Briefing: the science of biofuels and indirect land use change

September 2010

Context

In December 2008 the EU adopted a new biofuels policy as part of the Renewable Energy Directive (RED) and the revised Fuel Quality Directive (FQD). Both directives contain targets that will drive the development of biofuels and a set of sustainability criteria that biofuels must adhere to in order to be counted as contributing towards the targets. However, there is an important loophole: emissions resulting from indirect land use change (ILUC) remain unaccounted for in the emissions calculations.

What is ILUC?

Biofuel mandates cause increased demand for agricultural land as food crops are displaced to grow fuel feedstocks. Where rainforests are cut down or peatlands drained for agriculture, the emissions can be huge. An accurate measure of the sustainability of biofuels must account for ILUC.

At the time when the RED and FQD directives were being negotiated, many scientific reports were already indicating that ILUC due to increased biofuel production has a high potential to outweigh any GHG benefits from the use of biofuels. Since the laws were passed, scientific evidence has accumulated further. ILUC emissions can no longer be ignored.

The European Commission will have to report on ILUC and suggest an appropriate way of dealing with this issue by the end of 2010.

This briefing brings together the findings of a number of major reports on biofuels that examine the issue of ILUC and GHG emissions calculations for Biofuels. Drawing from a large amount of scientific evidence, it shows that a legislative proposal to account for ILUC in the emissions calculations is timely and appropriate.

EU-funded studies

Joint Research Centre of the European Commission (JRC)

"Indirect land use change could potentially release enough greenhouse gas to negate the savings from conventional EU biofuels."

De Santi, G. et al (ed.) (2008): Biofuels in the European Context: Facts and Uncertainties. JRC, European Commission
ec.europa.eu/dgs/jrc/downloads/jrc_biofuels_report.pdf

"Some people may view ILUC as a secondary effect of biofuel production, but it is really a critical component of answering the question of whether diverting the photosynthetic capacity of land to biofuels from its present use results in greenhouse gas reductions or not."

Edwards, R. et al (2010): Indirect Land Use Change from increased biofuels demand. JRC, European Commission
http://re.jrc.ec.europa.eu/bf-tp/download/ILUC_modelling_comparison.pdf

International Food Policy Research Institute (IFPRI)

"Simulations for EU biofuels consumption above 5.6% of road transport fuels show that ILUC emissions can rapidly increase and erode the environmental sustainability of biofuels."

Al-Riffai, P. et al (2010): Global Trade and Environmental Impact Study of the EU Biofuels Mandate. IFPRI study for DG TRADE
http://www.ifpri.org/sites/default/files/publications/biofuelsreportec.pdf

European Environment Agency (EEA)

"Further expansion of bioenergy production may cause direct adverse effects on the environment and indirect effects due to displacement effects (changes and shifts in land-use, e.g. from grassland to arable land). These direct and indirect effects may undermine an important goal society is trying to achieve with the use of bioenergy — reducing greenhouse gas emissions — and jeopardise the

achievement of other environmental goals, such as the protection of biodiversity and water resources."

"This matters as indirect land-use change, in particular deforestation, affects the overall greenhouse balance of bioenergy production (Fargione et al., 2008; MNP, 2008). Deforestation and associated land-use change were responsible for about 17 % of global greenhouse gas emissions in 2004 (IPCC, 2007). In fact, deforestation is a more important factor at the global level than emissions from transport (Stern, 2006)."

"Future revisions of the EEA 2006 modelling work should therefore address potential indirect effects of EU bioenergy production and consumption, in particular on land use."

EEA Technical Report (2008): Maximising the environmental benefits of Europe's bioenergy potential. European Environment Agency reports.eea.europa.eu/technical_report_2008_10/en/Bioenergy_Potential.pdf

AEA Group

"The most important message from the modelling steps are that direct and indirect land use changes play a very important role for assessing GHG emission reductions with a significant impact for the ex-post evaluation of the Directive itself."

AEA (2009): Quantification of the effects on greenhouse gas emissions of policies and measures. Annex 1: Examination of land-use change on emissions savings [unpublished annex]

Government advisory bodies

Renewable Fuels Agency, UK

"…current greenhouse gas lifecycle analysis fails to take account of either indirect land change or avoided land use from co-products. Failing to include these factors may create perverse incentives which lead to higher greenhouse gas emissions by encouraging feedstocks that lead to higher net land use."

"The balance of evidence shows a significant risk that current [biofuel] policies will lead to net greenhouse gas emissions."

Gallagher, E.et al (2008): The Gallagher Review of the Indirect Effects of Biofuel Production, Renewable Fuels Agency www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf

Netherlands Environmental Assessment Agency (PBL)

"Even with emission reductions of 35 or even 60% (criteria for direct emissions in the EU-Directive for biofuels), model calculations indicate that it would take several hundreds of years to compensate for the short term direct biodiversity loss due to the conversion of natural area for the energy crop."

Kos, J.P.M. et al (2010): Identifying the indirect effects of bio-energy production. http://www.pbl.nl/en/publications/2010/Identifying-the-indirect-effects-of-bio-energy-production.html

Netherlands Commission on Sustainability Issues concerning Biomass (CDB)

"...indirect land use change effects are real and must therefore figure in biofuel and bioenergy policy. Doing nothing is clearly not an option, as the unintended indirect consequences (threats) of incentives for energy crops are too serious."

"By including the ILUC value in the greenhouse gas balance sheet, inefficient energy crops are ruled out and the maximum utilisation of residual flows and by-products is encouraged. This will cause productivity to rise and investments in efficiency to increase."

CDB (2009): Make agriculture part of the solution! - Recommendation on Indirect Land Use Change (ILUC) http://www.corbey.nl/includes/download.asp?media_id=585

German Advisory Council on Global Change (WBGU)

"From the point of view of climate change mitigation the first-generation biofuels (such as biodiesel from rape or bioethanol from maize), which involve the cultivation of temperate, annual crops on agricultural land, score very badly. When emissions from indirect land-use changes are taken into account, they frequently result in higher emissions than would arise from the use of fossil fuels."

"WBGU considers emissions from indirect land-use change to be an indispensable part of any appraisal of the climate change mitigation effect of bioenergy use. Although research on the quantification of such emissions has only just started, it is necessary to produce quantitative estimates of these effects even today. WBGU therefore proposes using the iLUC factor (50 per cent) (...) for standard-setting (...), while adjusting it in future in line with new scientific findings."

"In all pathways for liquid fuels in the transport sector, the analysis shows that if energy crops are deployed whose cultivation leads to indirect land-use changes the emissions balance is even negative, i.e. emissions are higher than they would be if fossil fuels were used."

Schubert, R. et al (2009): Future Bioenergy and Sustainable Land Use. London: Earthscan.

International institutions

Food and Agriculture Organization of the United Nations

"Some biofuels may, under certain conditions, help reduce greenhouse gas emissions. In practice, however, the global effects of an expansion of biofuel production will depend crucially on where and how the feedstocks are produced. Land-use change resulting from increased feedstock production is a key determining factor. For many locations, emissions from land-use change – whether direct or indirect – are likely to exceed, or at least offset, much of the greenhouse gas savings obtained by using biofuels for transport. Moreover, even when biofuels are effective in reducing greenhouse gas emissions, they may not be the most cost-effective way of achieving this objective compared with other options."

"It must be ensured that further expansion of biofuel production will provide a positive contribution to climate-change mitigation. For this purpose, there is a critical need for an improved understanding of the effects of biofuels on land-use change, which is the source of the most significant effects on greenhouse gas emissions."

FAO (2008): The State of Food and Agriculture 2008 ftp.fao.org/docrep/fao/011/i0100e/i0100e.pdf

"EU palm oil imports have already doubled during the 2000-2006 period, mostly to substitute for rapeseed oil diverted from food to fuel uses."

Thoenes, P. (2006): Biofuels and Commodity Markets – Palm Oil Focus. Rome: FAO Commodities and Trade Division. www.rlc.fao.org/es/prioridades/bioenergia/pdf/commodity.pdf

United Nations Environment Programme (UNEP)

"Altogether, the land conversion for biofuel cropland could lead to significant GHG emissions. Even if abandoned land and pastures were mainly used, a global average of up to 10% biofuel use for transport would render the overall mitigation effect of the use of first-generation biofuels questionable."

Bringezu, S. et al (2009): Towards sustainable production and use of resources: Assessing Biofuels http://www.unep.fr/scp/rpanel/pdf/assessing_biofuels_full_report.pdf

Scientific bodies / consultancies

Scientific Committee on Problems of the Environment (SCOPE)

"Recent studies on potential indirect land-use change identify and focus on a real concern, i.e. the risk that biofuel deployment could accelerate and worsen the current unsustainable trends of deforestation and depletion of natural resources in a framework of accelerated growing population, and food and feed demand."

"Recent studies (...) show that land-use conversion from native land-uses to biofuel crops lead consistently to significant GHG emissions and a negative carbon balance, or carbon-debt, for decades to centuries."

"According to the present assessment, the potential CO2 emission from land conversion to biofuel crops by growing first-generation biofuel crops is likely to be greater than the savings expected from the first thirty years of growing biofuel crops."

Howarth, R.W. and Bringezu, S. (eds) (2009): Biofuels: Environmental Consequences and Interactions with Changing Land Use. Proceedings of the SCOPE International Biofuels Project Rapid Assessment, 22-25 September 2008, Gummersbach Germany. Cornell University, Ithaca NY, USA. http://cip.cornell.edu/biofuels/

Oeko-Institut – Institute for Applied Ecology (OEKO)

"Disregarding how and in which quantitative figures the possible GHG emissions from ILUC are expressed, it should be noted that the EU RED scheme in its current format is, in comparison to the Californian LCFS, fundamentally flawed with regard to favoring low-ILUC risk biofuels"

Fritsche, U. R. et al (2010): The "iLUC Factor" as a Means to Hedge Risks of GHG Emissions http://www.oeko.de/oekodoc/1030/2010-082-en.pdf

Smith School of Enterprise and the Environment

"When land-use is taken into account, these first-generation biofuels have significantly higher GHG emissions than conventional fuels due to substantial biomass and soil carbon release if carbon-rich land such as forest is cleared to grow the feedstocks (so-called carbon debt). It could take decades or centuries to offset these upfront carbon emissions by substituting conventional fuels with biofuels. Furthermore, additional impacts could also include soil erosion and biodiversity loss."

"Conserving the existing forest and restoring forest on cropland not used for food production could achieve greater GHG mitigation than first-generation biofuels as well as additional environmental benefits."

King. D. (ed.) (2009): Future of Mobility Roadmap. Oxford: University of Oxford. http://www.smithschool.ox.ac.uk/wp-content/uploads/2010/02/Future_of_Mobility.pdf

US agencies

Californian Air Resource Board (CARB)

"ARB staff has concluded that the land use impacts of crop-based biofuels are significant and must be included in LCFS [California Low Carbon Fuel Standard] fuel carbon intensities. To exclude them would allow fuels with carbon intensities that are similar to gasoline and diesel fuel to function as low-carbon fuels under the LCFS. This would delay the development of truly low-carbon fuels and jeopardize the achievement of a 10 percent reduction in fuel carbon intensity by 2020."

CARB (2009): Proposed Regulation to Implement the Low Carbon Fuel Standard. Volume I. www.arb.ca.gov/fuels/lcfs/030409lcfs_isor_vol1.pdf

US Environmental Protection Agency (EPA)

"...it would be far less scientifically credible to ignore the effects of land use changes altogether than it is to use the best approach available to assess these known emissions sources."

"We believe that uncertainty in the effects and extent of land use changes is not a reason for not accounting for land use change emissions."

EPA (2009): Draft Regulatory Impact Analysis: Changes to Renewable Fuels Standard Program. www.epa.gov/orcdizux/renewablefuels/420d09001.pdf

Scientific publications

"Our model predicts that indirect land use will be responsible for substantially more carbon loss (up to twice as much) than direct land use; however, because of predicted increases in fertilizer use, nitrous oxide emissions will be more important than carbon losses themselves in terms of warming potential."

Melillo, J. et al (2009): Indirect Emissions from Biofuels: How Important? Science vol. 326, 4 December 2009 pp. 1397-1399 http://www.sciencemag.org/cgi/reprint/326/5958/1397.pdf

"policymakers would (...) be wise to assign emissions factors for ILUC that are high enough to provide a level of reasonable assurance that hoped for greenhouse gas reductions will be real."

Searchinger, T. (2010) Biofuels and the need for additional carbon. Environmental Research Letters 5 (2010) 024007. http://iopscience.iop.org/1748-9326/5/2/024007/fulltext

"Our results demonstrate that the net effect of biofuel production via clearing of carbon-rich habitats is to increase CO2 emissions for decades or centuries relative to fossil fuel use."

Fargione, J.; Hill, J.; Tilman, D.; Polasky, S., and Hawthorne, P., 2008. Land clearing and the biofuel carbon debt. Science, 29/02/2008, pp. 1235–1238 - www.sciencemag.org/cgi/content/abstract/319/5867/1235

"By using a worldwide agricultural model to estimate emissions from land-use change, we found that corn-based ethanol, instead of producing a 20% savings, nearly doubles greenhouse emissions over 30 years and increases greenhouse gases for 167 years. Biofuels from switchgrass, if grown on U.S. corn lands, increase emissions by 50%. This result raises concerns about large biofuel mandates and highlights the value of using waste products."

Searchinger, T. et al (2008): Use of U.S. Croplands for Biofuels Increases Greenhouse Gasses through Emissions from Land Use Change. Science, 08/02/2008, pp. 1238-1240 - www.sciencemag.org/cgi/content/abstract/1151861

Conclusions

The RED and FQD include a legislative mandate for the Commission to produce a proposal for including the emissions from indirect land use change. There is clearly an overwhelming body of scientific evidence revealing the appropriateness and the urgency of addressing these known but as yet unaccounted sources of GHG emissions. The Commission should therefore use the best available science to propose a robust ILUC factor, which is the only short and medium term measure that would send a market signal to biofuels producers and drive sustainable development of the industry.

Further information

www.transportenvironment.org/low-carbon-fuels