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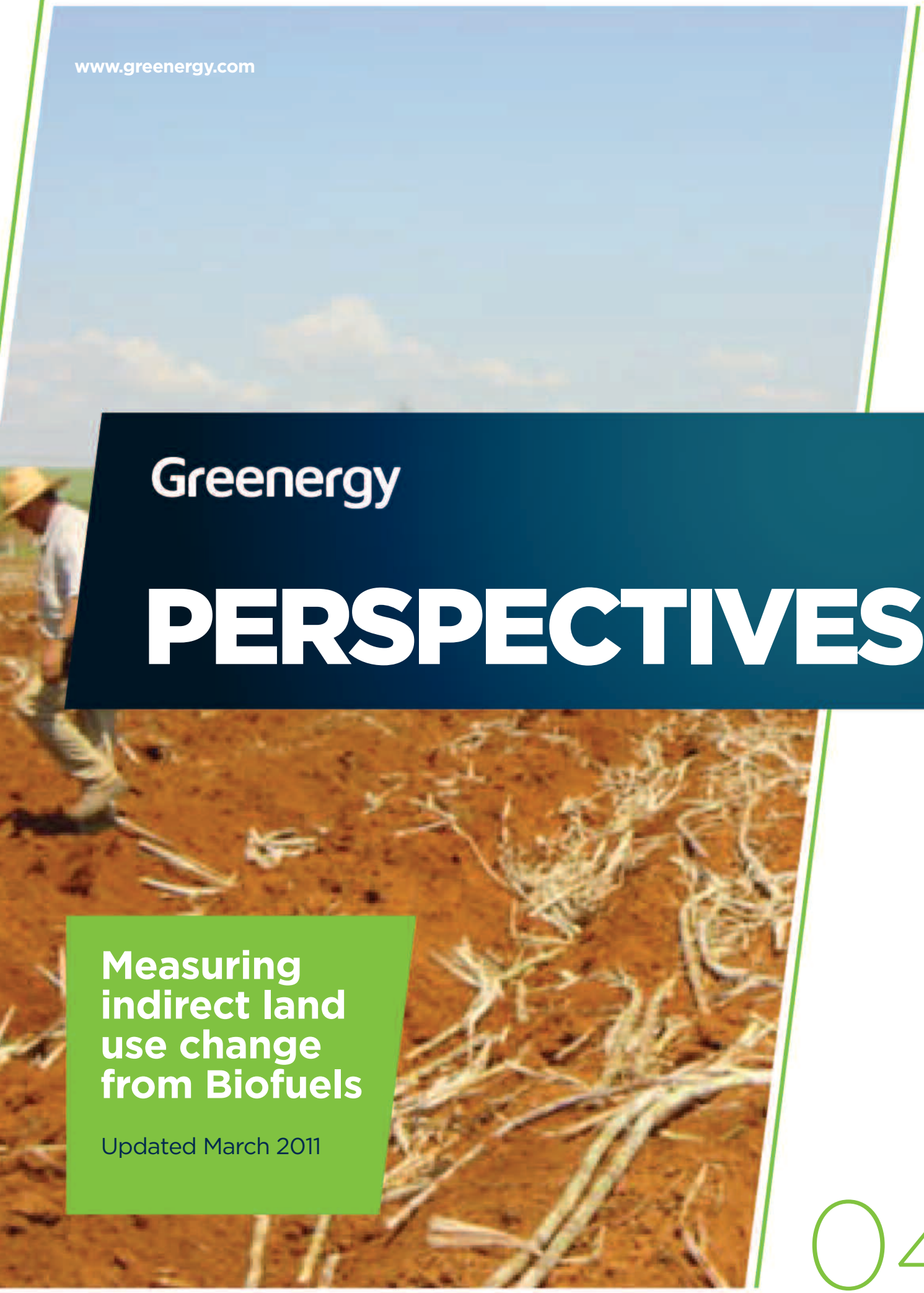
PERSPECTIVES



Measuring indirect land use change from Biofuels

Updated March 2011

04

Increased biofuel usage has the potential to cause greenhouse gas emissions from *Indirect* land use change (ILUC) if changing patterns of demand cause displacement of agricultural production onto previously uncultivated land. This Perspective discusses the uncertainties over quantifying ILUC emissions and the steps that Green*ergy* is taking to further understanding in this area.

Summary

Green*ergy* is a significant producer and supplier of petroleum and biofuels into the UK transport fuels market, supplying one fifth of the UK's overall petrol and diesel market and approximately one third of the biofuels market. Green*ergy* has extensive worldwide sourcing experience and manufacturing operations in the UK.

This Perspective presents the following:

- There is currently a debate on how to measure the greenhouse gas emissions resulting from indirect land use change that may occur when increased demand for biofuel crops displace other crops to new areas. Direct land use change emissions (when biofuels are grown on newly converted land) are already accounted for under in European law and the European Commission is currently evaluating whether ILUC emissions should also be included.

- Increased demand for agricultural products such as biofuels does not necessarily lead to direct or indirect land use change. There is substantial capacity to increase agricultural output by using land more productively, while also protecting carbon stored in vegetation and soil. For example, a significant decrease in the deforestation rate of Brazilian Amazon has coincided with a significant increase in biofuel production both nationally and internationally during the same period.

- Indirect land use change emissions for biofuels should be stated on the basis of actual measured land use change, looking at real data rather than complex and inherently uncertain economic forecasts of supply and demand.

- In a study of a 150 square mile area in Argentina, Green*ergy* has shown that it is possible to use satellite imagery to measure the greenhouse gas emissions associated with direct and indirect land use change. The methodology demonstrated in this study is more accurate than economic models which have been applied so far.

- Green*ergy* is now using satellite imagery in the development of BioCarbon Tracker, a web platform showing where carbon reserves are located, and which are most at risk from agricultural expansion. By presenting a "big picture" of land use change, BioCarbon Tracker will provide valuable input to the ILUC debate.

- Land use change needs to be understood as an ongoing phenomenon with many complex causes. Halting the use of biofuels will not prevent land use change.

1 Defining direct v. indirect land use change emissions

Perspective
Direct land use change emissions occur when biofuels are grown on newly converted land and are already accounted for under European law. There is now a debate on how to measure indirect land use change, occurring when increased demand for biofuel crops displace other crops to cause land use change.

If demand for agricultural output exceeds the capacity of an agricultural system to supply from within the productive area, some of that demand must be met from land use change (LUC). When newly demanded products, such as biofuel feedstocks, are grown on converted land this is described as direct land use change (DLUC) and is included in the carbon accounting procedure applying to all biofuels under the EU Renewable Energy Directive (see Perspective on Carbon Benefits of Biofuels).

However, if the production of newly demanded products on existing cropland displaces other agricultural activity to previously non-productive land this is described as indirect land use change (ILUC). The possible extent of ILUC, and the resulting GHG emissions that may occur as a result of additional demands for different crops in different regions is hotly debated.

A link between indirect land use change and biofuel production was first investigated by the US Environmental Defense Fund attorney Timothy Searchinger in 2008. He claimed that "higher prices triggered by biofuels will accelerate forest and grassland conversion (in Latin America) even if surplus croplands exist elsewhere"[1].

Searchinger suggested that the greenhouse gas emissions associated with bioethanol could be twice as bad as fossil fuel gasoline (when the hypothetical ILUC emissions are included). Although this claim has been contested within the scientific community, his findings have been widely cited by biofuel opponents.

1 http://www.sciencemag.org/content/319/5867/1238.abstract

2 Relationship between increased agricultural production and land use change

Perspective
Increased demand for agricultural products such as biofuels does not necessarily lead to land use change. There is substantial capacity to increase output by using land more productively while protecting carbon stored in vegetation and soil.

Considered at the level of regions, all agricultural systems have some level of capacity (carrying capacity) to increase output while avoiding LUC. This regional capacity will depend on a combination of factors that include:

- The base level of productivity relative to the productive potential;
- The cost of increasing yield through intensification relative to the cost of converting new land to agriculture;
- The rate of development of new crop cultivars and yield improving machinery;
- Laws and policies protecting high carbon stock land; and
- The relationship between livestock and arable cropping sectors.

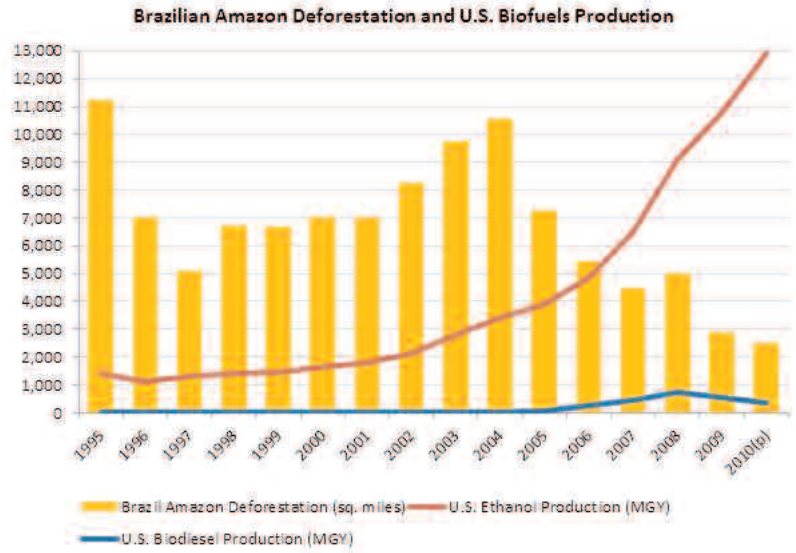
Where a region's carrying capacity is in danger of being exceeded there are a number of actions which may be implemented to mitigate (or protect against) ILUC. For example, a region could increase investment in agricultural infrastructure, or research and development, or strengthen the protection of its high carbon stock land. These measures can help to mitigate ILUC within the region (intra-regional ILUC) and may also mitigate the transmission of ILUC pressures to other regions (inter-regional ILUC).

While the additional demand placed on agricultural systems by biofuel production may tend to increase the likelihood of LUC, the additional investment in productive assets and agricultural research from the biofuels sector may reduce LUC.

3 Example: Brazil - cutting deforestation at a time of increasing global biofuel production

Perspective

Using satellite imagery the Brazilian Space Agency (INPE) has demonstrated a reduction in deforestation by 76% since 2004 to it's lowest since 1988[2]. This reduction in deforestation coincides with a 60% increase in Brazilian bioethanol production[3] and also a 279% increase in bioethanol prooduction in the United States since 2004[4]. This opposing trend of biofuel production increase, and deforestation decrease, is demonstrated in the following diagram:



Source: http://www.ethanolrfa.org/exchange/entry/if-a-tree-doesnt-fall-in-the-forest-will-engos-and-regulators-notice/

A reduction in deforestation has been attributed to more effective governance, with the following measures:

- Strengthening the enforcement powers and capabilities of the federal and state level forest protection service;
- Expanding the protected area status to include large areas of vulnerable forest;
- 15 day cycle of forest monitoring by the DETER programme;
- High profile legal cases against illegal loggers;
- A new "Social Forest Law" stating that any forested land that is not privately owned is therefore publicly owned and must remain forest (avoiding speculative land grabbing attempts); and
- Collaboration with agricultural and livestock industries to concentrate production and to vet supplies (banning material from deforested areas from the supply chain).

Given effective governance, increased agricultural output in Brazil does not need to lead to deforestation. In fact, the reverse may be true if increased investment focuses production on existing areas and more advanced farms are better able to apply environmental controls.

While the additional demand placed on agricultural systems by biofuel production may tend to increase the likelihood of LUC, the additional investment in productive assets and agricultural research from the biofuels sector may reduce LUC.

2 http://www.ethanolrfa.org/exchange/entry/if-a-tree-doesnt-fall-in-the-forest-will-engos-and-regulators-notice/
3 Renewable Fuels Association (www.ethanolrfa.org) and Biofuels Platform (www.biofuels-platform.ch)
4 http://www.ethanolrfa.org/exchange/entry/if-a-tree-doesnt-fall-in-the-forest-will-engos-and-regulators-notice/

4 Estimating ILUC emissions

Perspective
Scientific opinion is divided as to the global impact of biofuels on indirect land use change. Due to the inherent assumptions required, estimating indirect land use change is very difficult.

Since the publication of Searchinger's article, a number of substantial pieces of contradicting evidence have been published[5,6,7]. As evidence increases to contradict Searchinger's findings, it is hoped that a critically evaluated and substantiated examination of potential ILUC will be undertaken.

As a result of European policy support for biofuels in 2009/10, the EU undertook a series of exercises to investigate indirect land use change, which included the use of models. The results of these models were inconclusive as calculated land use change values varied greatly within feedstocks. The European Commission described the modelling as having "deficiencies and uncertainties" including:

- Predicting into the future can not be based on historical trends;
- Modelling is dependent on assumptions;
- Inability of models to capture a number of important factors which could increase or decrease indirect land use change;
- Indirect land use change is impossible to observe; and
- Inherent conceptual limitations.

Going forward the Commission is undertaking an Impact Assessment to investigate indirect land use change. The EC believes that "it is important to tackle indirect land use change for biofuels through a holistic approach considering, comparatively, the life-cycle sustainability of fuels used in the transport sector"[8].

Green*ergy* has championed the use of objective data, traceability and supplier responsibility for proving the environmental benefits of biofuels. Indirect land use change is a complex process and there is a potentially a wide ranging source of drivers. Biofuel regulation should be based on appropriate and substantiated evidence and not on unfounded claims made with little or no corroborative evidence.

5 http://www.ethanolrfa.org/exchange/entry/ILUC-Real-World-Results-Vs.-Economic-Theory/
6 http://www.ethanolrfa.org/news/entry/new-study-undercuts-california-low-carbon-fuel-standard-shows-evolving-land/
7 http://pubs.acs.org/doi/full/10.1021/es101864b
8 http://ec.europa.eu/energy/renewables/biofuels/doc/land-use-change/com_2010_811_report_en.pdf

5 Using satellite data to calculate land use change emissions

Perspective

In a study of a 150 square mile area in Argentina Green*ergy* has shown that it is possible to use satellite imagery to accurately and cost-effectively measure the greenhouse gas emissions associated with direct and indirect land use change. The method demonstrated in this study is more accurate than economic models which have been applied so far.

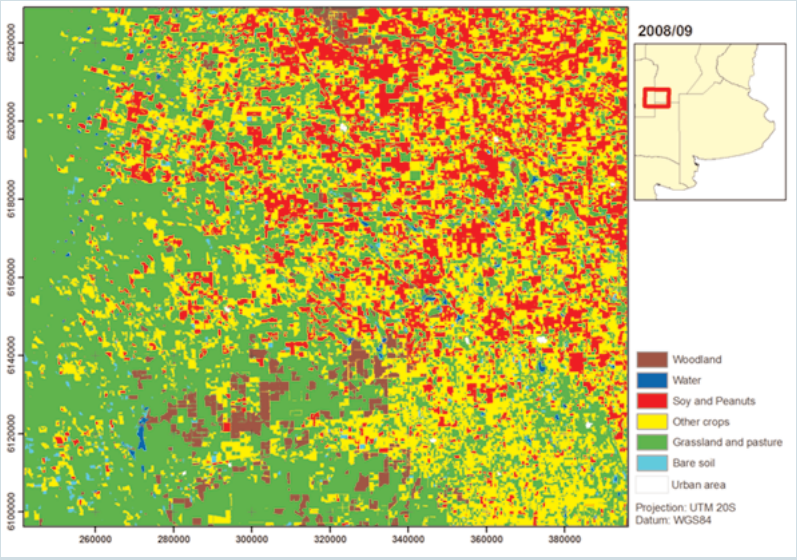
Green*ergy* tested a methodology to attribute actual and use change emissions to different causes. This method was peer reviewed and followed consultation with stakeholders including the UK Government, European Commission and interested industrial and NGO parties. The research demonstrated that it is possible to use satellite imagery to measure the actual land use change impact of particular crops.

Summary of results from Green*ergy* study on LUC in Argentina

A novel method for quantifying CO_2 emissions from direct and indirect land use change using satellite based sensors was developed and applied to an area of 2.1 million ha in Argentina.

From 2002/03 to 2008/09 the conversion of grassland to cropland within the study area resulted in the emission of 4.7 million t CO_2. 3.7 million t CO_2 were produced as a result of direct conversion to soy and 1 million t CO_2 as an indirect effect of soy displacing other crops (mainly corn) which in turn expanded into grassland.

The resulting emissions were attributed to the agricultural outputs using marginal (consequential LCA) and average (attributional LCA) methods. The marginal ILUC factor for soy based biodiesel produced on pre-existing cropland was 10.9 g CO_2 / MJ and the average ILUC factor for the period was 6.6 g CO_2 / MJ.



6 Understanding land use change emissions through BioCarbon Tracker

Green*ergy* is using satellite imagery in the development of BioCarbon Tracker, a web platform to understand where biological carbon reserves are located, and which are most at risk from agricultural expansion. By presenting a “big picture” of land use change, BioCarbon Tracker will provide valuable input to the ILUC debate.

BioCarbon Tracker will provide interactive maps of biocarbon stored in vegetation (trees, shrubs, grasses) and soil. It will identify where biocarbon is at risk from agricultural expansion and monitor changes in high risk areas. BioCarbon Tracker will also identify opportunities for increasing biocarbon through improved land management and ecosystem restoration.

By improving understanding of the relationship between agriculture and land use, BioCarbon Tracker will provide positive outcomes in terms of managing biocarbon resources and avoiding both direct and indirect emissions from land use change.

7 Land use change needs to be understood as an ongoing phenomenon with many complex causes

Perspective

Land use change is an ongoing phenomenon with many complex causes including socio-economic, legal and political drivers. We believe that speculative land acquisition, illegal logging, cattle ranching and subsistence farming are more important drivers than the expansion of productive agriculture in most parts of the world.

We consider that the most effective way to reduce deforestation is to improve governance hand in hand with investment in improving existing agricultural areas. Brazil has provided an excellent example in recent years – through a combination of improved laws, legal enforcement and investment in agriculture it has increased agricultural output while halving deforestation.

More information is given in our Deforestation Perspective.