



DIRECTORATE-GENERAL FOR INTERNAL POLICIES

POLICY DEPARTMENT
ECONOMIC AND SCIENTIFIC POLICY **A**

Economic and Monetary Affairs

Employment and Social Affairs

**Environment, Public Health
and Food Safety**

Industry, Research and Energy

Internal Market and Consumer Protection



**Workshop on Biofuels and
Indirect Land Use Change**

Brussels, 25 January 2012

ENVI

Table of Content

Agenda

Short biographies of experts

Presentations



European Parliament Policy Department A-Economy & Science
Committee on the Environment, Public Health and Food Safety (ENVI)

Workshop on Biofuels and Indirect Land Use Change

Wednesday, 25 January 2012 - 15:00 - 17:30
European Parliament, József Antall (JAN) 4Q2

Expecting the release of the European Commission's impact assessment on "indirect land use change (ILUC) related to biofuels and bioliquids on greenhouse gas emissions and addressing ways to minimize it" in January 2012, the Coordinators of the ENVI Committee requested to organize a workshop on this issue. The workshop will consist of different presentations and an exchange of views with Members and established experts in the area of the biofuels and ILUC.

Interpretation will be provided in: EN-DE-FR

AGENDA

15.00 *Welcome by MEP Sabine Wils, Member ENVI Committee*

PART 1: HOW TO ASSESS THE IMPACT OF ILUC

15.05 Summary of the study "Indirect land use change", published by the EP PolDep A, February 2011

Uwe R. Fritsche, Öko-Institut

15.15 The EC's impact assessment on ILUC

Hans Van Steen, DG Energy, European Commission

15.30 The environmental pressure of biofuels

Jan-Erik Petersen, EEA

15.50 Existing methodologies and best practices on assessing ILUC

Luisa Marelli, EC DG JRC

16.10 Q&A, open discussion

PART 2: ROUNDTABLE ON ILUC CHALLENGES

16.30 *Introduction to the roundtable MEP Richard Seeber, Member ENVI Committee*

16.35 The EU bioenergy industry view

Kjell Andersson, AEBIOM

16.45 Indirect land use change – a view from IEA Bioenergy

Göran Berndes, Chalmers University & IEA Bioenergy Task 43

16.55 Views of the EU Environmental NGOs

Nuša Urbancic, T&E

17.05 Q&A, open discussion

17.25 Conclusions by the Chairman

17.30 End of workshop

Short biographies of speakers

Uwe R. Fritsche, Oeko-Institut (Institute for applied ecology)

U. Fritsche studied applied physics at the Technical University Darmstadt, Germany, and works since 1984 as a scientist at Oeko-Institut where he headed the Energy & Climate Division in Darmstadt until 2010. Currently he is concerned with institute-wide research on system analysis and sustainable resources. He is an expert in material-flow and life-cycle analysis of energy, biomass/food, and transport systems, coordinating work on the institute's core model and database GEMIS.

In the 1990ies, he worked with the World Bank on environmental issues of energy, and since 2000, contributes to the European and global sustainable energy discussion, especially regarding biomass. Since 2007, his work focuses especially on GHG emissions from land use change related to biomass. He works with his team on national, European, and global sustainability standards and criteria for bioenergy together with EEA, FAO and UNEP as well as CI, IUCN, and WWF, among others. He is German National Team Leader for IEA Bioenergy Task 40, and contributes to the Global Bio-Energy Partnership (GBEP), leading the workstream on indirect effects.

Hans van Steen, DG Energy, European Commission

Hans van Steen is Head of Unit in the European Commission, DG Energy. He is responsible for Regulatory Policy & Promotion of Renewable Energy and holds a Master Degree in Political Science from the University of Århus, Denmark. Mr van Steen has been with the European Commission since 1989 and has been Head of Unit for Renewable Energy since June 2006. In this capacity, he was the Commissions representative in the negotiations of the Renewable Energy Directive and is currently responsible for overseeing the transposition and implementation of the Directive in the EU Member States.

Jan-Erik Petersen, European Environment Agency (EEA)

J-E. Petersen studied biology, agroecology and public law at the universities of Bayreuth and Kiel (Germany), and in 1998 received a PhD in political science on the implementation of EU agri-environment schemes in Spain from the University of East Anglia, Norwich (UK). He worked as International Liaison Officer for the central office of ADENEX (a nature conservation organization in Spain) from 1992-1994. After his PhD he became a Research Fellow at IEEP London, working as analyst on agri-environment policy, nature conservation, rural development and eastern enlargement of the EU from 1997-2001.

In 2011, he joined the EEA as Project Manager for Agriculture and Environment, responsible for developing EEA analysis in the area of agriculture and environment, including the development of EU agri-environment indicators and EEA bioenergy analysis. Since 2009 he is Head of Group for Major Integrated Assessments at EEA, , coordinating EEA-wide projects, such as the EU state-of-the-environment report 2010 and the EEA indicator review process.

Luisa Marelli, Joint Research Center Ispra (JRC)

L. Marelli has been official of the European Commission, Joint Research Center, since 2003, where she started working in the European Reference Laboratory for Air Pollution, in support to Air Quality validation and implementation of particulate matter monitoring systems

Since 2008, she has been responsible for the JRC research programs on biofuels (Biofuels Coordinating Action). Research activities of the group develop on the analysis and testing of sustainability of biofuels production and use, such as direct and indirect land use changes and related GHG emissions, impacts on biodiversity, pressure on tropical forests, life cycle GHG emissions from biofuels production, compatibility with vehicle and energy efficiency, development of second generation biofuels. She is responsible of internal and external communications of the Biofuels Coordinating Action, to establish and maintain contacts and information exchange with customers DGs of the Commission, external delegations, identified stakeholders etc. She is also a member of the Scientific Committee of the JRC Institute for Energy and Transport.

Kjell Andersson, European Biomass Association (AEBIOM)

K. Andersson has a degree in journalism from Stockholm College of Journalism, and a MA degree in history and political science from Stockholm University. From 1973-1987, he worked as a journalist and assistant editor of Land (weekly magazine published by the Swedish Farmer's Federation). From 1987-2001, he was communications director at the Swedish Centre party. Since 2003 he works at Svebio (Swedish Bioenergy Association) in Stockholm as information director and policy advisor, and acts as chairman of AEBIOM's working group on sustainability.

Göran Berndes, Chalmers University and IEA Bioenergy Task 43

G. Berndes is a physicist and Associate Professor at the Department of Energy and Environment at Chalmers University of Technology, Sweden. His work integrates land use strategies and energy systems development in response to climate, energy and other policies put in place to guide the development.

He is international leader of Task 43 (Biomass feedstocks for energy markets) within IEA Bioenergy, and is also a member of several other international expert groups. He was lead author of the recent IPCC Special Report on Renewable Energy and Climate Change Mitigation and is contributing author of the IPCC Fifth Assessment Report.

Nuša Urbancic, Transport & Environment (T&E)

Nuša Urbancic is T&E's specialist on fuels and electrification since w2008. A Slovene, she worked previously in Greenpeace's EU unit on the renewable energy campaign. She has also worked as a journalist and translator and at the French economic mission to Slovenia.

Presentations

Jan-Erik Petersen, The environmental pressure of biofuels

Luisa Marelli, Existing methodologies and best practices on assessing ILUC

Kjell Andersson, The EU bioenergy industry view - *not available when going to print*

Göran Berndes, Indirect land use change – a view from IEA Bioenergy

Nuša Urbancic, Views of the EU Environmental NGOs

Environmental aspects of bio-energy production DRAFT VERSION

Workshop in European Parliament, 25/01/2012



Jan-Erik Petersen, EEA

1

European Environment Agency



Approach to presentation

- 1) Background
- 2) Environmental issues
- 3) Outlook

2

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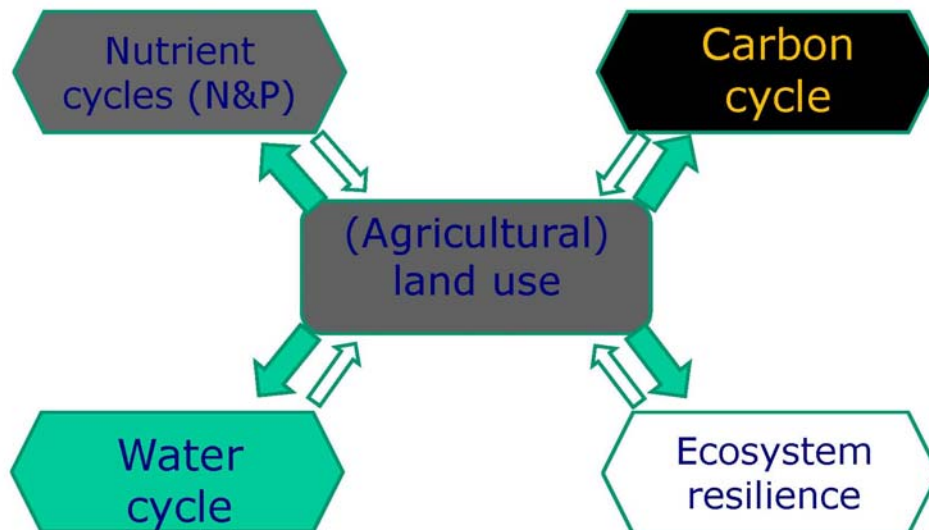


Two different bioenergy systems – which one is more 'sustainable'?

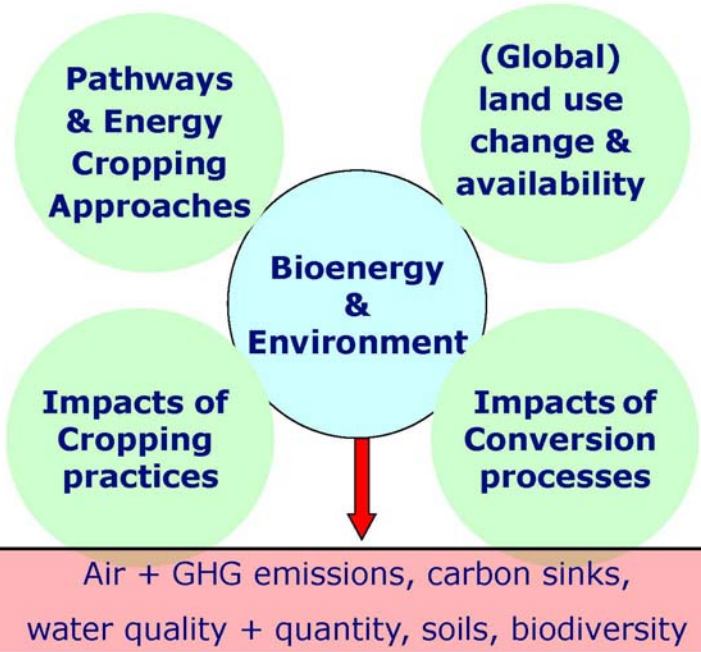


Source: www.radford.edu

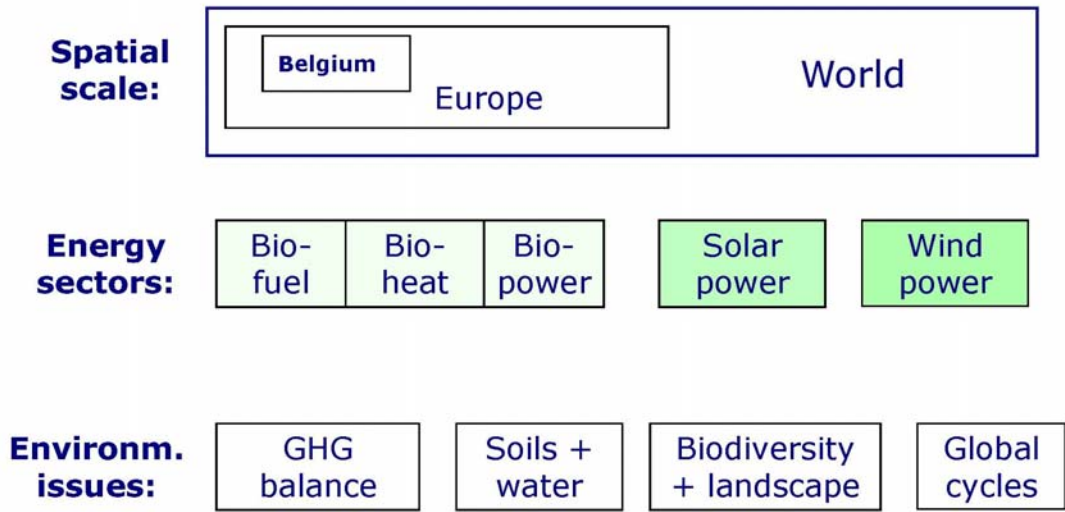
Land use impact on natural cycles



Environmental issues of energy cropping



2) The question of system boundaries



What tools do we have?

Analytical tools:

- Life cycle analysis
- Agro-economic modeling
- Satellite and field observations
- Scenario analysis

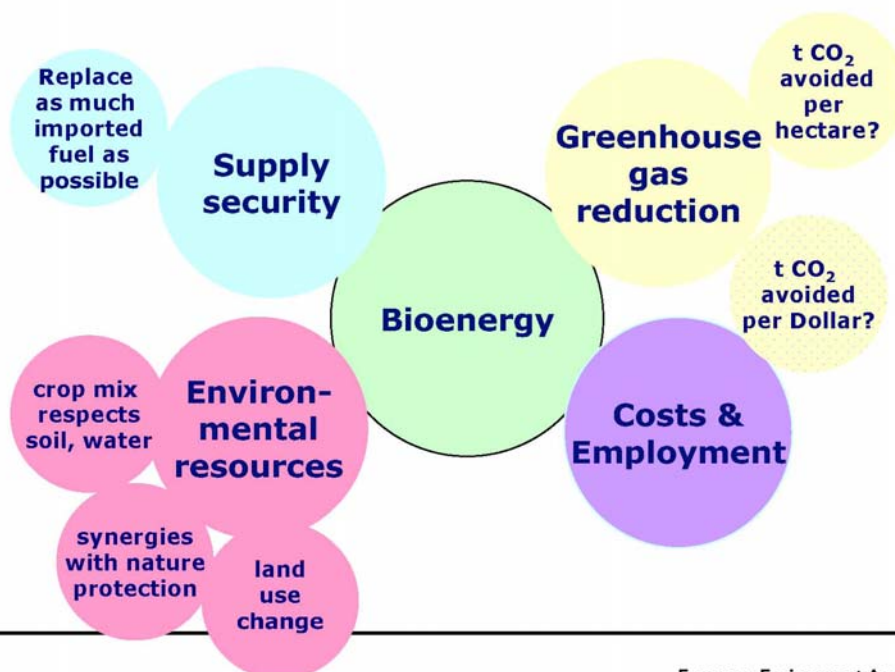
Weaknesses:

- *Indirect land use effects*
- *Environmental impacts*
- *Analysis of economic drivers*
- *Assumptions and system boundaries*

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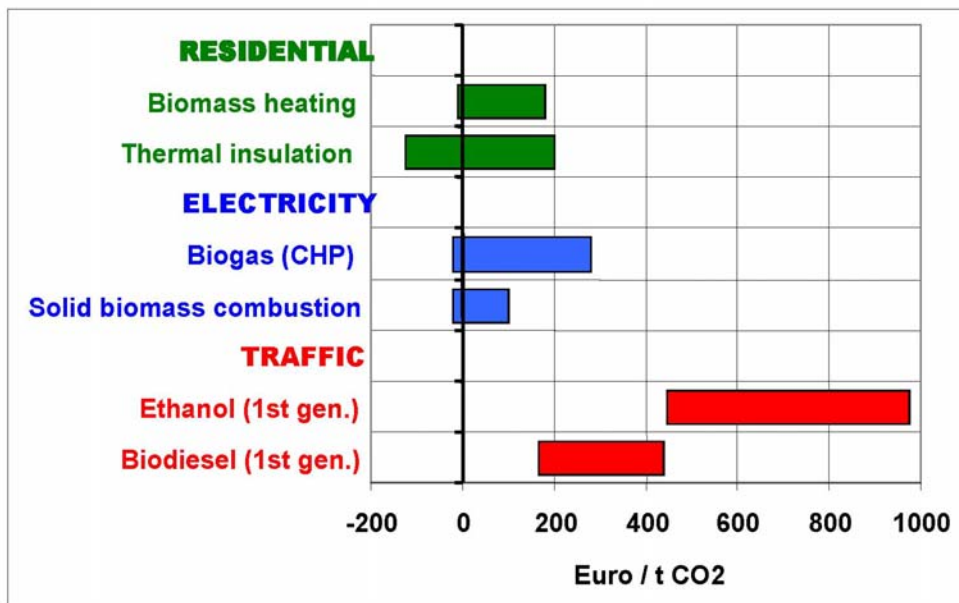
Resource efficiency of biomass



European Environment Agency



Estimate of cost-efficiency for different bioenergy pathways



Sources: IEA, Heissenhuber, own calculations

Present CO₂-Mitigation cost
(approximate values)

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What public investments to make?

Developing a better basis for (policy) decisions:



- ❖ Development of suitable global data sets on land use and farming systems
- ❖ Consider the interactive impact of national policies on global resources
- ❖ Need to combine various analytical approaches & consider interactions between different sectors
- ❖ Create/maintain sufficient capacity for integrated analysis
- ❖ Knowledge transfer and extension to producers and stakeholders

European Environment Agency



Thank you for your attention !

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EUROPEAN COMMISSION
JOINT RESEARCH CENTRE (JRC)
Institute for Energy and Transport
Sustainable Transport Unit

Existing methodologies and best practices on assessing ILUC **Luisa Marelli – EC Joint Research Center**

Abstract

To respond to obligations from the Renewable Energy Directive (2009/28/EC) and the Fuel Quality Directive (2009/30/EC) to report on indirect land use change (ILUC), the Commission carried out a number of analytical exercises and various consultations with the wider community, and prepared an Impact Assessment to evaluate the impact of ILUC.

The purpose of this presentation is to explain the main outcomes of the Commission's reference studies included in the Impact Assessment, specifically focusing on modeling works and discussing uncertainties in the models.

During 2010 and 2011 the Commission mandated the International Food Policy Research Institute (IFPRI) to analyse the impact of the EU biofuels mandate and possible changes in EU biofuels trade policies on global agricultural production and the environmental performance (greenhouse gas emissions) of the EU biofuel policy, with the general equilibrium model MIRAGE.

Building on results of the economic model, GHG emissions from the estimated land use change were calculated by the JRC and by IFPRI with two different methodologies, showing that emissions induced by increased land demand are relevant (36 gCO₂/MJ from JRC analysis in the scenario where projections from National Renewable Action Plans are assumed), and that in general ethanol crops have lower ILUC impacts than oilseeds/biodiesel crops. IFPRI and JRC methodologies gave similar results.

To better understand how different models calculate increased land use change due to biofuels policies, the JRC launched in 2010 a survey committing various agro-economic modelers to work out net crop area changes due to similar biofuel scenarios. For each model, the JRC worked out how increased crop demand is made up of contributions from increase in yield, credits from by-products use and reduction in food and feed consumption.

Other "alternative" ILUC analysis (e.g. causal-descriptive modeling and historical approaches) carried out by various research groups will be also shortly presented.

Change of land use to grow biofuel crops may also result in other environmental impacts than GHG emissions. For example, according to a preliminary estimation of the JRC, land use changes to cropland will cause a decrease in the Mean Species Abundance values, which are indicators of losses in biodiversity.

Note on bioenergy, land use change and climate change mitigation

Bioenergy projects can lead to direct and indirect land use change (LUC), which can affect greenhouse gas (GHG) balances with both beneficial and adverse outcomes for bioenergy's contribution to climate change mitigation. The effects are difficult to quantify with high confidence, especially those associated with indirect LUC. Achieving a consensus on the extent of the effects is unlikely in the near future. Long-rotation forest management represents a special case, which is associated with carbon emissions and sequestration that take place at different times during the forest rotation. This leads to mitigation trade-offs between biomass extraction for energy use and the alternative to leave the biomass in the forest, where the carbon in the biomass is emitted later as the biomass decays.

So far, studies of bioenergy and LUC have primarily been concerned with the contribution of specific bioenergy projects/products (primarily biofuels for transport) to near term GHG targets. LCA and economic equilibrium modelling are commonly used tools. LCA studies are useful for comparing products and for identifying improvement options in production processes. Economic equilibrium modelling advances our understanding of complex system dynamics by indicating how small changes in conditions influence a system in a state of equilibrium (e.g., the effect of higher fertilizer prices on agriculture activities).

However, project level evaluations that use a relatively short time horizon and narrow spatial perspective are insufficient basis for developing guiding principles for bioenergy.

The contribution of bioenergy to climate change mitigation needs to be evaluated from many points of view reflecting a balance between near-term targets and the long-term objective to hold the increase in global temperature below 2°C. There is otherwise a risk that the development of policies and incentives structures creates a situation where the most economically rational way of managing land is very different from how land management is best developed in response to prospective demand for food, bioenergy and other biomass products considering the ultimate requirements of a far reaching energy system transformation. Adding landscape level considerations to complement project level indicators and metrics is one important step, but also additional perspectives are needed.

Recent years' bioenergy-LUC debate has reflected little on the fact that near term GHG targets are only means for inducing energy system transformation towards meeting longer-term stabilization objectives. It is clear that mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. But ***the effectiveness of near term mitigation efforts cannot be evaluated only in terms of their immediate GHG savings.***

Given the long lifetime of energy infrastructure – leading to that the present day investments into the energy systems have implications for GHG emissions several decades into the future – ***it is essential to investigate how mitigation strategies shape development in the energy sector.***

The concept of ‘GHG emissions space’, which focuses on accumulated emissions up to a given year, is relevant in relation to temperature targets since the peak warming appears to be insensitive to the CO₂ emissions pathway, i.e., timing of emissions or peak emission rate. Depending on the atmospheric lifetime of specific GHGs the trade off between emitting more now and less in the future is not one to one in general. But the relationship for CO₂ – the major component in LUC emissions – is practically one to one, so that one additional (less) ton CO₂ emitted today requires that one have to reduce (can increase) future CO₂ emissions by one ton. The reason for this is the close to irreversible climate effect of CO₂ emissions.

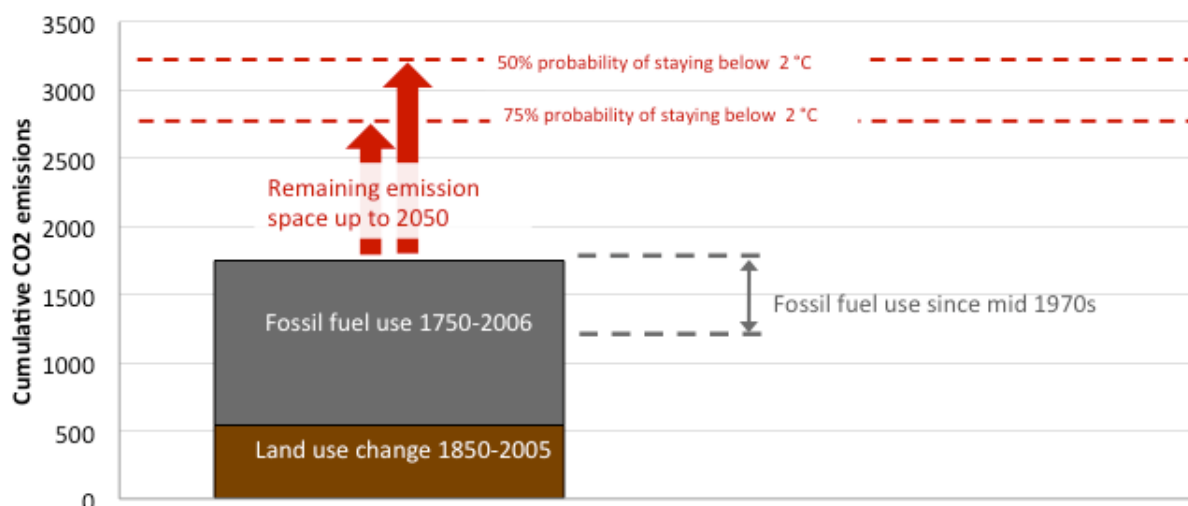


Figure 1. Cumulative CO₂ emissions and indicative remaining emission space in relation to 2°C target. Source: IEA Bioenergy ExCo:2010:03.

Thus, from the perspective of temperature targets and GHG emission space, the exact shape of C fluctuations associated with bioenergy systems is not relevant. For example, it does not matter whether carbon in forest residues is emitted to the atmosphere early after the forestry operations take place (such as when used for energy) or is emitted some decades after the forestry operations (such as when the residues are left in the forest to decay). What matters is whether forest bioenergy systems are part of a changed forest management paradigm that results in systematic decreases or increases in the forest carbon stocks. If such changes in carbon stocks would occur, they need to be considered in evaluations of forest management strategies that are developed in response to climate and energy policies.

At present, fossil energy infrastructure is expanding rapidly around the world, and given the typical lifetime of many decades for fossil energy plants this implies considerable claims for future GHG emission space. The recent years' bioenergy-LUC debate has paid too little attention to the question how promotion of bioenergy affects the larger development of energy- and associated systems, i.e., the rate at which coal power plants are built to meet the growing electricity demand, directions and size of investments (R&D into coal based liquid fuels and unconventional oil vs. bioenergy vs. other renewables), and institutional capacity building, policy development, and learning in relevant areas – including land management and the protection of natural ecosystems.

Bioenergy and its influence on carbon flows need to be evaluated within this larger context of energy system transformation and adaptation in agriculture and forestry to a prospective situation where bioenergy and other renewable energy sources contribute a substantial part of the primary energy supply – and where climate change also influences the conditions for biomass production.

One critical strategic question is how society should make use of the remaining allowable 'space' for GHG in the atmosphere. To some extent, the establishment of new energy technologies and associated infrastructure will in itself occupy part of the remaining space for GHG emissions. For example, electric vehicle fleets will contribute to increasing atmospheric CO₂ levels as long as electricity is mainly generated from fossil fuels (although, they may cause lower GHG emissions than present gasoline and diesel vehicles). Yet, promotion of electric vehicles can be justified because they can provide efficient transport services that cause low GHG emissions in a future situation when electricity is less reliant on fossil fuels.

Similarly – ***in view of the long-term benefit of bioenergy – it may be found attractive to use part of the GHG emission space for developing a bioenergy industry capable of providing renewable and climate friendly energy services for the world in the long-term.*** Furthermore, possible LUC emissions associated with bioenergy expansion will decrease over time as above ground biomass and soil C stabilize at new equilibrium levels, and also other GHG emissions decrease as conversion technologies improve and use renewable process fuel, and feedstock production systems develop into less GHG intensive systems. Should Carbon Capture and Storage (CCS) technologies become available for large scale implementation, bioenergy is currently the only energy technology that, combined with CCS, allows net removal of CO₂ from the atmosphere, making it pivotal for achieving ambitious climate protection targets should the peak in GHG emissions occur late.

There are certainly many other reasons for protecting soils and natural vegetation than the desire to avoid GHG emissions, and these may have become too little considered when LUC impacts are considered.

Future LUC rates will depend on the willingness of national governments to protect forests and other natural ecosystems – and the effectiveness of legislation and other measures to reduce deforestation. ***Strict focus on the climate benefits of ecosystem preservation may put undue pressure on valuable ecosystems that have a relatively low carbon density.*** While this may have a small impact in terms of climate change mitigation, it may impact negatively on, e.g., biodiversity and water tables. Similarly, soil carbon losses associated with land use may have limited influence on GHG balances but might be a large concern in relation to soil productivity. In fact, research results indicate that the pricing of carbon from LUC emissions may not even be sufficient to protect forests with relatively high carbon density, since forest conversion to bioenergy plantations may remain profitable due to that the price of bioenergy increases along with the carbon prices.

Policy measures implemented to minimize negative impacts of LUC should be predictable and based on a holistic perspective recognizing bioenergy's strong interconnectedness with food and fibre, and the multiple drivers and consequences of LUC. They need to acknowledge that LUC for bioenergy can lead to positive effects, that LUC claimed to be indirectly associated with bioenergy has a direct cause that can be addressed, and also that the conversion of some natural ecosystems into high-yielding plantations might in some places represent an attractive response to climate change concerns, despite leading to near-term LUC impacts.

Better models and more data will help advance our understanding of complex interactions behind land use change, but will not produce the definite answer to the question “how much GHG emissions are associated with a certain type of biofuel?”

EXECUTIVE SUMMARY

The major opportunities to reduce fossil CO₂ emissions involve improving the efficiency with which energy is used and making the transition to alternative sources of energy and materials. These include increasing the sustainable use of biomass for the production of biomaterials, heat and power, and for transport. Two recent reports – IEA Bioenergy (2009a) and IEA RETD and IEA Bioenergy (2010) concluded that, when responsibly developed, bioenergy can make an important contribution to energy and climate policy, and can also contribute to social and economic development objectives. Even so, there is still an ongoing discussion about the role of sustainable bioenergy in the future. This concerns both environmental and socio-economic aspects, and involves a wide set of issues and many contrasting viewpoints.

This report discusses one much-debated issue, the connection between bioenergy and land use change (LUC) and especially whether there is a risk that greenhouse gas (GHG) emissions associated with LUC could significantly undermine the climate change mitigation benefits of bioenergy, and how this risk can be minimised.

Bioenergy's contribution to climate change mitigation needs to reflect a balance between near term GHG targets and the long-term objective to hold the increase in global temperature below 2°C (Copenhagen Accord). Sound bioenergy development requires adequate and transparent criteria that can be applied in a robust, predictable way. Incentives should discourage systematic decreases in biospheric carbon stocks while encouraging the sustainable use of biomass to substitute fossil fuels instead of decaying unutilised.

There are a number of options that society can choose to ensure that the benefits of bioenergy can be realised while taking into account LUC issues. These are:

- Promote only bioenergy options that meet set requirements with respect to LUC, e.g. use bioenergy which is certified to have avoided undesirable LUC, or met target GHG reduction thresholds when LUC is taken into account.
- Assign a certain level of LUC emissions to bioenergy options, depending on their land use replacement. It might be advisable to allow producers who are close to eligibility requirements to acquire and retire emission rights as a way of complying with the requirements rather than exclude them from the market, or allow other 'offsets'.
- Support development of bioenergy options that have smaller LUC risks, such as biomass production on degraded or other marginal lands, integrated biomass/food/feed production, and the use of residues, waste and bioenergy plants that can avoid competition for prime cropland.
- Shape GHG accounting policies to encourage low-LUC bioenergy. For example, carbon neutral status could be applied only to bioenergy produced and consumed in countries that include LUC and forest management emissions/removals in GHG accounting.
- Promote an integrated and international approach among energy, agriculture, and development policies to stimulate much-needed agricultural productivity increases in the developing world.

- Promote climate friendly alternatives in addition to bioenergy, although this may be a particular challenge in the transport sector where it is likely to be some decades before such alternatives become established on a substantial scale.

Depending on their implementation, the above options for addressing bioenergy-driven LUC may not be able to avoid indirect GHG emissions completely, due to the interconnectedness of the agricultural and forestry systems. In the longer term, a global GHG emissions cap that regulates both fossil and biospheric carbon emissions could be one option providing flexibility. Countries may then decide to use a certain share of their permitted emission space to develop a bioenergy industry to secure long-term domestic energy supply, or to generate export revenues.

While emissions from LUC can be significant in some circumstances, the simple notion of LUC emissions is not sufficient reason to exclude bioenergy from the list of worthwhile technologies for climate change mitigation. Sound bioenergy development requires simple and transparent criteria that can be applied in a robust and predictable way. Policy measures implemented to minimise the negative impacts of LUC should be based on a holistic perspective recognising the multiple drivers and effects of LUC, and taking into account the dynamics of both energy and climate systems.

Climate Change Mitigation

The GHG savings associated with specific bioenergy options depend on what fossil fuels they are replacing, the geographical location, and the design of the bioenergy system. The precise quantification of GHG savings for specific systems is often hampered by lack of reliable empirical data. Furthermore, alternative methods of quantification lead to variation in estimates of GHG savings.

Nonetheless, it is possible to conclude that practically all bioenergy systems deliver large GHG savings if they replace fossil-based energy causing high GHG emissions and if the bioenergy production emissions – including those arising due to LUC – are kept low. Efficient fertiliser strategies (minimising emissions of N₂O, which contributes to global warming) and the minimisation of GHG emissions from the biomass conversion process are essential.

Land Use Change

Changes in land use, principally those associated with deforestation and expansion of agricultural production for food, contribute about 15% of global emissions of GHG. Currently, less than 1% of global agricultural land is used for cultivating biofuel crops and LUC associated with bioenergy represents a very small percentage of overall changes in land use. However, given that reducing emissions is one important driver for bioenergy, policy makers are understandably concerned that the impacts of LUC are properly taken into account when planting more energy crops is being contemplated or incentivised.

Bioenergy projects can lead to both direct and indirect LUC.

- Direct LUC (dLUC) involves changes in land use on the site used for bioenergy feedstock production, such as the change from food or fibre production (including changes in crop rotation patterns, conversion of pasture land, and changes in forest management) or the conversion of natural ecosystems.
- Indirect LUC (iLUC) refers to the changes in land use that take place elsewhere as a consequence of the bioenergy project. For example, displaced food producers may re-establish their operations elsewhere by converting natural ecosystems to agriculture land, or due to macro-economic factors, the agriculture area may expand to compensate for the losses in food/fibre production caused by the bioenergy project. A wide definition of iLUC can include changes in crop rotation patterns and/or intensification on land used for food or feed production.

LUC can affect GHG emissions in a number of ways, for example:

- when biomass is burned in the field during land clearing;
- when the land management practice is changed so that the carbon stocks in soils and vegetation change;
- when changes in the intensity of land use lead to changes in GHG emissions, in particular N₂O emissions due to fertiliser use; and
- when LUC results in changes in rates of carbon sequestration, i.e. the CO₂ assimilation of the land may become lower or higher than would have been the case in the absence of LUC.

The impacts of these changes can increase the net GHG emissions (for example when land with large carbon stocks is brought into cultivation) or have a beneficial outcome (for example when perennial crops replace annual crops grown with high fertiliser levels, or where energy crops are developed on marginal lands with carbon-poor soils).

LUC may also influence the extent to which the land surface reflects incoming sunlight. This reflectance is referred to as albedo. Such changes in albedo may influence global warming. In regions with seasonal snow cover or a seasonal dry period (e.g. savannas), reduction in albedo due to the introduction of perennial green vegetative cover can counteract the climate change mitigation benefit of bioenergy. Conversely, albedo increases associated with the conversion of forests to energy crops (e.g. annual crops and grasses) may counter the global warming effect of CO₂ emissions from the deforestation.

Bioenergy does not always entail LUC. The use of post-consumer organic residues and by-products from the agricultural and forest industries does not cause LUC if these biomass sources are wastes, i.e. were not utilised for alternative purposes. Biomass that is burned – such as straw on fields or natural vegetation during forest clearing – are obvious examples. The use of biomass that would otherwise be landfilled, or decompose in wet conditions, can also lead to additional benefits through reduced methane emissions. If not utilised for bioenergy, some biomass sources (e.g. harvest residues left in the forest) would retain organic carbon for a longer time than if used for energy. This difference in timing of emissions can be considered a disbenefit for bioenergy in

evaluations which only use a short-time horizon and also a relevant factor in longer term accounting in regions where biomass degradation is slow.

Bioenergy feedstocks can be produced in combination with food and fibre, avoiding land use displacement. The targeting of unused marginal and degraded lands can also mitigate LUC emissions associated with bioenergy expansion. Wisely designed, located, and managed bioenergy plantations can improve the productive use of land and can provide benefits in addition to GHG savings, such as reduced erosion, reduced eutrophication, improved biodiversity, and improved socioeconomic conditions in the areas where bioenergy production expands.

One promising way of reducing emissions from LUC is to increase the amount of lignocellulosic feedstocks for bioenergy that are grown on low carbon pasture land less suitable for annual crops, thereby decreasing the pressure on prime cropping land. Since the production of lignocellulosic feedstocks commonly requires less fuel, fertiliser and other inputs, there is also scope for higher GHG savings than when biofuels are produced from conventional crops such as cereals and sugar beet. However, a mix of lignocellulosic material and conventional food/feed crops is likely to be used as bioenergy feedstocks during the coming decades to supply biofuels and the heat and power markets. Strategies to increase agricultural productivity, especially in developing countries, will be critical to minimising LUC impacts. In general, stimulation of increased productivity in all forms of land use reduces the LUC pressure.

Effects of Land Use Change on Greenhouse Gas Savings

The GHG effects of LUC are difficult to quantify with precision in relation to a specific bioenergy project, particularly for iLUC where the causes are often multiple, complex, interlinked and change over time. Despite the significant uncertainties involved in the quantification of LUC effects of a specific bioenergy project, it can be concluded that LUC can significantly influence the climate change mitigation benefit of bioenergy – in both positive and negative directions.

Some bioenergy projects cause very large LUC emissions and these will not contribute positively to climate change mitigation within relevant time horizons. The clear-felling and drainage of peat swamp forests to establish oil palm plantations is one example. On the other hand, the establishment of bioenergy plantations can also lead to assimilation of CO₂ into biomass and soils, and this enhances mitigation benefits. One example is the reforestation of degraded land that has carbon-depleted soils and sparse vegetation. An additional benefit in this case is that the soil quality, and therefore productivity, can improve over time given appropriate plant selection and land management.

When bioenergy expansion causes increases in LUC emissions, the negative impact is usually greatest in the near term and the cumulative net GHG savings then improve over time as the savings from fossil fuel replacement accumulate.

The overall net emissions savings may therefore be subject to a time lag, and this needs to be taken into account in considering the role of biofuels, for example, as one of the few near term options for climate change mitigation in the transport sector. However, biofuels can be considered a useful measure to reduce GHG emissions even if net savings are not always instantly achievable. Their long-term contribution can become especially important in a scenario where the alternative is to produce transport fuels based on unconventional oil and coal, without employing carbon capture and storage (CCS) technologies. Furthermore, meeting ambitious climate targets will also require climate-friendly fuels in air and marine transport where no alternative to biofuels is currently available.

Bioenergy's Contribution to Climate Stabilisation

Climate targets set limits on future GHG emissions. In order to stabilise the concentration of GHGs in the atmosphere, emissions need to peak and decline thereafter. Many different emission trajectories are compatible with a given stabilisation target. Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilisation levels. Drastic changes in the global energy system are needed. However, the establishment of the required new energy technologies and associated infrastructure will in itself lead to GHG emissions, implying that a portion of the 'emission space' allowed within the GHG target will need to be 'invested' for energy system transformation. For example, electric vehicle fleets may contribute to increasing atmospheric CO₂ levels as long as electricity is mainly generated from fossil fuels. However, promotion of electric vehicles can be justified because they will be able to provide efficient transport services that cause low GHG emissions if nations can overcome the challenge of modifying their electricity matrix towards cleaner energy sources, relying less on fossil fuels.

Similarly, some level of LUC emissions associated with bioenergy expansion may be an acceptable *temporary* consequence of the establishment of an industry capable of providing long-term renewable and climate-friendly energy services for the world. The GHG emissions associated with bioenergy will decrease over time as above-ground biomass and soil carbon stabilise at new equilibrium levels, conversion technologies improve and use renewable sources for process fuel, and feedstock production systems become less GHG-intensive. Should CCS technologies become available, bioenergy is the only currently available energy technology that – combined with CCS – allows net removal of CO₂ from the atmosphere, making it pivotal for achieving ambitious climate protection targets should the peak in GHG emissions occur late.

Bioenergy and Land Use Change in a Wider Context

Climate change mitigation is not the only issue that needs to be considered when assessing the merits of bioenergy.

Other important aspects include security of energy supply, job creation and income generation, and consequences for biodiversity, water, and soils. Also, it is important to note that climate change mitigation is just one of many rationales for ecosystem protection. Measures to reduce emissions due to LUC may encourage LUC on low-carbon stock lands, such as natural grasslands. While this may have a small impact in terms of climate change mitigation, it may impact negatively on biodiversity and water tables. Land owners may also see a net profit from converting relatively high-carbon stock land to high productivity bioenergy plantations even if this incurs additional carbon payment costs due to initial LUC.

As stated above, improving agricultural productivity is an important way of reducing LUC pressure. But minimising future LUC rates will also depend on the establishment of sustainable land use practices when agriculture expands into new areas. In some places removal of natural vegetation to establish agriculture leads to only short-term benefits, which are followed by land degradation and low productivity, in turn leading to the need for further land conversion. The application of established best practice and mixed production systems can sustainably increase land productivity. These measures are not applied in many developing countries at present because of a lack of information dissemination, capacity building, and access to capital and markets. Economic pressure to maximise short-term returns may also make landholders in industrialised countries reluctant to apply sustainable techniques that would result in a short-term yield penalty.

As has been described above, bioenergy production interacts with food and forestry production in complex ways. It can compete for land, water and other resources but can also strengthen conventional food and forestry production by offering new markets for biomass flows that earlier were considered waste products. Bioenergy demand can provide opportunities for cultivating new types of crops and integration of bioenergy production with food and forestry production in ways that improve overall resource management. It can also lead to over exploitation and degradation of resources.

Bioenergy development ultimately depends on the priority of bioenergy products versus other products obtained from land – notably food and conventional forest products – and on how much biomass can be mobilised in total from agriculture and forestry. This in turn depends on natural factors (e.g. climate, soils, and topography) and on agronomic and forestry practices employed to produce the biomass, as well as how society understands and prioritises nature conservation and soil/water/biodiversity protection and how the production systems are shaped to reflect these priorities.

Q&A - Biofuels:

Dealing with indirect land use change (ILUC)

Update: October 2011

Why is the EU reviewing its biofuels policy?

Under the terms of the Renewable Energy Directive (RED), EU member states are required to source 10% of transport energy from renewable sources, mainly biofuels, by 2020. The RED includes 'sustainability criteria' that dictate the minimum CO₂ savings biofuels should achieve relative to fossil fuels in order to qualify for the scheme (and receive state subsidies). These criteria account only for the emissions that occur when land is converted specifically to grow biofuel crops (direct land use change). However it does not currently contain measures to calculate the impact of indirect land use change (ILUC). The law states that the European Commission must investigate and propose a way of dealing with the ILUC problem by the end of 2010, a deadline that has obviously passed.

What is ILUC?

The production of biofuels can indirectly cause additional deforestation and land conversion. When existing agricultural land is turned over to biofuel production, agriculture has to expand elsewhere to meet the existing (and ever-growing) demand for crops for food and feed. This expansion happens at the expense of forests, grasslands, peat lands, wetlands, and other carbon rich ecosystems. This results in substantial increases in greenhouse gas (GHG) emissions from the soil and removed vegetation.

What is at stake?

EU targets for biofuels, along with generous national subsidies, have helped create an industry worth €17bn a year in Europe alone. Many of these biofuels would no longer pass criteria for GHG savings if the emissions calculation methodology accounted for ILUC. Farmers who grow biofuel crops, and biofuels companies who process and distribute them, have been urging the EU to ignore the problem. But failing to address ILUC now will mean the EU's flagship renewables policy will end up making climate change worse and billions of Euros will be wasted. An area of additional land

twice the size of Belgium will be cleared, most likely in the developing world, to grow the lost food crops¹. Development groups such as Oxfam have warned of devastating impacts on poor communities in the developing world².

Is there a scientific consensus that ILUC is a real problem?

Numerous scientific and public bodies agree that ILUC is real and should be accounted for when calculating the emissions savings (or not) from biofuels. The list could hardly be more venerable, it includes the Joint Research Centre of the European Commission (JRC); the European Environment Agency; the International Food Policy Research Institute (IFPRI); the Renewable Fuels Agency, UK; the Netherlands Commission on Sustainability Issues concerning Biomass (CDB); the German Advisory Council Global Change (WBGU); the Food and Agriculture Organization of the United Nations (FAO); the United Nations Environment Programme; the Scientific Committee on Problems of the Environment (SCOPE); Oeko-Institut; the Smith School of Enterprise and the Environment; the California Air Resources Board and the US Environmental Protection Agency³

The European Commission has ordered five separate studies of its own and consulted extensively with scientists who also agreed that ILUC is a problem, and separate ILUC CO₂ 'factors' for each type of biofuel crop would be the best way of accounting for the issue when calculating the overall emissions from biofuels.

Is the industry against including ILUC emissions?

The industry is divided. Producers of biofuels that score badly on ILUC argue the science is uncertain, while producers of those that score well have indicated that they could support the inclusion of ILUC emissions⁴.

¹ See IEEP report briefing

² See Oxfam report

³ See T&E briefing on scientific reports on ILUC

⁴ See Reuters news story

Are biofuels being unfairly targetted?

It is worth remembering that the amount of biofuel used in Europe is mandated by law and the fuels themselves are often subsidised with public money, with climate being one of the key arguments. Many things people do have an impact on the climate. Eating beef is one example. But the difference between beef and biofuels is that the EU has not passed a law that forces everyone to get 10% of their calories from eating beef. If the EU has climate change laws to promote specific products, these products have to be sound.

Shouldn't the EU be targetting all types of transport fuel ?

It is. Article 7a of the Fuel Quality Directive, agreed at the same time as the RED, says emissions from the production of all transport fuels should be reduced by 6% by 2020. Though that law is also proving controversial to implement as the Canadian government objects to a higher carbon value for tar sands when accounting for the climate impact of fossil fuels.

What does the latest science on ILUC for the European Commission say?

The European Commission's Trade department requested a new study by the International Food Policy Research Institute (IFPRI) in order to assess the impact of various policy options for dealing with ILUC. That study was eventually published on 18 October 2011⁵.

Compared to previous studies carried out for the European Commission and by other bodies, the study's conclusions are conservative, estimating ILUC impacts to be considerably lower than other studies have suggested. Nevertheless, the IFPRI conclude that "emissions related to land use changes driven by biofuels policies are a serious concern". It also says that biofuels in terms of environmental benefits "may not be the best tool to achieve initial (climate) targets".

The IFPRI also suggest ILUC factors for different biofuel crops, for example the CO₂ impact of ILUC caused by sugar beet derived biofuel is listed as 7gCO₂e/M (equivalent to 7 grammes of additional CO₂ emissions for every megajoule of biofuel energy produced). The figure for palm oil derived biofuels is given as 54gCO₂e/MJ.

⁵ [See DG Trade website](#)

What is the European Commission's current position on ILUC?

Officially the EU has not yet taken a decision on how it will tackle the problem. But leaked minutes of a high-level meeting in July⁶ suggested that the Commission plans to raise the overall greenhouse gas threshold for biofuels without tackling ILUC head-on. In fact, there is no causal link between direct and indirect emissions and according to the scientific committee of the European Environment Agency such a move would make matters worse⁷.

Postponing action on ILUC itself, as that meeting also agreed, would compound the uncertainty and investment freeze the biofuels industry in Europe is currently experiencing.

What should the EU do?

In light of the wide body of research on likely ILUC impacts and the existing legislative mandate, the Commission should publish a proposal that would account for the full climate impact of biofuels, including the emissions resulting from indirect land use change. The policy should be fixed by introducing feedstock-specific 'ILUC factors' that reflect emissions from indirect land use change for different types of biofuel crops. The Commission should review these factors periodically, revising them as necessary in order to reflect the best available scientific evidence.

The practical effect of introducing ILUC factors is to promote biofuels that use little or no valuable land and effectively reduce GHG emissions compared to fossil fuels. This would ensure that the original policy objective for EU biofuels policy – to mitigate climate change – can be upheld, and makes investment in truly low carbon solutions much more secure.

www.transportenvironment.org/low-carbon-fuels

⁶ [See Reuters news story](#)

⁷ [See EEA scientific committee report](#)

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