors of bioenergy. The regional or national level elaborates and potentially goes beyond the international agreement's minimum standards, and can also establish implementation instruments (such as feed-in tariffs, admixture quotas, tax exemption and import regulations). National implementation must be consistent with regional and international regulations and sustainable standards, but allow for flexibility of national circumstances.

Bioenergy has great potential to provide a significant portion of global energy demand without competing with food production, forest-protection efforts and biodiversity, and can be pro-poor providing development opportunities and access to sustainable energy for those currently without. Given the range of issues bioenergy touches, controversies will continue unless standards are tackled in a multi-stakeholder process in the near future to ensure its sustainable development.