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Understanding options for ILUC mitigation

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Summary

Indirect land use change (ILUC) is land use change that occurs when existing cropland is used to cover the feedstock demand of additional biofuel or bioenergy production. ILUC results in the displacement of other agricultural production activities onto land with carbon stocks or other existing provisioning services. In European biofuel policy, ILUC has been debated for many years due to potentially high greenhouse gas (GHG) emissions associated with it and due to the high uncertainty in quantifying those emissions for different types of feedstocks.

The use of low indirect impact—or low ILUC—biofuels has been suggested as a way to mitigate ILUC caused by bioenergy and biofuel production in post-2020 EU renewable energy policy. This would be additional to sustainability safeguards in the existing legislation that are seen by some stakeholders as insufficient. In particular, the ILUC Directive (EU) 2015/1513 (European Parliament, 2015), which came into force in 2015, outlines the potential to define and certify low ILUC biofuels through the use of certification schemes.

Several groups have proposed methodologies to certify low indirect impact biofuel projects through these measures. Ecofys published three such methodologies between 2009 and 2012 in partnership with other organizations. The Roundtable on Sustainable Biomaterials also published such a methodology in 2015. Those methodologies set out criteria that would need to be complied with to enable individual companies to demonstrate that a biofuel has a low risk of indirect effects.

This paper surveys the existing literature on methodologies related to the certification of low ILUC biofuel projects through different measures. It also assesses the potential challenges, risks, and loopholes that could arise from the use of these methodologies.

We find that several methodologies lack detailed requirements on "additionality," which significantly diminishes the credibility of those methodologies and reveals potential loopholes in the proposed measures to avoid ILUC. Additionality is the demonstration that a project reduces GHG emissions below those that would have occurred in a baseline scenario (i.e., in the absence of that project). In the case of biofuels, demonstrating additionality means demonstrating that feedstock production or use is really additional to what would have happened in a baseline scenario without biofuel demand.

Regional approaches have also been proposed to apply the idea of low indirect impact biofuels certification at a higher level, notably by Ecometrica in 2011 and Utrecht University in 2014. Those methodologies are based on the assumption that ILUC mitigation needs to take a broad and integrated perspective by considering all crops and by addressing all land use across a region. Such approaches can offer benefits such as lower audit burden and larger supply of low ILUC risk feedstocks. However, regional approaches of low indirect impact do not seem to be implementable and certifiable as described in the reviewed literature. In particular, additionality would be difficult to demonstrate for integrated regional approaches compared with project-level measures: the reviewed methodologies assess changes across the agricultural sector as a whole, and it would be difficult to determine to what extent those changes are driven by biofuels rather than other factors.

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We conclude that the concept of low indirect impact biofuels, as described in the analyzed methodologies, is still in its infancy stage, and would require substantial supplementary requirements and risk analyses if it were to be included in a new European legislation as an additional sustainability criterion for the production of biofuels and bioenergy post-2020.

Introduction

Since 2008, indirect land use change (ILUC) has been an important question in global biofuel policy, in particular because emissions associated with ILUC can potentially negate any greenhouse gas (GHG) savings from the use of biofuel to substitute for fossil fuel.

Direct land use change (DLUC) refers to when a parcel of land is converted to a new agricultural use, and feedstock produced on that land is used for bioenergy. This would be the case, for instance, if an area of forest in Malaysia is chopped down and replaced with oil palms, and the oil is then supplied directly to a biodiesel plant (Malins et al., 2014a). DLUC is in principle prevented by existing biofuels legislation.

Indirect effects, in contrast, occur when the system has to adjust to accommodate increased feedstock demand for bioenergy. Indirect land use change is expected to occur when existing plantations are used to cover the feedstock demand of additional biofuel production (European Commission, 2010). In that case, the use of feedstock for biofuels might displace other agricultural production activities onto land with high carbon stocks or other existing provisioning services (Ernst & Young, 2011). The resulting land conversion can cause significant GHG emissions.

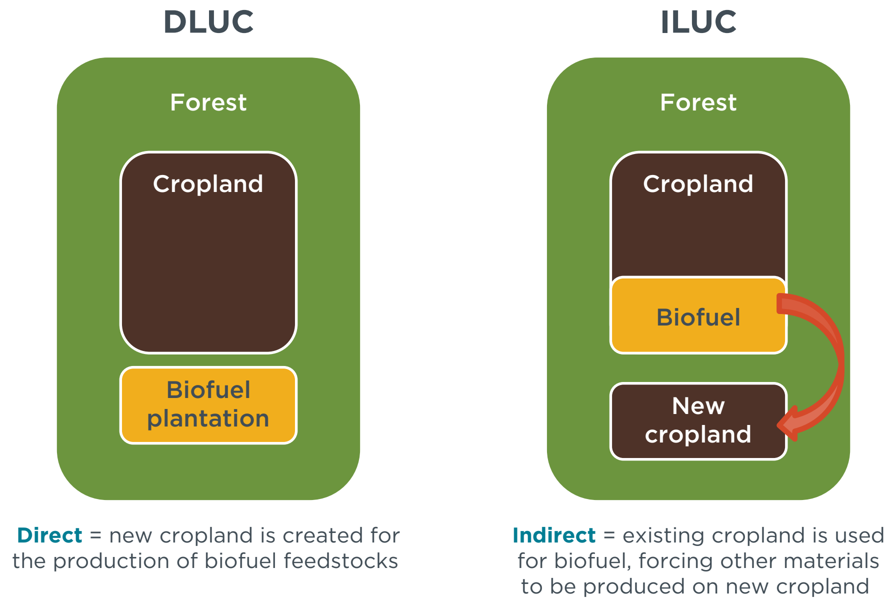

Figure 1. Illustration of direct (DLUC) and indirect (ILUC) land use change.

The difference between DLUC and ILUC is illustrated in Figure 1 The example is a conversion of forest to cropland, but other land use changes are possible.

An important aspect of ILUC is that it cannot be directly measured or observed. It is not possible to isolate the particular activity that is indirectly causing land use change from the many other factors that may also drive land use change.

GHG emissions from ILUC can be quantified through models, resulting in estimated GHG emissions called "ILUC factors." However, this quantification of ILUC has a high uncertainty. For example, a recent study published by the European Commission concludes that some inherent uncertainty cannot be avoided in the estimation of land use change emissions, and only a few feedstocks can be designated as having high or low land use change emissions with a high degree of confidence (Valin et al., 2015). The uncertainty associated with ILUC modeling has fueled debates about its inclusion in biofuel policies.

Over the past few years, there has been considerable interest in the concept of "low indirect impact biofuels" that cause minimal or no displacement of other uses of land. For example, in its recommended sustainability criteria for post-2020 EU biofuels policy, the Institute for European Environmental Policy (IEEP) concludes: "The use of feedstocks should not cause the displacement of food, feed, or timber production either directly or indirectly within a specific area or project" (Allen et al., 2016). This concept is especially relevant as Europe looks to develop a post-2020 framework to support the supply of advanced alternative fuels (European Commission, 2014). Allowing the certification and use of low ILUC biofuels in future European policy could potentially provide an approach to reduce ILUC impacts and thus overall emissions from biofuel production compared with business as usual.

This paper examines the concept of low indirect impact biofuels, how it is addressed in European legislation, and the existing literature on how it can be implemented and certified through different regional and local measures. We also assess the potential challenges, risks, and loopholes that could arise from the certification of low indirect impact biofuels. The emphasis here is on biofuels feedstock; however, the discussion would be similar for feedstock used for bioenergy or biomaterials in general.

POLICY BACKGROUND

The Renewable Energy Directive (RED) (European Parliament, 2009a) and the Fuel Quality Directive (FQD) (European Parliament, 2009b) provided an EU-level sustainability framework for biofuels and bioliquids. Both directives[1] include an obligation to review the impact of ILUC on GHG emissions associated with biofuels, and if appropriate to accompany this review with a proposal on ways to minimize that impact (European Commission, 2012).

As a response to this requirement, the ILUC Directive (EU) 2015/1513 (European Parliament, 2015) came into force on October 5, 2015, amending the RED and the FQD, and aiming to reduce the risk of ILUC and food security implications through several measures. First, there is a cap on the contribution of food-based biofuels of 7% of energy consumption in transport in 2020. Second, the Directive provides an indicative sub-target to prepare the transition toward advanced biofuels: 0.5% by energy content of the share of energy in transport in 2020 should be met with advanced biofuels.

A third measure to reduce ILUC risks is mentioned in the ILUC Directive language to promote low ILUC biofuels. Language from two particular parts of the directive provides some guidance on such biofuels. Article 2 of the Directive amends the RED by giving a characterization of low ILUC risk biofuels as being "biofuels, the feedstocks of which were produced within schemes which reduce the displacement of production for purposes other than for making biofuels." Recital 27 of the Directive also outlines the potential to define and certify low ILUC biofuels through the use of certification schemes "which can reliably prove that a given amount of biofuel feedstock produced in a given project did not displace production for other purposes." The two measures given as examples are "improved productivity above levels which would have otherwise been achieved," and production on unused or underutilized land ("land where direct land-use change occurred without significant negative impacts on pre-existing ecosystem services delivered by that land, including protection of carbon stocks and biodiversity").

Within the ILUC Directive, the word *displacement* is used differently in two places to characterize low ILUC biofuels. In Recital (27), the emphasis is on the production of biofuel feedstock that *did not* displace non-bioenergy feedstock production, whereas the definition of low ILUC biofuels in the abovementioned Article 2 refers to a production that *reduces* the displacement of non-bioenergy feedstock production. This discrepancy creates a tension between the ideas of certifying feedstocks for which there are believed to be no indirect effects, and certifying feedstocks for which the indirect effects are believed to be limited. This difference is, however, not fully explored in the directives.

The ILUC Directive recognizes that low ILUC biofuels certification is an option to mitigate ILUC, but the legislation does not include detailed procedures for the identification and certification of low ILUC risk biofuel production. This is a task that is left for the Commission to assess in a subsequent report in 2017, as stipulated in the ILUC Directive, Article 3(2). With these ILUC questions in mind, we explore below the concept of low ILUC biofuels, how they could be identified and certified, and the inherent risks and potential for loopholes that could arise in their certification and monitoring.

ILUC mitigation mechanisms

It is important to consider the geographical scale at which ILUC mitigation measures are aimed. Three levels of potential approaches can be described, as suggested by Ecofys (Ecofys et al., 2012):

- Prevent unwanted direct land use change, globally and for all sectors.
- Reduce pressure on land from the agricultural sector as a whole.
- Production models that prevent indirect impacts at a project level.

The first two mitigation measures take a macro cross-sectoral approach in which governments would be key actors. Such global approach to ILUC mitigation is mentioned in the RED (Article 18) in the form of "bilateral or multilateral agreements with third countries containing provisions on sustainability criteria," but to the extent of the authors' knowledge, the EU has not concluded any such agreements with third countries. The global approach to reduce overall land use change through measures such as international agreements can be seen as the most effective long-term policy to mitigate land-use change emissions, and hence to reduce ILUC related to bioenergy demand. While this approach is beyond the reach of the biofuel sector acting alone, it remains an important consideration for policy

1 Article 7d(6) of Directive 2009/30/EC and Article 19(6) of Directive 2009/28/EC.

makers. However, it is important to be clear that the prospect of improved land governance in future is certainly not a reason to ignore poor land governance in the present.

On the other hand, the project-level production models focus on the role individual producers can play in preventing indirect impacts of bioenergy feedstock production. The criterion of "no displacement" in the IEEP report reflects this approach, prohibiting displacement "outside of a specific area or project" (Allen et al., 2016). It is simple to assert that biofuels should be certified to demonstrate that they cause "no displacement," but for such an idea to be implementable in practice, rules must be identified that could be applied in the real world. Several groups have previously proposed methodologies for biofuel projects that would minimize indirect effects. Those methodologies are reviewed below.

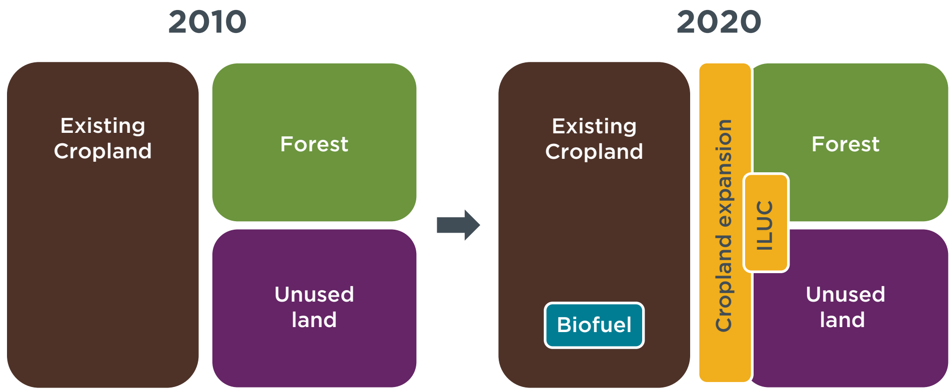

Figure 2. Situation with biofuels, without additional ILUC measures (adapted from Ecofys, 2010).

ADDITIONALITY

An important concept in any GHG reduction project, including ILUC mitigation efforts, is additionality. A project is considered additional if it reduces GHG emissions below those that would have occurred in a baseline scenario in the absence of that project (UNFCCC, 2006). The first step in demonstrating additionality is the determination of the most plausible baseline scenario; that is, what the counterfactual—or business-as-usual—situation would be without the project being implemented. One has then to demonstrate that the project is different from that scenario, resulting in GHG emission reductions that are additional to those that would occur in the baseline scenario. In the case of biofuels or bioenergy, the baseline corresponds to a situation where a feedstock is grown without demand for biofuel. Demonstrating additionality then means demonstrating that the bioenergy feedstock comes from increased production that would not have occurred in the baseline, due to factors such as national or sectoral policies and circumstances, technological or investment barriers, etc.

Additionality has been criticized in its effectiveness to deliver genuine GHG reductions. For example, the Institute for Global Environmental Strategies (Kuriyama et al., 2016) estimated that 17% to 34% of the total Certified Emission Reductions issued from the Clean Development Mechanism projects up to December 2015 had been issued from projects that are likely to be non-additional. Even though the concept of additionality is challenging and demonstrating additionality can lead to high transaction costs in some cases, it can be argued this concept is a necessary safeguard to verify whether the projects would have happened in the business-as-usual scenario. For example, in the context of upstream emission reduction projects in the oil industry, the ICCT has argued (Malins et al., 2014b) that additionality assessment is a central and necessary element required to identify projects that deliver genuine benefits.

This is equally relevant in the context of biofuels. If, for example, a parcel of land that is currently unused would have been taken into production to produce another commodity in the absence of biofuel-induced demand, then the production of biofuels effectively replaces that potential commodity and therefore leads to ILUC or other indirect impacts. On the other hand, in the case where a biofuel production is only partly additional, further provisioning compensation measures could be proposed to compensate the displaced services and provide equivalent benefits. Real-life examples of this idea still have to be seen in order to confirm that its implementation is feasible. Without a concrete system to demonstrate additionality, there is a considerable risk to credit projects that do not in fact deliver any real benefit over business as usual.

Ecofys (2010) provided an illustrated example of why a simplified low ILUC methodology without the need for additionality has an inherent risk of being ineffective in preventing unwanted indirect effects, because it could credit measures that may have been implemented anyway within the crediting period. This is adapted and summarized here in Figure 2, Figure 3, and Figure 4, where three scenarios are presented for the source of the feedstock turned into biofuel. The current year is 2010, and it is assumed that cropland expansion in 2020 takes place into a forested area and into currently unused land, in a proportion of 50:50.

The first scenario (Figure 2) assumes that biofuel is produced from existing cropland in 2020, with no additional ILUC measures. As indicated in the figure, when the new biofuel project is implemented by year 2020 onto existing cropland, this causes a displacement of production, leading to unwanted ILUC into the forested area and into unused land.

The second scenario (Figure 3) is like the first, but with an ILUC policy that requires all biofuels to come from land that was not in use by 2010, without the need for additionality. In this case, the 2020 scenario is that biofuel crops are grown on unused land that would have been used for food production. This causes an unwanted ILUC into the forested area, of the same magnitude as in the first scenario without ILUC policy.

In the third scenario (Figure 4), there is an ILUC policy "that requires all biofuels to come from land that would not have been taken in production in absence of the biofuel feedstock demand (additionality)." This situation does not cause additional unwanted ILUC, because it can reasonably be assumed that the unused land where biofuel crops are grown will not be taken into production for other crops in 2020.

The scenarios illustrate that, even if ILUC prevention measures are taken, such as certifying that a parcel of land is unused, they might be inefficient in mitigating ILUC if they do not include an assessment of additionality of the biofuel production.

Figure 3. Situation with biofuels, with ILUC measures, without the need for additionality (adapted from Ecofys, 2010).

Figure 4. Situation with biofuels, with ILUC measures, with the need for additionality (adapted from Ecofys, 2010)

Ecofys and the development of low ILUC methodologies

Since 2009, Ecofys has published a series of documents and methodologies that include different measures to identify low indirect impact biofuels at the project level. This section presents those methodologies in a chronological order, and outlines the differences and similarities between them.

ECOFYS AND WINROCK INTERNATIONAL—CASE STUDIES AND METHODOLOGY FOR MITIGATING INDIRECT IMPACTS

In 2009, the UK Renewable Fuels Agency commissioned Ecofys and Winrock International to develop a methodology that can objectively identify biofuels from energy crops with a low risk of indirect effects (Ecofys et al., 2009). The work was based on an analysis of six case studies, and aimed to set out the criteria that would need to be complied with to enable individual companies to demonstrate that a biofuel has a low risk of indirect effects, and how compliance with these criteria could be demonstrated and verified.

The methodology focuses on three main options. The feasibility of these options as well as their economics, barriers, sustainability impacts, and their potential were analyzed using case studies:

1. The use of land without provisioning services ("unused land"): the case study was the expansion of oil palm production on *Imperata* grassland in Indonesia.
2. Increasing land productivity through integration with non-bioenergy feedstock systems: the case studies were the integration of sugar cane with cattle in Brazil, and the integration of soy with cattle in a rotational system in Brazil.
3. Increasing the land productivity of existing bioenergy feedstock systems: the case studies were the increase of yields of an existing sugar cane plantation in the Philippines, and the increase of yields of existing palm oil production in Liberia.

The methodology gives, for the three approaches, details on how additionality can be demonstrated, how the baseline can be established, what monitoring is required, and what claim can be made. Table 1 gives a summary of the additionality and baseline determination for the three considered approaches.

These concepts create a basic framework that was further extended to other measures and developed into subsequent methodologies by Ecofys, which are described below.

The main barriers identified by the authors in these case studies were often not of an economic nature, but related to "less quantifiable areas such as governance issues, contractual relationships and business models, land right issues, and customary practices." For example, a case study in Indonesia assessed the feasibility of growing palm plantations on "degraded" grasslands that had been previously deforested and colonized by the invasive *Imperata* grass. Imperata grassland is systematically underutilized due to various barriers, in particular the difficulty of obtaining a permit for palm oil production on "degraded" areas, because many of these are officially classified as "forest" by the national government. However, the authors concluded that the use of Imperata grasslands for oil palm plantations could considerably reduce pressure on natural forests.

Table 1. Basic definition of additionality and baseline in the methodology (adapted from Ecofys et al., 2009).

	Land without provisioning services	Integration with non-bioenergy system	Increased productivity of existing bioenergy feedstock system
Demonstrating additionality—(i.e., that in absence of the bioenergy feedstock demand:)	… the land would not have been taken into production	… the integration model would not have been implemented	… the yield-increasing measure would not have been implemented
Setting the baseline	Zero (land previously unused)	Business-as-usual production levels of non-bioenergy system (e.g., milk or beef)	Business-as-usual production levels of existing bioenergy system, anticipating business-as-usual yield increases

ECOFYS—RESPONSIBLE CULTIVATION AREAS METHODOLOGY

In 2010, Ecofys published the RCA (Responsible Cultivation Area) methodology, commissioned by BP, Neste Oil, and Shell Global Solutions, with contributions from Conservation International and WWF (Ecofys, 2010). The RCA methodology draws on the concepts laid out in the previous methodology (Ecofys et al., 2009), and also aims to put forward a set of criteria and a methodology that enables parties to identify bioenergy with a low risk of indirect effects. As with the earlier case studies, it focuses on the unused land, intensification, and integration (with non-bioenergy-feedstock systems) models to prevent ILUC. An RCA is defined as a land area that does not provide provisioning services. Ecofys introduced this term in order to avoid confusion with existing terminology such as "idle land," "waste land," "degraded land," or "abandoned land."

The RCA methodology aims to identify bioenergy feedstock production with a low risk of unwanted effects. For this, one of the criteria requires that bioenergy feedstocks are sourced from additional production realized without displacing other provisioning services of the land. Or, where existing provisioning services are displaced, alternatives will be implemented. In this methodology, displacement is allowed if alternatives are implemented. This is similar to the idea of no displacement for the project as a whole, which is suggested by IEEP (Allen et al., 2016). However, the RCA does not limit the allowed displacement to any particular project boundary as suggested by IEEP. This allows greater flexibility in the implementation of alternatives, and also increases the risk of unwanted indirect effects, because the alternative activities could be more difficult to monitor and control, for example, if they are implemented in an area out of control of the project developers.

For the demonstration of additionality, the methodology cites two options: either the additionality is required for each individual project, or the additionality is required for a certain project type in a certain region. The choice between these options constitutes "a trade-off between transaction costs and a potential erroneous conclusion on the additionality of an individual project." There is greater risk that additionality would not be correctly assessed when a project type is certified for a region, but the reduced administrative burden for each project manager may encourage greater participation in the program.

For RCA projects on land without provisioning services, additionality could be demonstrated if the land did not deliver provisioning services in the past five years and is located in a region in which no agricultural expansion is expected. If it cannot be shown that the land would not have been used for provisioning services, additionality could still be demonstrated if displacement resulting from the project can be shown not to cause unwanted indirect effects (e.g., use of agricultural land that otherwise would have been abandoned).

ECOFYS, EPFL, AND WWF INTERNATIONAL—LOW INDIRECT IMPACT BIOFUEL METHODOLOGY

In July 2012, Ecofys, in collaboration with WWF International and Ecole Polytechnique Fédérale de Lausanne (former host of the Roundtable on Sustainable Biofuels[2]), published the methodology for Low Indirect Impacts Biofuels (LIIB), version 0 (Ecofys et al., 2012). The project was funded by the NL Agency, a Dutch development organization.

The LIIB methodology partly builds on the RCA methodology (Ecofys, 2010) described above, and aims to certify low indirect impact biofuels by identifying and describing four categories of certifiably low ILUC biofuel production practices, namely increasing feedstock availability for biofuels through:

- Yield increases;
- Integration of bioenergy and agriculture models (sugarcane-cattle integration);
- Production on unused land; and
- Biofuel production from residues.

The last category is an addition compared with the RCA methodology (Ecofys, 2010), which only included the first three measures. The four approaches involved test-pilot projects in four countries: sugarcane cattle integration in Brazil, oil palm yield increase in Indonesia, unused land in Mozambique, and biodiesel from residues in South Africa. Ecofys also used the LIIB methodology in a later study (Ecofys, 2013) to examine a number of waste and residue materials and to assess to what extent a "surplus" of the materials exists that can be used to produce biofuels without causing ILUC.

The methodology provides a means for biofuel/bioenergy producers to identify feedstock production pathways that cause little additional pressure on commodity demand. Direct impacts on sustainability (environmental, social, and economic) are not addressed in the methodology, and the document indicates that a certification of "low indirect impact risk" bioenergy should be integrated within a comprehensive sustainability certification scheme. The methodology is intended to be an independent module that can be added to biofuel policies and existing certification systems for sustainable biofuel and/or feedstock production.

A fundamental difference with the previous RCA methodology (Ecofys, 2010) is that the concept of demonstrating additionality is not directly included in the LIIB methodology. The authors justify this omission based on the fact that proving additionality is challenging because it requires proving the counterfactual (which by definition is not measurable and remains a hypothesis), and can lead to high transaction costs. Therefore, additionality is not included in the methodology in order to "keep transaction costs at a low and acceptable range while maintaining a high level of effectiveness" (Ecofys et al., 2012).

The subsequent methodology developed by the Roundtable on Sustainable Biomaterials (RSB, detailed below) also does not include criteria related to the demonstration of additionality. However, we understand that the idea of additionality is being revisited in ongoing work by Ecofys that we expect to be published later in the year. For example, such additionality-related requirements would require the need to demonstrate a clear link between the implemented measures and the biofuel sector.

Regional approach to ILUC mitigation

While the project-level approaches focus on the role of individual producers in preventing indirect impacts of bioenergy feedstock production, regional approaches have been proposed to apply the idea at a higher level. Such approaches can offer benefits such as lower audit burdens and larger supply of low ILUC risk feedstocks, but they have risks and challenges as well.

2 Previous name of the Roundtable on Sustainable Biomaterials.

Two studies applying regional approaches are described below.

UTRECHT UNIVERSITY, COPERNICUS INSTITUTE OF SUSTAINABLE DEVELOPMENT—ILUC PREVENTION PROJECT

In 2013–2014, the Copernicus Institute of Sustainable Development at Utrecht University (Faculty of Geosciences) carried out the "ILUC prevention project" (Utrecht University, 2016), with the aim of providing insights into how to mitigate ILUC risks, and how to quantify and regulate ILUC mitigation. The project was focused at the regional level, the rationale being that ILUC could be prevented if increased regional production (as a result of a biofuel mandate) is made possible without diverting other crop production or expanding onto high-carbon-stock land.

The project studied two key ILUC prevention measures (above-baseline yield increases and cultivation of currently underutilized land) in four case studies, assessing the amount of additional biofuels that could be produced with a low risk of causing ILUC from these case studies. The results are compared with biofuel targets (e.g., member states' NREAP[3] 2020 targets in the EU) for the case study regions in order to assess whether these targets are achievable without causing ILUC. The four chosen regions are expected to see large increases in production in the future, according to the study.

The project also includes a methodology to assess and quantify ILUC prevention measures (Brinkman et al., 2015). The methodology is based on a combination of a top-down and a bottom-up approach in three steps, illustrated in Figure 5. The first step is a top-down approach, where, for each region, the biomass production under a baseline scenario (the red line in Figure 5) and the amount needed to meet the biofuel target in 2020 (the blue line in Figure 5) are calculated based on outputs generated by the computable general equilibrium model MIRAGE (Modeling International Relationships in Applied General Equilibrium). The second step is a bottom-up assessment, where the biomass production potential from different ILUC mitigation measures is assessed. This potential from ILUC measures is represented as a stacked column on the right side of Figure 5. The measures included are: yield increase (in both agricultural crop and livestock productions), integration of bioenergy and non-bioenergy models, increased bioenergy and agricultural supply chain efficiencies, underutilized land, land zoning, and improved sustainability of the biofuel supply chain. The third and final step is a simple comparison, where the low ILUC risk biomass potential (bottom-up assessment) is compared with the difference between the target and baseline production (top-down model). If the low ILUC potential is equal to or larger than this difference, the ILUC mitigation measures identified in the second step are considered effective in entirely preventing ILUC; otherwise, the measures are considered ineffective in entirely preventing ILUC.

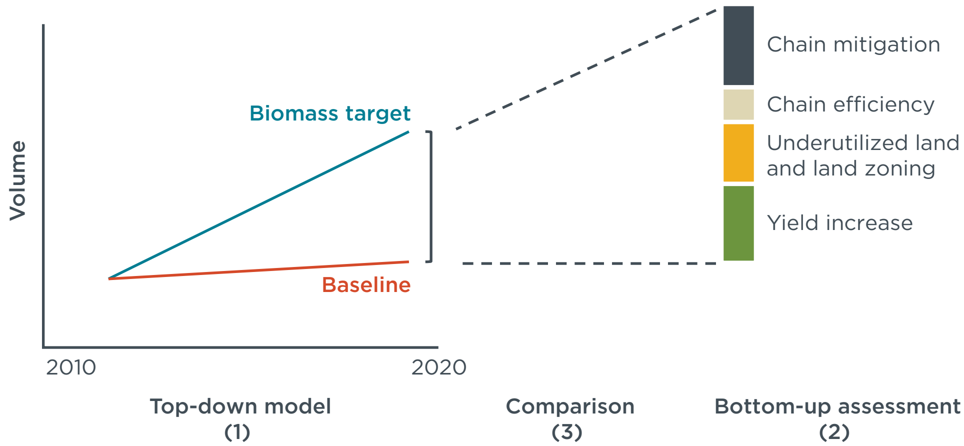

Figure 5. General approach to analyze and quantify biomass production potential with low ILUC risks (adapted from Brinkman et al., 2015).

The authors conclude that because ILUC is a consequence of the interconnected nature of the biofuel and agricultural sectors, a governing framework for ILUC mitigation needs to take a broad and integrated perspective by stimulating increases in resource efficiency and productivity across all crops (whether for food, feed, fiber, or fuel purposes) and by addressing all land use.

The project's key recommendations to prevent ILUC and to promote sustainable production practices for all crops are:

- Stimulating increasing productivity and resource efficiency in the agricultural sector through support and incentives schemes, including access to capital and technology, and capacity building.

3 National Renewable Energy Action Plans, as defined in the RED Directive (2009/28/EC), include the member states' indicative trajectory for the achievement of their final mandatory targets for renewable energy and energy efficiency.

- Providing support and incentives for production on currently under-utilized land.
- Promoting land zoning that excludes high carbon stock, high conservation value, and important ecosystem service areas from conversion to any agricultural use, and that incentivizes forest maintenance.

For example, in a case study in the province of Lublin in Poland, the authors conclude that yield improvement is an important measure to prevent ILUC, through intensification, scaling up, and modernization by farmers. The authors then argue that those measures are constrained by the agricultural system in the province, which is dispersed and characterized by a large number of small farms. The recommended policy to deal with these issues is described as a financial support to facilitate landownership reforms. One of the biggest challenges related to the yield improvement measure proposed in this case study is the demonstration of additionality, namely, to show that all the measures can be linked to the biofuel sector and would not have been the most plausible baseline scenario. This aspect is not clearly taken into consideration by the authors.

As a policy recommendation, the authors of Utrecht University suggest that EU legislation on ILUC mitigation should consider including more ways to mitigate ILUC than just capping first-generation biofuels, such as allowing certified low ILUC risk biofuel production to contribute to the renewable energy target outside of the cap on land-using biofuels (which is a measure already alluded to in the ILUC Directive).

There are a number of challenges to such regional measures (see Malins, 2015). For example, to implement these types of incentives through the RED would require "a European framework that requires implementation plans to be submitted by the appropriate regulatory authorities, that would ideally also require explicit buy-in from local stakeholders that involves ongoing monitoring to ensure that productivity goals are being successfully delivered, and that has systems in place to deal with any failure to deliver on yield targets." This type of system carries a high risk of allowing some biofuel production that is not low ILUC in reality, and could thus create a large and problematic loophole in the ILUC Directive.

Another issue arising with an integrated approach for all crops is that it can be difficult to distinguish between measures that are specifically targeted for the biofuel production and those targeted for the feedstock used in other sectors. It can then become more challenging to demonstrate the additionality of local projects. For example, if a regional authority decides to incentivize a specific yield-increase measure for all crops in a determined area, it becomes difficult to demonstrate that there is a direct link between the measure and the biofuel production—or in other words, that any resultant biofuel production is additional.

ECOMETRICA—REGIONAL LEVEL ACTIONS TO AVOID ILUC

In 2011, the UK Department for Transport published a study by Ecometrica (Department for Transport, 2011) identifying actions that can be undertaken at a regional level to mitigate ILUC, as well as ways to assess the effectiveness of implementation of those actions. These ILUC-mitigation actions include yield intensification, cultivating abandoned land, protecting high-carbon-stock land, reducing waste/increasing resource efficiency, and decreasing consumption of high-land-requirement commodities such as meat.

The report included examples of how these ILUC mitigation measures could be used. One example is the reduced expansion of palm oil plantations into forest and peat land in Indonesia and Malaysia, and increased yields and productive lifetimes of plantations. Another example is yield increase of wheat and rapeseed oil in the EU, and the use of their byproducts (wheat dry distillers' grain with solubles and rapeseed meal) for animal fodder.

The study mentions several advantages of a regional approach to mitigate ILUC. Compared with the project-level approach, it may be more efficient in terms of lower costs of monitoring per unit of bioenergy produced. A regional approach also allows flexibility in where mitigation measures occur within a region; namely, the mitigation action does not have to be physically linked to bioenergy feedstock production. In other words, managing and mitigating land use change, and the transmission of ILUC, for all agricultural production within a region means that a large proportion of biofuels are not produced within dedicated "bioenergy" plantations. This approach would thus cover the production of biofuels from feedstocks that are sold on the open market.

This last paragraph illustrates that it would be very difficult to demonstrate additionality using this methodology. In order to mitigate ILUC, even a regional approach has to include an evaluation of a baseline scenario versus a biofuel scenario, and this means that it has to assess to what extent an increase in agricultural production is linked to biofuel demand. In contrast, this methodology assesses changes across the agricultural sector as a whole, and it would not be possible to determine to what extent those changes are driven by biofuels rather than other factors.

This integrated perspective across all agricultural production is similar to the one proposed by Utrecht University, and presents similar advantages and limitations. The regional approach might be associated with less burdensome audits than the project-level approach, but it is not clear that these methodologies could effectively demonstrate ILUC mitigation.

ILUC mitigation in certification schemes

The European Commission recognizes a number of voluntary schemes that demonstrate compliance with the RED sustainability criteria for biofuels on direct land use change. At the time of writing, 19 schemes are approved (European Commission, 2016). In a similar fashion, the EC could recognize voluntary schemes for demonstrating a low risk of indirect impacts. Out of the recognized schemes, only the RSB provides a low ILUC risk set of criteria and compliance indicators at the time of writing. This is detailed below.

ROUNDTABLE ON SUSTAINABLE BIOMATERIALS

In 2015, the Roundtable on Sustainable Biomaterials (RSB) released a set of low ILUC criteria and compliance indicators (RSB, 2015) based on the LIIB methodology (Ecofys et al., 2012) and developed in collaboration with Ecofys. It is a voluntary addition to the more general sustainability certification, not a stand-alone certification. The low ILUC module is meant to be used in combination with the regular RSB certification process to ensure that all direct impacts are effectively addressed. Operators that successfully undergo a RSB certification audit are entitled to an extra "low ILUC risk" on-product claim.

The document includes three approaches for low ILUC risk biomass and biofuels production:

1. Yield increase: this applies to a situation where feedstock producers increase the amount of harvested biomass compared with a reference date, without any additional land conversion, as a result of:
    a. Improvement in agricultural practices (e.g., increase in organic matter content, reduction of soil compaction/erosion, decrease in pests);
    b. Intercropping: the combination of two or more crops that grow simultaneously, (e.g., as hedges or through an agro-forestry system);
    c. Crop rotation: the combination of two or more crops that grow at different periods of the year.
2. Unused/Degraded land,
3. Use of waste/residues.

Compared with the LIIB methodology (2012), the RSB does not include the approach of integration of bioenergy and agriculture models (sugarcane-cattle integration). It also does not adequately demonstrate additionality.

For each of the three measures, the methodology describes the requirements related to the determination of the baseline, the monitoring, and the calculation of the amount of "low ILUC risk biomass." In the first measure, yield increase, the operator must document a management plan describing the intended yield-increase measures and their expected contribution to increased yields of the target crops. A few examples of yield-increase management practices are provided, such as soil management, crop rotation, crop protection, and pollination. The reference year must be documented; it is the date before which agricultural practices cannot be considered as yield-increase measures. It is defined as either 2008 or the year preceding the implementation of yield-increase measures, whichever is later.

In the first measure, the baseline yield is calculated from a combination of the operator's historical reference yield (defined as an average of the yields of the four years before and including the reference year) and average annual yield growth (percentage) for similar producers in the same geographic region (calculated from a simple linear regression based on the average annual yields of similar producers in the 10 years before the reference year). The amount of low ILUC risk biomass is calculated by simply subtracting the actual yield and the baseline yield, and then by multiplying the difference by the concerned crop area. Under this approach, half of all producers in the region would, by definition, qualify as producing additional yield increases without having actually made any changes in response to biofuel demand. In addition, this approach does not address agricultural improvements driven by other factors. It is thus difficult to confirm that yield increases claimed by producers under this method are in fact delivering higher production than would have occurred without biofuel demand.

The second measure described is the unused land scenario. The first set of criteria is divided into two cases:

1. The land was not used for its provisioning services, including production of food, feed, or bioenergy feedstock, during the three years preceding the reference date. This must be

evidenced through interviews with the landowner, local people and authorities, satellite images analysis, and/or land use records. An additional criterion specifies that "No shifting cultivation shall take place on the land"; this refers to practices where fields can be left fallow for years before being planted again.

2. The land was used for limited provisioning services during the three years preceding the reference date. In that case, the operator has to demonstrate that "the land was used for provisioning level up to a yield that is 25% or less (by energy content, protein content or estimated market price) of the earnings or yield that can be reasonably expected from cultivation of the same crop(s) in normal conditions." This must be evidenced through official data or interviews with local stakeholders. The second criterion for this case requires that the "operations do not affect the limited provisioning service that existed prior to the reference date" and, when the operations do affect those services, the operator has to "demonstrate that compensation measures providing equivalent benefits to local communities are in place that are in line with criteria 2b, 12a, and 12b of the RSB Principles & Criteria."[4]

The amount of low ILUC risk biomass is calculated through the actual annual yield and the surface area of the land. In the case where the land was already used for provisioning services, only the additional biomass is eligible as low ILUC risk biomass. This measure also does not adequately demonstrate additionality because producers are not required to show that the land would not have been used for provisioning services in the absence of biofuel demand. For example, in an area where agriculture is expanding, cultivating biofuel feedstock on historically unused land could in fact displace food production that otherwise would have expanded onto this land.

The third and last measure included is the waste and residues scenario. The given examples are used cooking oil, municipal solid waste, agricultural residues, wastewater, and animal fats. The full set of cases for defining a biofuel from waste/residue as low ILUC is given as follows:

1. The biomass used for biofuel or biomaterial production is eligible as a waste or a residue under RSB requirements.[5]
2. The waste/residue is generally discarded for landfilling or incineration in the region where it is generated; in other words, there is no other use being made of it. The region considered can be at the subnational, national, or supranational level.
3. The use of the waste/residue does not result in any indirect increase in GHG emissions. For example, the material was not used previously for energy generation (electricity, heat, and power), as a fertilizer, and/or its diversion does not result in the use of fossil fuels as replacement.
4. The use of the waste/residue does not result in any displacement of land use. For example, the material was not used previously as food, feed, fiber, or any other use requiring arable land.

The second criterion can be replaced by the third and fourth criteria. The second criterion assumes that, if a waste is landfilled or incinerated, it can be deduced that it has no use associated with it and is therefore low ILUC risk. There is, however, no mention of the case where the waste is landfilled in a facility that implements landfill gas recovery. The diversion of waste from such a landfill can cause a diversion of energy that can lead to substitution with fossil fuel or biomass, which could eventually cause ILUC. Despite this omission, the waste and residue scenario offers the strongest case within the RSB Low ILUC methodology for producing biofuel feedstock that is additional.

Conclusion

Several low indirect impact measures have been addressed in this study, from the local to the regional level. After reviewing the proposed methodologies, it appears that if this concept were to be used for regulatory purposes in the European legislation, it would be necessary to integrate additional criteria in order to prevent potential risks and loopholes.

Some of the particular challenges with project-level approaches are related to yield improvement on existing cropland; however, this is more relevant for food crops at the moment, considering the relatively low uptake of energy cropping. It could be easy

4 In the *RSB Principles & Criteria for Sustainable Biofuel Production* (RSB-STD-01-001, Version 2.1, March 2011, retrieved from: http://rsb.org/sustainability/rsb-sustainability-standards/):

- Criterion 2b defines minimum requirements related to the stakeholder consultation.
- Criteria 12a and 12b define minimum requirements related to land rights and land use rights.

5 The *RSB Standard for certification of biofuels based on end-of-life-products, by-products and residues* (RSB-STD-01-010, Version 1.6, November 2013) or the *RSB EU RED Standard for certification of biofuels based on waste and residues* (RSB-STD-11-001-01-010, Version 0.7, May 2015). Retrieved from: http://rsb.org/sustainability/rsb-sustainability-standards/.

to imagine several situations leading to loopholes, where yield-increase measures are being rewarded even though they would have happened anyway without the biofuels demand, because of other external factors such as climatic variations or widespread regulatory changes in agricultural practices. Future methodologies should take this aspect into consideration. Furthermore, yield-increase measures are linked to a problem of variability in the sense that, when considering a group of individual projects, there is a probability that a subset of them will give above-trend yields, and without a clear demonstration of additionality there is a risk of crediting an essentially randomly determined subset of farms each year.

The unused land measure also inadequately demonstrates additionality if the producer is not required to show that the land would otherwise have remained unused. The use of waste and residues is somewhat less problematic. The main issue is in the identification of the existing or potential uses of the waste and residues, but this could be handled through careful and adequate documentation, and it should be feasible to certify and audit additionality in this case.

A combination of such project-level certification with policy actions at regional levels could further help in mitigating ILUC. However, the regional approach of low indirect impact is not implementable and certifiable as described in the available literature. Notably, proposed measures such as landownership reforms seem difficult to implement in practice, unless appropriate European or national frameworks are put in place. Additionality would be even more difficult to certify for regional approaches compared with project-level measures; because the reviewed methodologies assess changes across the agricultural sector as a whole, it would be difficult to determine to what extent those changes are driven by biofuels rather than other factors.

In general for all the measures described, the concept of additionality is a pillar in ensuring that a feedstock does not (or at least partially) substitute other uses in such a way that indirect effects such as ILUC are created. For each project-level measure, there exists a risk that if additionality cannot be demonstrated in a credible way, loophole situations will appear such that substantial amounts of high-ILUC risk biofuels will be certified as low ILUC risk. Any policy incentives for low ILUC certification should take this aspect into consideration, even though it may add burdens and additional costs to the certification process.

Our conclusion is that the concept of low indirect impact or “no displacement” biofuels, even though described through several measures and methodologies, is still in its infancy stage, and would require supplementary requirements and risk analyses if it were to be included in a new European legislation as an additional sustainability criterion for the production of biofuels and bioenergy post-2020.

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