DEPARTMENT OF THE COMMISSIONER -GENERAL FOR SUSTAINABLE DEVELOPMENT

No. 79

English version

March 2013

Études & documents

Studies and documents

Carbon footprint of biofuels: towards the gradual inclusion of indirect land use changes

ECONOMICS & EVALUATION

Economy, evaluation and integration of sustainable development service

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Ministère de l'Écologie, du Développement durable et de l'Énergie

www.developpement-durable.gouv.fr

**“Etudes et Documents” Collection of the Economy, Evaluation and Integration of Sustainable Development Service (SEEIDD)
in the Department of the Commissioner-general for Sustainable Development (CGDD)**

Title:	Carbon footprint of biofuels: toward the gradual inclusion of indirect land use changes
Publication director:	Xavier Bonnet
Author:	Antonin Vergez (CGDD) ; Pascal Blanquet et Olivier de Guibert (DGEC*)
Date of publication:	March 2013

* Direction générale de l’énergie et du climat (General directorate for energy and climate)

Acknowledgements

CONTENTS

Summary

A renewable energy target of 10% has been set for the transport sector on a European level. Life Cycle Assessments (LCA) generally show that biofuels reduce greenhouse gas (GHG) emissions compared to fossil fuels through the replacement of fossil fuels with "short-cycle" carbon. This was shown in the study carried out for ADEME in 2009. However, these conventional LCA do not take into account the consequences of the development of biofuels on land use and more specifically on land-use changes (LUC). These land-use changes may however be the source of significant GHG emissions. An important scientific and political debate has been ongoing since 2009 on the subject of GHG emissions from land-use changes induced by the production of biofuels.

This article initially aims to describe the carbon footprint of biofuels, and then explain the mechanisms and potential impacts of LUC associated with the development of energy crops.

There is generally a distinction made between two types of LUC: direct (DLUC) and indirect (ILUC). Two studies on LUC recently published in France (2012) are presented. They attempt to identify determining factors and assess the importance of direct and indirect LUC associated with the development of biofuels in France and in the European Union, resulting from the targets set by European Directive 2009/28/EC of 29 April 2009 on renewable energies. The two studies confirm the importance of ILUC and thus converge with the findings of the studies conducted by the European Commission (EC).

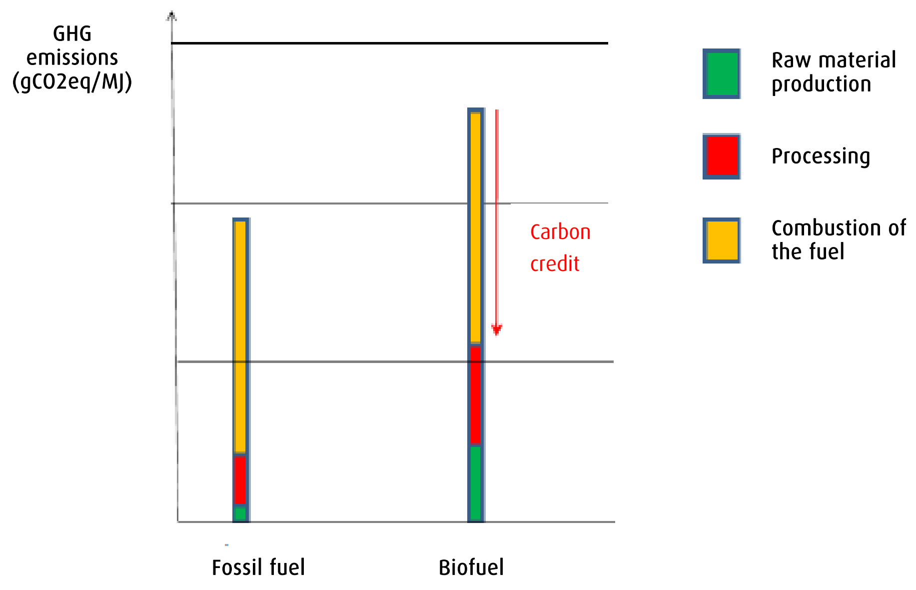
To tackle the impacts of ILUC, several strategic options have been considered by the EC: the article draws up a qualitative comparison, before concluding that from an environmental point of view, despite the methodological difficulties in quantifying ILUC, there is a need to take their impacts into account in biofuel development policies.

In October 2012, the EC proposed to report ILUC values, limit the contribution of first generation biofuels to achieve the renewable energy incorporation targets in transport, and provide an incentive to develop second generation biofuels produced from non-food raw materials, such as waste or straw, whose overall emissions are substantially lower than those of fossil fuels, and which do not directly interfere with global food production.

1. Carbon footprint of biofuels *vs.* fossil fuels: two sustainability thresholds in Directive 2009/28/EC

By convention, in the official emission inventories submitted by countries every year to the community or international bodies, the greenhouse gas emissions associated with the consumption of biofuels in the transport sector are considered to be zero, as the carbon dioxide released during the combustion of biofuels is removed from the atmosphere through photosynthesis during the biomass production phase. Compared with fossil fuels, the use of biofuels may therefore result in lower emissions (which may correspond to a "carbon credit").

Figure 1: Comparison of fossil fuels and biofuels: the "carbon credit" of biofuels



source: De Cara *et al*, 2012

In the figure above, it can be noted that the production (green lines) and processing (red lines) of biofuels produce more emissions than those of fossil fuels. Indeed, the agricultural activity of raw material production produces emissions, and the industrial stage of their processing produces more emissions than converting oil into fuel. The fuel consumption stage is essentially identical. In contrast, the production of biofuels benefits from an additional "carbon credit", which comes from atmospheric CO2 sequestration through photosynthesis during production of the raw plant material. (This carbon credit corresponds to the amount of emissions from combustion of the fuel. The difference can be seen as a small rectangle shown in bright yellow in Figure 4 on page 7: "combustion minus carbon credit".[1])

Thus, the carbon footprint of biofuels, assessed over their life cycle, i.e. from the production or extraction of raw materials to their combustion, is not zero and must therefore be compared with that of fossil fuels. The aim of introducing biofuels into the transport sector is in fact not to obtain a zero carbon footprint, but to reduce transport GHG emissions (relative to fossil fuels) for the same amount of energy produced (expressed in megajoules, MJ), taking into account the respective life cycles of the biofuel and fossil fuel.

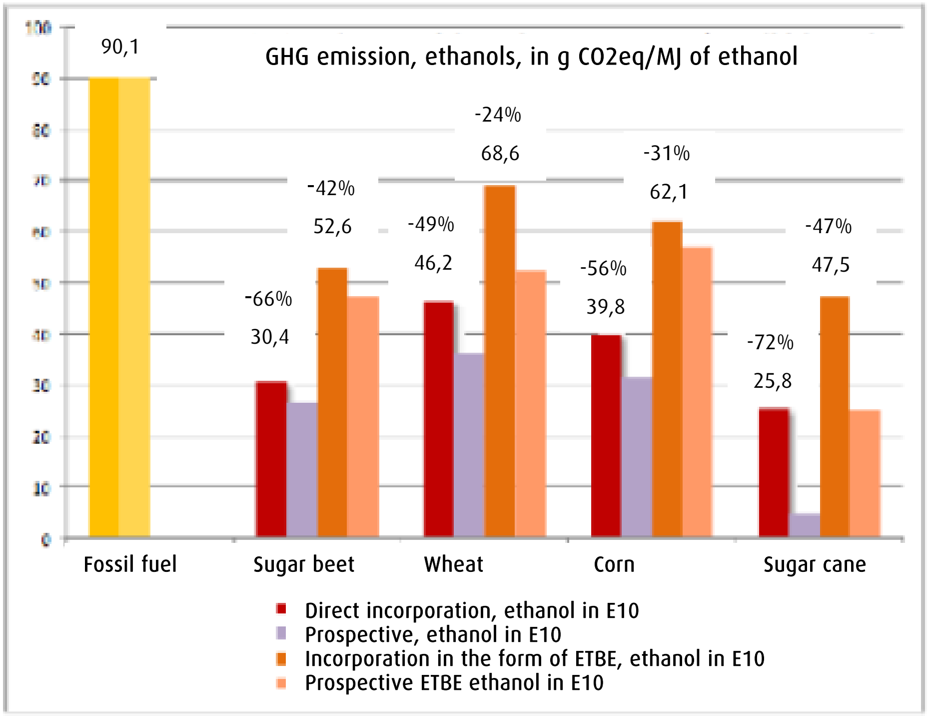
This GHG emission saving must be sufficiently high for biofuels to be qualified as "sustainable". Sustainability thresholds are specified in Article 17 of Directive 2009/28/EC on the promotion of renewable energy: "*The greenhouse gas emission saving from the use of biofuels and bioliquids taken into account [...] shall be at least 35%. With effect from 1 January 2017, the greenhouse gas emission saving from the use of biofuels and bioliquids taken into account* [...] *shall be at least 50%*".

[1] Marginal emissions of methane or nitrous oxide, during the combustion of biofuel may explain the fact that the CO2 equivalent of these emissions is greater than the total amount of CO2 emitted. On the other hand, traces of fossil fuel may be introduced into the biofuels via several synthetic additives, this time explaining the fact that the CO2 emitted is very slightly greater than the CO2 of plant origin. Thus, it is normal that the CO2 equivalent of combustion slightly exceeds the amount of plant-based fuel used, oxidised into CO2. The latter amount is by definition the carbon credit.

ADEME (2010) developed a calculation methodology for Life Cycle Assessment (LCA) of first generation biofuels used in France. According to the study, the average savings in the transport sector when comparing the GHG emissions involved in the production of raw materials and processing of biofuels, with those involved in the extraction, processing and use of the reference fossil fuel (without taking into account the impacts of land-use changes associated with the production of agricultural biomass), are the following:

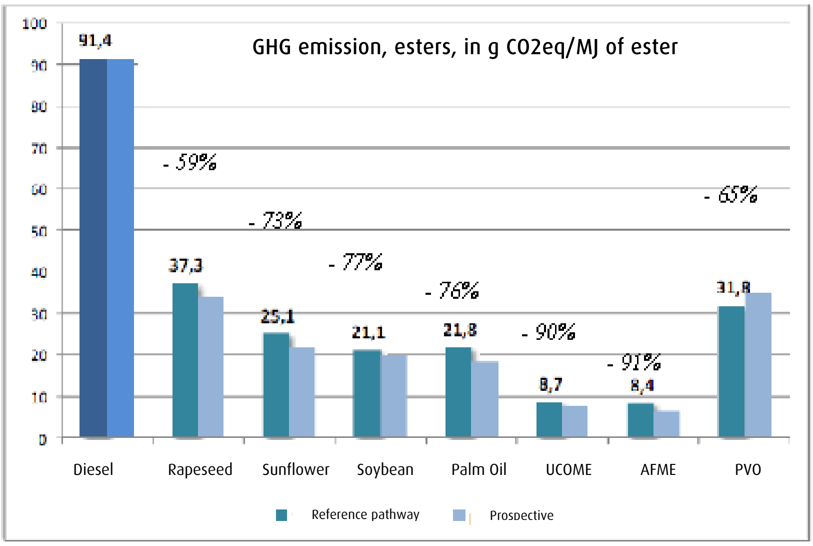
- For ETBE (ethyl tert-butyl ether) and ethanol (petrol pathway) biofuels: between 24% and 72%;

Figure 2: Greenhouse gas emissions of ethanols: Level of reduction compared with fossil fuel



- For ester-based biodiesel fuels (diesel pathway): between 59% and 91%.

Figure 3: Greenhouse gas emissions of esters: Level of reduction compared with fossil fuel



UCOME: Used Cooking Oil Methyl Esters; AFME: Animal Fat Methyl Esters; PVO: Pure Vegetable Oil

according to ADEME, 2010

According to this study, all of the biodiesel production pathways comply with the criterion to reduce greenhouse gas emissions by 35% (current threshold) and 50% (threshold applicable in 2017). In contrast, for bioethanol, only the sugar beet and sugar cane production pathways comply with these two criteria, as wheat and corn ETBE do not comply with the current 35% threshold. The Directive on the promotion of renewable energies sets out rules for calculating GHG emissions from biofuels that are a little different from those used in France for life cycle assessment. However, these are in line with those used throughout Europe, and they are set to be those preferred by economic operators. (The values shown are according to European standards; they have not yet been consolidated for France).

2. ILUC: definition, mechanisms and estimation

2.1. Definition

In general, the estimations for GHG emission savings through use of biofuels over fossil fuels do not take into account land-use changes (LUC).

However, LUC may cause a release of carbon from the land, i.e. significant greenhouse gas (GHG) emissions. LUC are divided into two types:

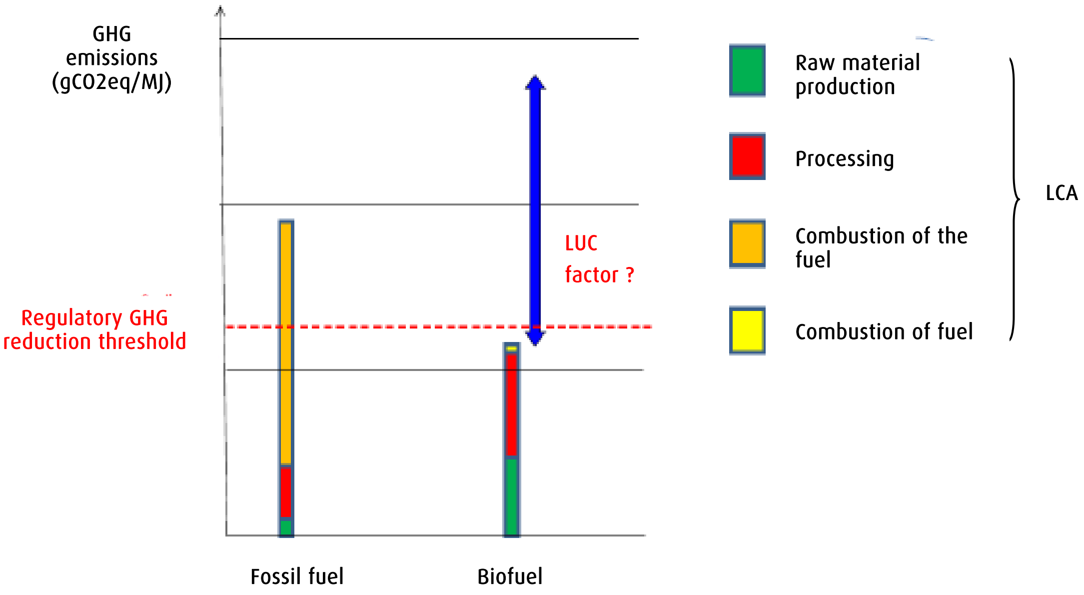
- Direct land-use changes (DLUC), when non-food crops are cultivated directly on land that previously stored carbon (pastures, forests);
- Indirect land-use changes (ILUC), when crops originally intended for food purposes are used for non-food purposes or when non-food crops replace food crops in crop agronomic rotations. This means lower food production and if it is assumed that there is a constant demand for food, this may mean converting new land to meet this demand, possibly in non-EU member countries.

ILUC may therefore also cause the disappearance of biodiverse and carbon-rich ecosystems, such as primary tropical forests or peatlands, which would have a significant negative impact on the greenhouse gas balance of biofuels. Inversely, the by-products (oil cakes) from the recovery of energy crops frees up land used for cattle rearing, a phenomenon which has a positive impact on the carbon footprint of biofuels.

Although DLUC are taken into account in the European calculation methodology for the greenhouse gas emissions of biofuels defined in Annex V of Directive 2009/28/EC, the same is not true for the impacts of ILUC.

Would biofuels be substantially less sustainable from the point of view of Directive 2009/28/EC, if ILUC were taken into account? Would they still comply with the regulatory threshold for GHG emission savings? Furthermore, would taking into account the impacts of ILUC be likely to reverse the comparison, obliging biofuels to be considered to produce more GHG emissions than fossil fuels, as illustrated in the figure below?

Figure 4: Comparison of fossil fuels and biofuels: potential impact of taking LUC into account



source: De Cara *et al.*, 2012

The De Cara *et al.* (2012) study presented in § 4.2 shows that these questions require careful consideration.

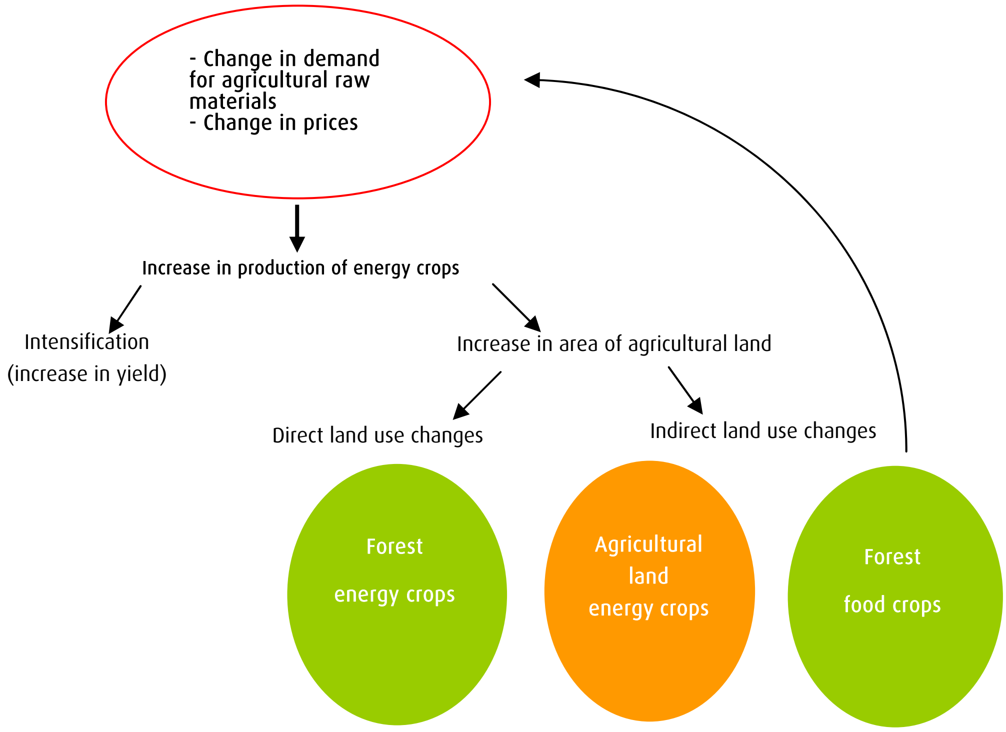
2.2. Agro-economic mechanisms of ILUC

Indirect LUC, resulting from a new agricultural product supply/demand balance, are activated via market mechanisms. For example, if corn fields which were used for producing food are now used for producing bioethanol, then the supply of corn for food decreases. However, if the demand for corn as food is constant, then corn prices rise, which may provide the incentive for other producers elsewhere to produce more corn. This increase in the production of corn elsewhere may occur either through:

- Intensification (increase in yield on land already cultivated for corn): no ILUC but increased emissions associated with extra fertiliser; or
- Cultivation of potentially carbon-rich land (forests, pastures, etc.). This second scenario would result in ILUC.

Both cases may cause a "substitution/by-product" effect. If by-product C from A replaces product D, less land is necessary to produce D, which may produce a positive, i.e. Favourable, ILUC effect (= contribute to reducing emissions from LUC). For example, higher production of rapeseed for biodiesel results in higher amounts of rapeseed oil cakes (by-product), which may substitute a proportion of imported soybean oil cakes (which in turn contributes to reducing the deforestation caused by soybean production).

Figure 5: Agronomic and economic mechanisms of ILUC



Source: authors

2.3. How are ILUC assessed?

A specific difficulty in the assessment of ILUC that are the result of the development of biofuels is that they cannot be observed directly, in so far as the extension of agricultural areas generally has several causes (demographic growth, economic growth).

Obviously, a causal relationship can be assumed between the development of biofuels and the LUC observed, but the mechanism of ILUC, based on economic dynamics, is difficult to characterise (due to supply, demand and price changes, as well as price demand and supply elasticities).

Indeed, several factors contribute to price changes: supply shocks (climatic accidents), stakeholder positions in the market (speculation), and variations in demand, *etc.*

In fact, ILUC cannot be measured directly, they need to be estimated, and therefore models should be used and simulations made to isolate the specific impact of biofuels.

To estimate ILUC, two major approaches exist:

- **Consequential LCA** complement conventional LCA taking into account ILUC via simplified hypotheses on market mechanisms. Nevertheless, they do not generally include explicit modelling of market balances;
- **Economic models** in partial or general equilibrium use supply and demand equations as well as price elasticity. They take into account indirect impacts that are channelled through prices. The results of the models are yet dependent on the hypotheses chosen.

2.4. Mention of ILUC in European Directives

Despite the difficulty in accurately quantifying them, two European Directives mention indirect land-use changes: Directive 2009/28/EC (Renewable energies) and 2009/30/EC (Quality of fuels), both belonging to the "Climate and Energy Package" adopted by the European Union in December 2008:

"*The Commission shall, by 31 December 2010, submit a report to the European Parliament and to the Council reviewing the impact of indirect land-use change on greenhouse gas emissions and addressing ways to minimise that impact. The report shall, if appropriate, be accompanied, by a proposal, based on the best available scientific evidence, containing a concrete methodology for emissions from carbon stock changes caused by indirect land-use changes […]*" (Directive 2009/28/EC, Article 19-6; Directive 2009/30/EC, Article 7e (6).

Consequently, between 2009 and 2012 the European Commission carried out several studies[2] on ILUC (literature review, understanding and modelling of the phenomenon and its impacts), which show that the increase in production of biofuel has negative indirect impacts on land use and that taking these impacts into account may significantly reduce the carbon footprint of biofuels. The report[3] stipulated by the Directive was also published by the European Commission in December 2010: it indicates that taking into account ILUC could lead to a significant increase in the carbon footprint of biofuels, while insisting on the complexity of the phenomenon and the uncertainties of the modelling exercises.

3. Two French studies on the consumption of biofuels in Europe and on its possible impact in terms of ILUC

What is the actual significance of direct and indirect LUC? Two studies were carried out by ADEME in 2012 on direct and indirect LUC (monitored by a technical committee associating ADEME, INRA, the Ministries for Agriculture and Ecology, FranceAgriMer and the representatives of the stakeholders). The main results of these studies are presented below.

3.1. Study 1: "Retrospective analysis of interactions between the development of biofuels in France with French and international market changes (agricultural products, processed products and by-products) and land-use changes"

The highly significant development of the consumption of biofuels in France, from 2004 and 2005, has had the following main impacts:

- For biodiesel:

- in France:
    - Cultivation of rapeseed and sunflower for the production of biodiesel has developed significantly, in particular with successive reforms in the Common Agricultural Policy (CAP). This development has occurred often to the detriment of protein crops and fallow land (reduction of approximately 100,000 hectares). The impacts of converting non-agricultural land into agricultural land were very low;
    - Development of rapeseed and sunflower crops was not sufficient to meet demand, which over 2008 and 2009 led to a significant increase in rapeseed, palm oil and soybean imports.
- outside France:
    - Upon initial analysis, rapeseed imports from Ukraine, Canada, and Australia did not result in significant conversions of non-agricultural land but in crop rotation changes.
    - In contrast, palm oil and soybean imports are probably the cause of significant conversions of non-agricultural land into cultivated land (Malaysia, Indonesia, Brazil and Argentina). The magnitude of these conversions, in particular those affecting forest areas, remains difficult to accurately quantify.

---

[2] IFPRI study: http://trade.ec.europa.eu/doclib/docs/2011/october/tradoc_148289.pdf
JRC study: http://iet.jrc.ec.europa.eu/sites/default/files/Technical_Note_EU24817.pdf
Ecofys study: http://www.ecofys.com/files/files/ecofys_2012_grandfathering%20iluc.pdf

[3] Report COM(2010)811 of 22 December 2010

- Conversion of non-agricultural land for soybean crops for the French biofuels market is difficult to characterise; in addition, its **exclusive assignment to French biofuel imports is debatable** due to the simultaneous production of oil and oil cakes, also imported to France.

- For bioethanol:

  - The only significant impact of the development of bioethanol production is the reduction in French sugar exports to countries in North Africa, the Middle East and sub-Saharan Africa. These countries have had to develop their imports, essentially from Brazil;

  - Production of wheat and sugar beet for manufacturing ethanol generates by-products (sugar beet pulp and more importantly corn and wheat distillers grains) that are in high demand as animal feed. However, this substitution, whose environmental impact is positive, could not be taken into account with available data.

3.2. Study 2: "Critical review of studies assessing the impact of LUC on the environmental balance of biofuels"

De Cara *et al.* (2012) studied 485 recent bibliographical references (working documents, articles, conference presentations, books, reports and theses). They selected those mentioning economic or LCA approaches, then those that adopted quantitative approaches, with clear and available results and hypotheses. Finally, 48 separate studies, based on sometimes different hypotheses (crop yield, demand elasticity for agricultural products, flexibility of biofuel development policies, commercial policies, carbon storage in ecosystems, farming practices on new land) were retained. Most of these studies confirmed the link between the development of biofuels and the existence of direct (D) and/or indirect (I) land-use changes.

In all, the authors had 561 GHG emission values from LUC (I + D), showing significant variability, and reflecting the uncertainties and also the diversity of approaches, definitions and hypotheses.

From the GHG emission values from LUC (I + D) collected, it appears that:

- in 26% of scenarios, GHG emissions from LUC (I + D) are higher than GHG emissions from reference fossil fuels;
- in 44% of scenarios, GHG emissions from LUC (I + D) represent over 65% of GHG emissions from reference fossil fuels;
- in 54% of scenarios, GHG emissions from LUC (I + D) represent over 50% of GHG emissions from reference fossil fuels.

In addition, the distributions of GHG emissions from LUC (I + D) are widespread. Depending on the type of biofuel, the median values of GHG emissions from LUC (I + D) are classified in the following increasing order:

2nd generation ethanol < 1st generation ethanol < 1st generation biodiesel

Similarly, depending on the types of crops, the median values of GHG emissions from LUC (I + D) are classified in the following increasing order:

Sugar beet < wheat < sugar cane < rapeseed < corn < palm oil < sunflower < soybean < jatropha

Some LUC lead to particularly high GHG emissions, in particular where conversion of carbon-rich peatland or tropical deforestation is involved.

4. The European Commission has studied 4 options to tackle the impacts of ILUC

Following the publication of its report in December 2010, in 2011 and 2012 the European Commission considered four options to tackle the impacts of I LUC:

1. Take no measures for the moment, while continuing to monitor the situation regarding the development of biofuels within the European Union.

2. Raise the target for greenhouse gas emission savings: this has the advantage of simplicity and immediately leads to environmental progress. However, this option has the major flaw of not directly targeting the indirect impact on land use as such for each biofuel pathway and therefore leaves the unresolved question of whether it is to be taken into account. In addition, the target for greenhouse gas emission savings is currently logically transversal and common to all pathways, whereas the indirect impact on land-use change is substantially different between the two main pathways for bioethanol, which causes moderate ILUC, and biodiesel, which causes more significant ILUC.

3. Introduce new sustainability requirements that apply to certain categories of biofuels. However, this option has not been described in details and has therefore not been analysed thoroughly.

4. Introduce a specific factor to take into account the greenhouse gas emissions that correspond to ILUC emissions: as with the first option, this has the advantage of simplicity and immediately leads to environmental progress. This offers the possibility of simple and natural differentiation according to the two pathways. As the ILUC assessment progresses, this will eventually make it possible to differentiate the various energy crops or supply sources, and therefore sub-pathways.

Qualitative analysis of the various 2012 options highlights the importance of but also the difficulty in taking action.

Figure 6: Analysis of the strengths and weaknesses of the European Commission's initial 4 options

Option	Strengths	Weaknesses
1: take no measures for the moment, while continuing to monitor the situation	- sends a signal of stability to economic operators and investors who as from now are starting to implement sustainability criteria - gives time to implement already existing tools that are likely to reduce the pressure on land intended for the production of energy crops (bonuses, use of waste and residues) - allows time for discussion in order to choose the best possible solution that takes into account better understanding of the impacts of ILUC and their dynamics based on the policies of the various States.	- risks undermining the credibility of the image of the biofuels pathway in relation to the target to be reached for high-environmental value renewable energies - does not allow the impacts of ILUC to be taken into account at this point in time
2: raise the minimum target for greenhouse gas emission savings for biofuels	- offers the possibility of very simple legislative and regulatory implementation - makes it possible to obtain an environmental benefit	- sends a signal of instability to economic operators (modification of a mandatory sustainability criteria) - constitutes a random approach for addressing the impacts of the ILUC for the land, without taking into account the specific efforts for a pathway to reduce them. - requires, in practice, a deadline and pathway improvement efforts
3: introduce new sustainability requirements that apply to certain categories of biofuels	- would include the entire agricultural production chain, irrespective of status - should make it possible to obtain environmental benefits	- would highlight the problems in identifying appropriate criteria - would require, in practice, pathway improvement efforts - would raise significant questions on the measuring and assessment tools
4: assign a quantity of greenhouse gas emissions to biofuels, reflecting the presumed impact of indirect land-use changes (in gCO2/MJ)	- offers easy legislative or regulatory implementation (penalties will be defined by the regulations and applied according to the LCA-type methodology defined by the REN Directive) - is an approach already adopted by other States (California) - sends a signal about ILUC that provides the incentive to reduce this phenomenon - makes it possible to differentiate the signal according to the pathway and the scale of the ILUC, - lends itself to progressive and adaptable implementation based on the measures implemented to reduce this impact.	- is based on a certain methodological fragility (involves a penalty reflecting an impact estimated on a global level, assessed by modelling). The measuring and assessment tools still need to progress further.

In 2012, the European Commission resumed its work and published a legislative proposal on 17 October.

Key measures for this project involve:

– confirming the role of biofuels within Europe's climate and energy policies;

– scaling down incentives for their development with regards to biofuels that use raw materials in competition with agricultural commodities;

– intensifying incentives to develop new forms of biofuels that do not result in LUC;

– reporting the impacts of ILUC in the environmental assessment of its productions.

According to the terms of the European Commission's press release, this is a proposal that aims to restrict the conversion of land into crops intended for biofuel production, and to increase the climate benefits of the biofuels used in the European Union. The use of biofuels produced from foodstuffs in order to reach the 10% renewable energies target set by the Directive on renewable energies will be limited to 5%. The aim is to stimulate the development of other biofuels known as "second generation", produced from non-food raw materials, such as waste or straw, whose emissions are substantially lower than those of fossil fuels, and which do not directly interfere with global food production. For the first time, the estimation of the impact of land conversion, i.e. indirect land-use change (ILUC), will be taken into consideration when assessing the performance of biofuels in terms of emission saving.

This legislative proposal is currently debated during this first semester of 2013 under the aegis of the European Council's Irish Presidency.

5. Conclusion

Given the increasing scientific evidence confirming the importance of ILUC and their negative effect on the carbon footprint of biofuels, taking them into account in European policy is now essential.

Thus, the pursuit of the 10% renewable energies target by 2020 should be complemented with actions to tackle ILUC in order to reduce their negative impacts on the carbon footprint of biofuels.

The European Commission proposes to set a limit of 5% on biofuels produced from raw materials that may also include foodstuffs. On the French market, this would correspond to a reduction relative to the current level (approximately 7%) of incorporation. In contrast, on the European market level, there is still room for commercial developments (currently approximately 5%), including for French industries that are well positioned in these markets.

Developing other "second generation" biofuels, which are sustainably produced from non-food raw materials, is now a priority.

At the same time, it is essential to continue research and development (R&D) efforts to strengthen our ability to assess ILUC. In this respect, it is important to note that ILUC and their related emissions are not inevitable. Beside the use of non-food raw materials, they can also be reduced by various technical or organisational measures that can be developed (by the bioethanol and biodiesel sectors). For example, all other things being equal, improvement in yield, better recovery of by-products (such as in livestock feed) and globally, better agronomic synergy with other productions. Reducing these ILUC is currently the main challenge for the biofuel sectors, and subsequently, to achieve it, the revision of the biomass sustainability system. Also, including ILUC impacts by pathways (in the assessment of these productions) is a necessary signal, which in the long term will provide the incentive to control this impact.

6. Bibliography

ADEME (2010). *Analyses de Cycle de Vie appliquées aux biocarburants de première génération consommés en France*. A study carried out on behalf of the French Environment and Energy Management Agency, the Ministry for Ecology, Energy, Sustainable Development and Sea, the Ministry for Food, Agriculture and Fisheries, and France Agrimer by BIO Intelligence Service.

ADEME (2012). *Analyse rétrospective des interactions du développement des biocarburants en France avec l'évolution des marchés français et mondiaux (productions agricoles, produits transformés et coproduits) et les changements d'affectation des sols*. A study carried out on behalf of ADEME by In Numeri.

Rabl A. *et al* (2007). *How to account for CO2 emissions from biomass in an LCA*. International Journal of Life Cycle Assessment, vol. 12, p. 581.

De Cara S. *et al.* (2012). *Revue critique des études évaluant l'effet des changements d'affectation des sols sur les bilans environnementaux des biocarburants*.

Directive 2009/28/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=Oj:L:2009:140:0016:0062:en:PDF

Directive 2009/30/EC. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0088:0113:EN:PDF

Ecofys (2012). *Assessing grandfathering options under an EU ILUC policy.*
http://www.ecofys.com/files/files/ecofys_2012_grandfathering%20iluc.pdf

IFPRI (2011). *Assessing the Land Use Change Consequences of European Biofuel Policies*. Final Report October 2011. ATLASS Consortium, Specific Contract N° SI2. 580403 implementing Framework Contract No TRADE/07/A2.
http://trade.ec.europa.eu/doclib/docs/2011/october/tradoc_148289.pdf

JRC (2010*). Indirect Land Use Change from increased biofuels demand. Comparison of models and results for marginal biofuels production from different feedstocks*.
http://ec.europa.eu/energy/renewables/consultations/doc/public_consultation_iluc/study_4_iluc_modelling_comparison.pdf

Commissariat général au développement durable
(Department of the Commissioner-general for Sustainable Development)

Service de l'économie, de l'évaluation et de l'intégration du développement durable
(Economy, evaluation and integration of sustainable development service)
Tour Voltaire
92055 La Défense cedex, FRANCE
Tel: +33 (0)1.40.81.21.22

This publication can be found on line at:
http://www.developpement-durable.gouv.fr/developpement-durable/

Summary

A renewable energy target of 10 % has been set for the transport sector on a European level. Life Cycle Assessments (LCA) generally show that biofuels reduce greenhouse gas (GHG) emissions compared to fossil fuels through the replacement of fossil fuels with "short-cycle" carbon. This was shown in the study carried out for ADEME in 2009. However, these conventional LCA do not take into account the consequences of the development of biofuels on land use and more specifically on land-use changes (LUC). These land-use changes may however be the source of significant GHG emissions. An important scientific and political debate has been ongoing since 2009 on the subject of GHG emissions from land-use changes induced by the production of biofuels.

This article initially aims to describe the carbon footprint of biofuels, and then explain the mechanisms and potential impacts of LUC associated with the development of energy crops.

There is generally a distinction made between two types of LUC: direct (DLUC) and indirect (ILUC). Two studies on LUC recently published in France (2012) are presented. They attempt to identify determining factors and assess the importance of direct and indirect LUC associated with the development of biofuels in France and in the European Union, resulting from the targets set by European Directive 2009/28/EC of 29 April 2009 on renewable energies. The two studies confirm the importance of ILUC and thus converge with the findings of the studies conducted by the European Commission (EC).

To tackle the impacts of ILUC, several strategic options have been considered by the EC: the article draws up a qualitative comparison, before concluding that from an environmental point of view, despite the methodological difficulties in quantifying ILUC, there is a need to take their impacts into account in biofuel development policies.

In October 2012, the EC proposed to report ILUC values, limit the contribution of first generation biofuels to achieve the renewable energy incorporation targets in transport, and provide an incentive to develop second generation biofuels produced from non-food raw materials, such as waste or straw, whose overall emissions are substantially lower than those of fossil fuels, and which do not directly interfere with global food production.

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE
Ministère
de l'Écologie,
du Développement
durable
et de l'Énergie

Legal Deposit: March 2013
ISSN: 2102 - 4723