Low Indirect Impact Biofuel (LIIB) Methodology

WORKING WITH
ECOFYS AND EPFL
TO DEVELOP A
METHODOLOGY
FOR LOW INDIRECT
IMPACT BIOFUEL

Ecofys
EPFL
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Low Indirect Impact Biofuel (LIIB) methodology

Pictures cover page:
1.) Cows and animal feed ingredients: Cattle sugarcane integration, Brazil. © Sigrid Brynestad, DNV.
2.) Oil samples: Biodiesel production based on used cooking oil by Biogreen, South Africa. © Sigrid Brynestad, DNV.
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Low Indirect Impact Biofuel (LIIB) methodology

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Foreword

This document contains a methodology to distinguish biofuels with a low risk of causing indirect impacts. It develops concepts proposed for mitigation of indirect land-use change (ILUC) and other indirect impacts into a practical and cost-effective methodology that can be used by policy makers and voluntary certification schemes that wish to stimulate biofuel production with a low risk of unwanted indirect impacts.

The low indirect impact biofuel (LIIB) methodology presents approaches for four different solution types with a certifiably low risk of causing indirect impacts, namely increasing feedstock availability for biofuels through: yield increases; integration of bioenergy and agriculture models; production on unused land; and biofuel production from residues. To date, only one integration model has been worked out in detail, namely the integration of ethanol sugarcane and cattle production.

These approaches have been field-tested in four pilot projects (sugarcane cattle integration in Brazil, oil palm yield increase in Indonesia, unused land in Mozambique, and biodiesel from residues in South Africa). In addition, the LIIB methodology has been applied and tested in desk-studies on bioenergy projects in Tanzania and Ukraine. Extracts of the results of the pilots are included in this document. The detailed pilot reports will become publicly available.

The LIIB methodology has been developed by WWF International, Ecofys and Ecole Polytechnique Fédérale de Lausanne (EPFL; hosting the RSB Secretariat) with important contributions from Wageningen University, the University of São Paolo, WWF Indonesia, WWF Mozambique, Biogreen and the certification body DNV.

This project to develop Version Zero of the methodology, which ran from January 2011 until July 2012, was funded by the Dutch development and implementation organisation NL Agency. Version Zero of the methodology will be subjected to peer-review and presented at a public workshop in 2012. Future goals include further piloting of the methodology and the development of additional solution types, including production on “Underused Land” and additional “Integration Models”.

Acknowledgements

We gratefully acknowledge the contributions of all experts that provided their input to the project during consultations carried out. Special thanks goes to the consortium partners for their valuable contributions in developing this methodology (in random order): Sigrid Brynestad (DNV), Gerd Sparovek, Marina Guyot, Lister Duarte, Ricardo Bürgi, Alberto Barretto, Adriano Bachi (University of São Paulo), Idsert Jelsma, Ken Giller, Thomas Fairhurst (Wageningen University), Hans Smit, Arif Budiman, Dari Rahadian, Margaretha Nurrusina, Nur Anam, Riko Kurniawan (WWF Indonesia), Heko Koster, Gabriel Albano, Rogério Marcos Chiulele, Joachim Macuacua (WWF Mozambique) and Roy de Gouveia (Biogreen).

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Table of contents

1 Background – distinguishing bioenergy with a low risk of indirect impacts 5
  1.1 The importance of bioenergy 5
  1.2 Bioenergy requires large land areas 5
  1.3 Direct impacts of bioenergy feedstock production 5
  1.4 Indirect impacts of bioenergy feedstock production 6
  1.5 Options to prevent unwanted indirect impacts 8
  1.6 The LIIB methodology 10
  1.7 Application of the LIIB methodology in other sectors 11

2 Key considerations for a Low Indirect Impact Biofuels methodology 12
  2.1 Objective of the Low Indirect Impact Biofuels methodology 12
  2.2 Effectiveness and practicality of the methodology 13
  2.3 Incorporating the methodology for Low Indirect Impact Biofuels in existing certification schemes and policies 14

3 LIIB methodology 16
  3.1 Process steps in the LIIB methodology 16
  3.2 Generic requirements for chain of custody, audit frequency and claims 19
  3.3 Yield increase projects 21
  3.4 Biofuel feedstock integration projects: Sugarcane-cattle integration 29
  3.5 ‘Unused land’ projects 34
  3.6 End-of-life feedstock projects 41

References 45

Appendix A - Cost of certification to LIIB methodology 47
  A.1 Analysis of costs of LIIB certification 47
  A.2 Extra cost of certification to LIIB methodology if performed as part of a sustainability certification process (DNV comments, extracted from pilot reports) 48
  A.3 Conclusion on costs of certification of LIIB methodology 48

Appendix B - Project Application Document 50

Appendix C - Plan of Operation 52
1 Background – distinguishing bioenergy with a low risk of indirect impacts

1.1 The importance of bioenergy

Because of climate change, increasing energy demands and the drive to secure a steady supply of energy, the urge to implement non-fossil energy technologies is increasing. Expectations are that the worldwide use of biomass as a source of sustainable energy will increase considerably in the coming decades. Much of the demand growth is expected to be driven by government mandates for obligatory shares of energy from renewable sources in transport or energy, or by government support schemes.

Biofuels and other forms of bioenergy are expected to play an important role in meeting future energy demands, especially in a number of sectors for which few alternatives exist, such as aviation, shipping, long distance road freight transport, and industries requiring high temperature heating. During the transition to other alternatives, bioenergy can also play an important role in decreasing greenhouse gas (GHG) emissions from passenger vehicles, and heat and power generation. Developing a successful and sustainable bioenergy sector is therefore of key importance to decarbonising our economy.

1.2 Bioenergy requires large land areas

Nowadays, large-scale bioenergy and especially biofuel production imply large land requirements, since most biofuel feedstocks today are produced from crops that need productive land and water. Non-land based biofuels (e.g. from residues) are not likely to be sufficient to cover the total bioenergy demand (see Ecofys 2008). Nonetheless, as illustrated in several studies, large potentials exist for the sustainable production of land based biofuels (e.g. WWF and Ecofys, 2011; Ecofys and Winrock, 2009a). The challenge is to ensure that production takes place in a sustainable manner.

1.3 Direct impacts of bioenergy feedstock production

The bioenergy feedstock demand and the associated land requirements can have direct and indirect impacts. One of the main direct impacts is direct land use change (LUC). In general terms, direct LUC occurs when there is a change in the land use of an area: for example, when new areas that were previously uncultivated are taken into production to produce additional bioenergy feedstock, or when there is a change from grazing land to crop land, and vice-versa. This can impact biodiversity, carbon stocks and livelihoods.

Direct LUC and other direct impacts of biofuel/bioenergy feedstock production can generally be measured and attributed to the party that caused them. These properties make direct LUC relatively...
easy to control. The EU Renewable Energy Directive (RED) and voluntary certification schemes such as the Roundtable on Sustainable Biofuels (RSB) Standard already include criteria for the prevention of unwanted direct LUC of feedstock production for biofuel and bioliquids.

1.4 Indirect impacts of bioenergy feedstock production

Bioenergy feedstock production can have unintended consequences well outside the boundary of production operations. These are indirect impacts, which cannot be directly attributed to a particular operation. The most cited indirect impacts are indirect land use change (ILUC) and food/feed commodity price increases (an indirect impact on food security).

The extent of indirect impacts caused by increased bioenergy production has been modelled for different bioenergy production scenarios. The majority of ILUC quantification studies estimate that biofuels from most feedstocks commonly used today have ILUC emissions associated with them and these emissions are of an order of magnitude that seriously threatens the GHG savings potential of the biofuels (Laborde, 2011; Bauen et al., 2010; Edwards et al., 2010). These modelling exercises roughly make the following assumptions: Nowadays, the additional bioenergy and biofuel production mainly comes from agricultural commodity feedstocks. An increased demand for such commodities results in higher commodity prices in global markets in the short-term. This can have important impacts on food security. Because these commodity price hikes cannot be attributed to any one concrete biofuel operation, we call it an indirect impact of biofuel production on food security.

Increased commodity prices, in turn, can cause the following market reactions, some of which have impacts on land use change:

1. Additional commodiy production through *extensification*, i.e., through the conversion of additional land. Because this land can be anywhere in the world, its conversion is termed an **indirect land use change (ILUC)**. If the converted land has high carbon stocks and/or ecosystem values and services, its conversion can release substantial GHG emissions and/or result in the loss of such ecosystem services and biodiversity.

2. Additional commodity production through *intensification*, i.e., increasing the yield and/or the efficiency of the lands currently in production through, e.g., additional inputs, denser planting, better seed varieties, intensification of cattle farming, etc. This can also have negative consequences on sustainability, not addressed in this paper.

3. Price-induced reduction in consumption: higher commodity prices may force people to consume less food, or consume cheaper alternatives (e.g. less meat), resulting in lower global demand for commodities.

Indirect land use change and indirect impacts on food security are just two aspects of potential indirect impacts caused by increased biofuel production from agricultural commodities. Other
potential indirect impacts of increased biofuel production could include, for example, additional fertiliser, water, or other inputs required for intensification of non-biofuel crop production.

**Biofuels and Bioenergy are just one driver of ILUC and increased commodity prices**

Increased biofuel production is just one cause for increasing commodity prices. Other drivers are:

- Increased global demand for food (especially meat) and feed caused by rising incomes
- Population growth
- Poor harvests
- Higher cost of fossil fuels
- Market speculation
- Export and trade restrictions
- Fluctuations in currency markets, etc.

It is also important to note that food commodity prices are not the only determinant of food security. Out of the four “pillars” of food security, namely availability, access, utilization and stability (FAO), short-term commodity prices have an impact on both access and stability.

Global (or indirect) land use change is a result of the cumulative direct land use changes in the part of the world where they take place. Direct land use change is, to a degree, attributable to increased commodity prices (which are, to a degree, attributable to increased biofuel production). But there are many other drivers for direct land use change, including:

1. Poor land governance, linked to poorly enforced land use policies and uncertain land tenure regimes;
2. Economic and/or policy incentives to deforest (“manage”) the land in order to claim ownership of the land;
3. Urban development, etc.

**The role of certification**

Certification can play a role in addressing ILUC and indirect impacts on food security caused by increased bioenergy/biofuel production. Best management practices implemented at the operator level can, cumulatively, help reduce global pressures on land. This document provides a means for biofuel/bioenergy producers that cause little additional “pressure” on commodity demand to differentiate their operations and make a “low risk” claim. Nevertheless, certification-level action alone is not sufficient.

**The role of governments and policy**

The role of governments and governance in reducing conversion and degradation of natural habitats and addressing food security is critical. The European Commission cites ineffective governance in the form of poorly enforced land use policies and uncertain land tenure regimes as “the most important”
underlying cause of deforestation (European Commission, 2011, draft). Policy actions at the regional, national and international level and addressing all land-use activities (agriculture, cattle farming, biofuels, etc.) will be essential in tackling the issues of ILUC and food security.

1.5 Options to prevent unwanted indirect impacts

The bigger picture: Global versus project-level mitigation measures

In theory, three types of mitigation measures are available to prevent or minimise unwanted indirect impacts from bioenergy. The first two options concern global mitigation measures, while the third describes project-level mitigation measures. Note that these options can be applied in a complementary way, and an optimum, long-term solution would likely combine all of these:

1. **Prevent unwanted direct land use change, globally and for all sectors.** ILUC manifests itself through direct LUC from all land use activities (e.g. agriculture, cattle farming, biofuel production, urban development, etc.). Preventing unwanted direct LUC from all land use sectors would thus eliminate unwanted ILUC altogether. Because of the global, cross-boundary characteristics of ILUC and the competition for land between different sectors, to be effective, this mitigation measure requires global action across all land-intensive sectors.

2. **Reduce pressure on land from the agricultural sector as a whole** by increasing yields, supply chain efficiencies and/or through a reduction in waste (post-harvest and post-consumer), for example through increased public R&D or policy incentives. This would reduce the need for expanding the area used for agricultural production. However, projections from leading agricultural institutions predict an expanding agricultural area during the next decades\(^1\). In addition, even a globally constant or shrinking agricultural area does not necessarily prevent unwanted LUC. Shifts in land used for agricultural production (without a net increase in the total area) can still cause unwanted LUC.

3. **Production models that prevent indirect impacts at a project level.** While the first two mitigation measures take a macro, cross-sectoral approach (in which governments are key actors), this approach focuses on the role individual producers can play in preventing indirect impacts of bioenergy feedstock production. This includes implementing mitigation measures such as yield and efficiency increases, integration of food and fuel production, production on “unused” or “underused” land and the use of end-of-life products as feedstock. Such indirect impacts mitigation measures can be implemented at the project level and thus focus on the actions that individual producers can implement. The next section explains this option in more detail.

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\(^1\) According to an estimate by FAO (2010), global food production will need to increase by 70% by 2050 (and by 100% in developing countries) to meet the growing demand for food due to demographic growth and dietary changes.
What individual producers can do to prevent unwanted indirect impacts

A number of solutions have been proposed that reduce the risk of indirect impacts of biofuel and bioenergy production (RSB, 2010; Ecofys, 2010; Ecofys and Winrock 2009a; RFA, 2008; Ecofys, 2008). Indirect impacts, including indirect land use change and other indirect impacts such as food security, are to a large extent the result of the “displacement effect” of food/feed commodities caused by biofuel/bioenergy production. Thus the project-based solutions listed below are aimed at reducing this “displacement effect”:

1. Biomass production on “unused land” - land that does not provide provisioning services. Because this does not displace other human uses of the land, it does not cause indirect impacts. Expanding production on unused land does lead to a direct LUC, but such direct LUC is controllable (e.g. through certification) and can be limited to those areas where impacts are acceptable.

2. Increasing feedstock availability for biofuels without increasing the pressure on land through increased yield or land productivity. Potential negative environmental or social impacts from intensification models have to be taken into consideration.

3. Biomass production on “underused land” – falls between the above two categories, and is of special relevance in smallholder farming operations in developing countries.

4. Increasing feedstock availability through reduction of post-harvest waste. This is especially relevant in some developing countries where post-harvest waste (e.g. due to inadequate storage facilities) can be significant.

5. Integrating food and fuel production in ways that lead to a higher overall land productivity and thereby prevent additional pressure on land.

6. Bioenergy production from end-of-life products (residues and wastes). Current functions and uses of these residues must be well understood; otherwise displacement, and the associated indirect impacts, may still occur.

7. Bioenergy production from feedstocks that require little land, such as aquatic biomass (algae), as long as they are currently not used for other purposes.

In all categories, the direct impacts on sustainability (environmental, social and economic) should be taken into account. Hence, a certification of “low indirect impact risk” feedstock or bioenergy should always be integrated within a comprehensive sustainability certification scheme.

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2 The Millennium Ecosystem Assessment (2005) distinguishes four categories of ecosystem services: Provisioning services, regulation services, cultural services and supporting services. Provisioning services are defined as products obtained from ecosystems, including food, fibre, fuel, natural medicines, water and timber.

3 Also referred to as “idle land”, “degraded land”, “marginal land”, “waste land” or “abandoned land”.

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1.6 The LIIB methodology

This report presents a methodology to distinguish biofuels with a low risk of unwanted indirect impacts (LIIB). Concretely, it develops a practical and cost-effective methodology for four of the "low risk" categories listed in the section above (Unused land; Increased yield; Integration of sugarcane and cattle; and End-of-life products). Over time, it is the intent of the project partners to expand the methodology to include other categories listed above.

This methodology can be used in biofuel policies and voluntary certification schemes that wish to stimulate biofuel production with a low risk of unwanted indirect impacts. We will refer to this as the Low Indirect Impact Biofuels (LIIB) methodology.

The LIIB methodology is developed as an independent module that can be added to biofuel policies and existing certification systems for sustainable biofuel and/or feedstock production, such as the Roundtable on Sustainable Biofuels (RSB) Standard.

The methodology can be used in combination with all policy options that wish to differentiate between biofuels with a low or high risk of such unwanted indirect impacts. For example, the EC currently recognises voluntary schemes for the purpose of demonstrating compliance with the requirements of the EU Renewable Energy Directive on direct land use change. In a similar fashion, the EC could recognise voluntary schemes for demonstrating a low risk of unwanted indirect impacts.

It is important to note that this methodology should be used in conjunction with certification schemes/policies that already address direct impacts, as this methodology does not address any direct impacts on sustainability.

Note that, as stated above, we do not believe that project-level action alone is an effective measure in mitigating global land use change and increasing food/feed commodity prices, which are caused only to a degree by the expanding bioenergy sector. Government-level action across land use sectors (agriculture, biofuels, cattle ranching, urban planning, etc.), and across international borders, is key.

Box 1 - Further reading

This methodology offers practical and field-tested methods to reduce the risk of indirect impacts. The methodology has been tested in four different pilots in Brazil (sugarcane cattle integration), Mozambique (cultivation on unused land), South Africa (residue and waste) and Indonesia (smallholder palm oil yield increase). For each pilot a report is available describing the process and findings. Extracts of the pilot reports have been included in this report.

More information on the concepts of ILUC mitigation can be found in the Responsible Cultivation Area (RCA) methodology (Ecofys, 2010, 'Responsible Cultivation Areas - Identification and certification of feedstock production with a low risk of indirect effects'). More information on the potential for low indirect impact production models and their main barriers can be found in 'Mitigating indirect impacts of biofuel production - Case studies and Methodology' (Ecofys and Winrock, 2009).
1.7 Application of the LIIB methodology in other sectors

This version of the LIIB methodology focuses on biofuels. It could also be applied to other non-traditional uses of bioenergy and to non-bioenergy uses of biomass with minimal modification.

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4 Traditional bioenergy is mainly composed of solid fuels for cooking, heating and lighting, often with low efficiency and in developing countries

2 Key considerations for a Low Indirect Impact Biofuels methodology

The next chapter sets out the proposed design of the Low Indirect Impact Biofuels methodology. This chapter first discusses a number of considerations on important aspects such as the scope, the practicality and effectiveness of the methodology, and how it could be used by existing certification systems for sustainable biofuel/feedstock production. These considerations form the basis and set the boundaries for the detailed design in the next chapter.

2.1 Objective of the Low Indirect Impact Biofuels methodology

The objective of this methodology is to enable biofuel production with a low risk of unwanted indirect impacts and to allow biofuel producers to reliably claim this. Therefore, this methodology has been developed to certify that biomass feedstock for biofuels have been produced with a low risk of indirect impacts\(^5\). Please refer to the previous chapter for a theoretical discussion of indirect impacts.

The overarching principle for a low risk of unwanted indirect impacts applied in this methodology is to produce biofuel feedstock without displacing previous productive functions or provisioning services of the land. By not displacing food or feed production, the risk that biofuels feedstocks will contribute to additional commodity price hikes and/or additional global LUC is minimized.

In chapter 3, this report presents a detailed approach for the following four solution types (as introduced in Section 1.5\(^6\)):

1. Biomass production on 'Unused' land
2. Increasing biomass availability through yield increases
3. Integration model: sugarcane ethanol and cattle
4. End-of-life products (residues and wastes)

\(^5\) Note that to ensure the sustainability of biofuels it is indispensable that the direct effects are also taken into account; this is further elaborated in section 2.3 and 3.2.

\(^6\) An approach for feedstock production on "underused land" or biofuel from aquatic biomass is currently not worked out in this document.
Box 2 - Comparison definitions of degraded land and residues in the LIIB methodology versus the RED

The solution types worked out in this report include, amongst other things, biofuels produced from residues and biofuels produced from feedstock cultivated on previously unused land. The RED also distinguishes biofuels from residues and wastes and biofuels from feedstock cultivated on “degraded land”. Here we clarify the similarities and differences between these concepts in the RED and the concepts used in this methodology:

Degraded land in the RED is defined as land that was not in use for agriculture in January 2008 and that was either heavily contaminated or severely degraded. Thereby this concept forms a subset of the concept “unused land” as used in this methodology, see section 3.5. The focus of the “unused land” concept is to prevent displacement of e.g. food or feed production: the land does not have to be contaminated or degraded for this purpose. Therefore, more land will qualify as “unused land” in this methodology than would qualify as “degraded land” in the RED.

Wastes, for the purpose of double counting in the RED, are defined as a substance which the holder discards. Residues, for the same purpose, are not defined in detail but include agricultural residues, forestry residues and processing residues. A processing residue is not the end product that a production process directly seeks to produce. The focus of the “end-of-life products” concept in the LIIB methodology is on substances that otherwise would not be used for alternative uses other than land filling or waste incineration (wastes and residues), see section 3.6. Thereby, presumably fewer substances will qualify as a residue under this methodology than would qualify as a residue in the RED.

The LIIB methodology aims to minimise the risk of unwanted indirect impacts from biofuel production by identifying low or lower risk feedstocks (e.g. end-of-life products), and by defining best practices that lower the risk of negative indirect impacts for any biofuel feedstock (e.g. increasing yield/productivity, cultivating on unused land, etc.). Therefore, one of the aims of the methodology is to make it possible for a large number of biofuel feedstock types to potentially qualify as having a low risk of negative indirect impacts if specific production practices are implemented.

2.2 Effectiveness and practicality of the methodology

Effectiveness and practicality – why they matter

For the LIIB methodology to be effective it must ensure that certified biofuels have a low risk of unwanted indirect impacts. As discussed in the previous section, the principle requirement for this is that biofuel feedstock production does not displace other production. To meet this requirement the biofuel feedstock production must be additional. In practical terms this means that the project activity should not have occurred in the absence of the biofuel demand. After all, if the project activity would have been implemented anyway (e.g. the yield increasing measure or the integration model) and the resulting feedstock production is diverted to biofuels at a later stage, a displacement of existing production has occurred, with the resulting risk of unwanted indirect impacts. However, additionality is extremely difficult or even impossible to prove in practice because it essentially
requires proving the counter-factual (what would otherwise have occurred), which is by definition not measurable and will always remain a hypothesis. Experience from carbon markets developed as part of the Kyoto Protocol, such as the Clean development Mechanism (CDM), shows that proving such additionality is challenging, is not infallible and, depending on the methodology chosen, can lead to high transactions costs.

For the methodology to deliver results it must be both effective (minimising the risk of unwanted indirect impacts) and have acceptable transaction costs. The methodology proposed in this document is based on an analysis of the lessons learned from the carbon markets\(^7\). It is designed to keep transaction costs at a low and acceptable range while maintaining a high level of effectiveness. For a discussion on the cost of LIIB certification, please refer to Appendix A.

**Evaluation criteria used in the design of the methodology**

The next chapter sets out the proposed methodology for each solution type. The methodology for each solution type will be analysed on:

- **Free-rider potential.** The free-rider potential consists of the projects that meet the requirements of the methodology but that are not truly additional. The larger the free-rider potential is relative to the demand for Certified Low Indirect Impact Biofuels, the lower the effectiveness.

- **Transaction costs.** The following proxies are used for analysing transaction costs, including practical experiences gained during the pilot projects:
  - Data requirements: the amount of data that has to be gathered and the availability of such data;
  - Methodological complexity;
  - Ease of verification by an auditor.

Note: In analysing the free-rider potential it is assumed that LIIB claims can only be transferred through the supply chain using a Mass Balance chain of custody system. The Mass Balance approach is in line with current EU biofuel legislation.

2.3 Incorporating the methodology for Low Indirect Impact Biofuels in existing certification schemes and policies

The LIIB methodology is envisaged to be incorporated by existing certification systems for sustainable biofuel and/or feedstock production, such as the Roundtable on Sustainable Biofuels (RSB) Standard. Thereby, the LIIB methodology can be added as an optional module to the existing

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\(^7\) A summary of the analysis and lessons learned from the carbon markets is available on the LIIB website.
standard for operators wishing to demonstrate and subsequently make an extra claim of “low risk” of unwanted indirect impacts.

Several existing voluntary certification schemes already include criteria for the prevention of unwanted direct impacts of energy crop cultivation. This LIIB methodology focuses on indirect impacts of biofuels. To ensure the sustainability of biofuels it is indispensable that the direct impacts are also taken into account. For example, a local increase in water consumption due to additional production of energy crops may affect water availability in the wider area and should be taken into account during the assessment of direct impacts.

If scheme owners (such as the RSB, RTRS, Bonsucro, RSPO etc.) choose to incorporate the LIIB methodology into their certification system, they will fit this into the existing operational certification system procedures and rules. For example, the certification system may already have detailed requirements in place for the audit frequency and the chain of custody system. To allow various certification systems to incorporate the LIIB methodology into their existing systems in a flexible manner, while maintaining its integrity and reliability, this methodology only sets out the minimum requirements for aspects such as auditing frequency and chain of custody systems that should be adhered to for a credible and effective implementation. This implies that the requirements for aspects such as auditing and chain of custody will be formulated in a more generic way, while the specific methodology for demonstrating a low risk of indirect impacts (Chapter 3) is much more specific.

If multiple voluntary schemes are to adopt the LIIB methodology, a coordinated approach would be beneficial. For this purpose and to provide ongoing support to users, a central body to host, administer and maintain the LIIB methodology is recommended.

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<th>Box 3 - Terminology</th>
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<td><strong>Scheme owner:</strong> it is the aim of this project to deliver a methodology that can be integrated in new and existing biofuel/bioenergy/biomass sustainability certification schemes. In the methodology discussed in Chapter 3 the owner of such a certification scheme is referred to using the term “scheme owner”.</td>
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**Unit of certification**

Under the LIIB methodology, biomass production locations (e.g. plantations and farms) are certified. Operators/producers can make claims on individual units of product produced that meet the LIIB requirements. Claims are discussed for each LIIB category in (Chapter 3).
3 LIIB methodology

This chapter sets out the methodology for the certification of biofuel feedstock with a low risk of unwanted indirect impacts. Section 3.1 first describes the various steps that lead to certification and explains each step in detail. Next, section 3.2 sets out the generic minimum requirements for auditing, the chain of custody and the claims that can be made. This becomes especially relevant when existing certification systems incorporate the LIIB methodology. Having set out the overall process and the generic requirements for certification, the next sections describe the detailed methodologies for each solution type. This includes 1) the system boundary, 2) the rules for project acceptance (project acceptance requirements), 3) how to set the baseline, 4) the monitoring process, and 5) guidance on how to deal with special situations. Each proposed methodology is analysed on its effectiveness and transactions costs, using the indicators set out in Section 2.2.

3.1 Process steps in the LIIB methodology

The figure below summarises the steps in the LIIB methodology from project application to LIIB certified production. The various steps and the parties responsible are discussed below. Three moments in time can be distinguished (see Figure 1). The LIIB methodology starts with a project application from the party that wants to develop a project with a low indirect impact risk ("Project Developer"). Once the application is received and confirmed by the scheme owner, the biomass project needs to have its project design audited to make sure it meets the requirements and can be accepted by the scheme owner. From this moment on the biomass project can start producing and selling LIIB material. Ongoing monitoring and auditing ensures continued compliance with the requirements and that no more material is sold as LIIB than eligible.
3.1.1 Project application

Prior to project implementation, the project developer notifies the intention to develop a LIIB project to the scheme owner. This is done through a Project Application Document (see Appendix B). Only projects that have applied prior to their implementation will be considered for certification. This is to reduce the free-rider potential, as discussed in Section 2.2. The scheme owner notifies the biomass project developer once the project application is received or when additional information is needed.

After the project application is submitted and receipt is acknowledged by the scheme owner, the biomass project developer can start with the implementation of the project. The certification body will check at the first audit whether the project application has been submitted and confirmed by the scheme owner. The project developer only has certainty on the acceptance of his project after the plan of operation has been validated and the project has been registered by the scheme owner, as set out in the next section.

3.1.2 Plan of Operation

The next step is to design the project in more detail and demonstrate that the acceptance requirements are met. The project developer presents these details in the Plan of Operation Document (see Appendix C). The plan of operation includes a project description and information on the project’s system boundaries, how the project complies with the requirements for project...
acceptance for that project type, the baseline and the monitoring procedures. Additional guidance on the content of the LIIB plan of operation is included in sections 3.3 - 3.6, depending on the applicable solution type.

The plan of operation is validated by a Certification Body during a project audit (the Project Application and Plan of Operation can be verified during the same audit). The Certification Body will check the accuracy of the information included in the plan and will determine whether the biomass project meets the acceptance requirements, whether the baseline has been set correctly and whether appropriate monitoring systems are in place to register additional production above the baseline.

**Project Acceptance Period**

Project acceptance is valid for a given period after project implementation, as follows (recommendation):

1. Yield increase projects (10 years);
2. Integration projects (10 years);
3. Unused land projects (10 years);
4. End-of-life projects (5 years).

The scheme owner shall determine the project acceptance period. The acceptance period starts at the first year of harvest after the project was implemented. Project acceptance should not be confused with certified production. Project acceptance means that the acceptance requirements have been met. After project acceptance, there will be periodic verification to determine the actual performance of the project over time, which also determines the amount of certified production.

After the acceptance period the operator must go through the project application step again. The reason for this is that after a number of years, the situation may have changed and the project may no longer be considered additional. The project acceptance period provides biomass project developers with investment security.

**3.1.3 Monitoring Report**

After the project has been accepted and implemented, the biomass project developer can start selling LIIB compliant biomass.

The actual performance of the project is monitored by the project developer, using the procedures laid down in the plan of operation. The resulting monitoring report is verified periodically (see below the section on audit frequency) by the Certification Body, leading to a verification conclusion to ensure that only the amount of biofuel feedstock production eligible is sold as LIIB certified. This amount eventually depends on the actual performance of the project relative to the baseline. **If a biomass project has sold more biofuel feedstock as LIIB certified than it was entitled to, this needs to be corrected in the first three months of the next harvesting season.**
3.2 Generic requirements for chain of custody, audit frequency and claims

As discussed in section 2.3, the LIIB methodology can be incorporated into existing certification schemes. These schemes will have their own rules and procedures for matters including verification frequency, group certification, chain of custody and claims. Therefore, these aspects of a certification scheme are not worked out in detail here. However, to ensure credible implementation of the methodology, this section sets out high level minimum requirements for these aspects. Existing certification schemes incorporating the LIIB methodology shall adhere to these.

3.2.1 Audit frequency

Project audits, conducted by the Certification Body, are recommended to take place at least annually. Scheme owners will have to determine the frequency, ensuring that it fits the scheme’s practices.

3.2.2 Smallholder group certification

Group certification is permitted for smallholders if implemented in line with the ISEAL Common Requirements for the Certification of Producer Groups (ISEAL, 2008). Note that this implies that only a sample of the smallholders would need to be audited.

In order to establish the relevant management unit for a group of smallholders, it is important to relate this to how records are kept, and how administrative units are defined, so it fits with management practices and legal definitions (e.g. cooperation). Any special provisions for smallholders need to fit the certification scheme’s approach to smallholders. The scheme owner should also provide guidance on the amount of data that needs to be available in case of smallholders (e.g. a minimum of 90% of producers in the management unit need to have data available), how precise the data needs to be, and what level of verification of the data is needed.

3.2.3 Chain of custody

The following chain of custody systems are permitted:

- Physical segregation, in which LIIB-certified feedstocks and biofuels are separated from non-LIIB-certified feedstocks and biofuels;
- Mass Balance, in which LIIB-certified and non-LIIB-certified feedstocks and biofuels can be physically mixed but in which each party cannot sell more LIIB-certified products than it sourced (taking into account relevant conversion factors).

Book and claim (certificate trading) is not permitted for Low Indirect Impact Biofuels as this could increase the free-rider potential (see also the text box in section 3.3).
3.2.4 Claims

The claims that can be made at the end of the supply chain depend on the chain of custody used. For example, the following claims can be made for the various chain of custody methods.

- Physical segregation: “This biofuel is produced from feedstock with a low risk of unwanted indirect impacts”.
- Mass Balance: “This biofuel is produced by a supply chain that sourced feedstock with a low risk of unwanted indirect impacts”.

3.2.5 Sustainability requirements for direct impacts

To ensure the sustainability of biofuels it is indispensable that also the direct impacts are taken into account. As the direct impacts are typically already in the scope of existing schemes or policies that intend to adopt the LIIB methodology for indirect impacts, no specific acceptance requirements are included for the different solutions described in sections 3.3 - 3.6. As a minimum, biofuel feedstock projects would need to meet the land use requirements of the RED as set out in Article 17(3) – 17(5). Scheme owners adopting the LIIB methodology may want to add other criteria to this.

3.2.6 Sustainable intensification

Several of the approaches to minimise indirect impacts focus on using land more efficiently. However, there is a limit to how much one can intensify land use in a sustainable manner. The aim of this methodology is to allow only sustainable intensification of land use. Measures carried out within the system boundary of the project should not cause negative physical impacts on site (e.g. yield improvement should not result in negative environmental consequences in terms of water and soil quality parameters) or on land productivity outside of the system boundary (e.g. yield improvement should not lead to water scarcity downstream). To ensure this, scheme owners should allow options in their certification systems to address concerns about over intensification. Requirements relating to impact assessments and/or systems for monitoring impacts of the biofuel feedstock production are recommended. Again, in most cases this will already be covered by the existing requirements and systems in place in the certification systems that intend to adopt the LIIB methodology.
3.3 Yield increase projects

This section describes the methodology for yield increase projects. The aspects covered are: system boundary, project acceptance requirements, baseline methodology, and monitoring methodology. This section also addresses special situations that may occur and how these are proposed to be dealt with.

3.3.1 System boundary

The system boundary is made up of the management unit (e.g. farm or plantation) in which the yield increasing project activity is implemented (expressed in hectares).

3.3.2 Project acceptance requirements

Projects need to meet the following requirements:

1. Projects must have been notified to the scheme owner (project application) before implementation of the yield increasing project activity and the project application must have been confirmed by the scheme owner;

2. Projects must present the intended yield increasing measure(s), compare these to the current situation and demonstrate that the measures are expected to lead to an average yield increase of at least 20% compared to the baseline within the project acceptance period. Milestones for improvement need to be defined.

3.3.3 Baseline methodology

The baseline is set as follows (see Figure 2 for illustration):

1. Determine the baseline yield for the biofuel feedstock for the current year \( Y_{b,t=0} \) expressed in mass or volume per area. This baseline yield for the current year \( t=0 \) is set equal to the highest of the following two values:
   a. The average yield of the project site during the last 5 years; or
   b. The expected yield of similar producers in the current year. This value is determined by the current-year value of the yield trend line of similar (non-LIIB) producers. The yield trend line is taken as the best linear fit for the annual yield values in the last ten years. Similar producers are defined as producers of the same feedstock that:
      i. Grow the same crop;
      ii. Are located in the same geographic region. For data availability reasons it is recommended that this is an administrative region for which reliable data is available (e.g. through the local government or statistics agencies); and
iii. Use a similar management model. The type of management models will depend on the crop and region (see below for additional information).

2. Determine the *average annual yield growth* rate for the last 10 years for similar producers in the region ($y_{gr}$ expressed in % per year) based on the same information as described under 1b above;

3. Set baseline yield in future years ($Y_{b,t=x}$ expressed in mass or volume per area): Extrapolate $y_{gr}$ starting at the baseline yield in the current year ($Y_{b,t=0}$). The baseline yield in future year $x$ is calculated as follows:

$$Y_{b,t=x} = Y_{b,t=0} + Y_{b,t=0} \times y_{gr} \times x$$

*Equation 1*

Where:

- $Y_{b,t=x}$ = Baseline in year X (volume in m$^3$/ha or mass in kg/ha)
- $Y_{b,t=0}$ = Baseline in year t=0 (volume in m$^3$/ha or mass in kg/ha)
- $y_{gr}$ = Average annual yield growth for similar producers in the region (%)
- $x$ = Time since t=0 (years)

The figure below provides an illustration of a baseline for a yield increase project.

*Figure 2: Illustration of baseline methodology for yield increase projects. In this example, (1a) is the 5 year average yield of the project and (1b) is the expected yield of similar feedstock producers in the current year determined by the yield trend line of the region. The baseline is extrapolated from whichever yield figure is highest (in this case (1a)).*
Additional Guidance

“Similar producers”

- Similar management model refers to the agricultural management method.
  - For palm oil in South East Asia the following management models are generally distinguished (which may be applicable in other parts of the world as well):
    - Independent smallholder
    - Outgrower schemes (i.e. smallholders associated to a larger estate that supports the smallholders with inputs like fertiliser, machinery, etc.)
    - Centrally controlled large scale plantation
  - Ideally, the definition of similar producers also addresses similar growing conditions (in terms of soil quality, topography and climatic conditions, etc.). However, this data is often not available and hence for practical reasons this is not included as a strict requirement in the baseline methodology, but may be addressed.
  - Scheme owners may provide additional guidance on “similar producers” depending on the scope, feedstock and region of the scheme, e.g. by determining the relevant management models for the crop and region.

3.3.4 Monitoring methodology

Monitoring consists of measuring the actual yields of the project. All production achieved above the baseline is eligible for certified production.

The volume of LIIB compliant material is calculated using the following Equation:

\[
V_{LIIB,t=x} = (Y_{t=x} - Y_{b,t=x}) \times A
\]

Equation 2

Where:

\(V_{LIIB,t=x}\) = Volume of LIIB compliant biomass in year \(x\) (volume in \(m^3/ha\) or mass in \(kg/ha\))

A = System boundary area (ha)

\(Y_{t=x}\) = Yield in year \(x\) (volume in \(m^3/ha\) or mass in \(kg/ha\))

\(Y_{b,t=x}\) = Baseline in year \(x\) (volume in \(m^3/ha\) or mass in \(kg/ha\))
One of the acceptance requirements is that a 20% yield increase is expected and justified. It is possible that in a certain year this yield increase is not (completely) realised. In this case a biomass project is not rejected from participating in the scheme, but needs to realise at least a 5% yield increase above the baseline to be allowed to sell any LIIB certified material (e.g. if a project realises 6% above baseline, this 6% additional production can be LIIB certified. If a project realises only 4% above baseline, no production can be certified as LIIB in that year).

The actual yields can be measured by various methods. It is important that the measurement is standardised based on what is common in the market (i.e. how payments are calculated and connected to how sales records are kept). The measurement of the yield needs to be verifiable and yield should be measured in the same unit as the baseline. The way yields are measured (methodology & technology used, units, wet vs. dry, etc.) needs to be consistent over time.

### 3.3.5 Special situations

- **Yields of the primary feedstock or the processed feedstock.** The yield is normally taken as the yield of the agricultural feedstock as it leaves the field for further processing. For example, rapeseed, soy beans, oil palm fruit and sugarcane. For projects that process the feedstock themselves, the yield can also be measured in terms of processed feedstock, for example crude palm oil, as this incentivises yield improvements in the processing stage.

- **Perennial (non-annual) crops.** Yields of annual crops and perennial crops develop differently. Perennial crops, typically, start with a non-productive youth phase, and develop via a growth phase to the plateau phase, before declining in yields towards the end of their life-cycle.
  
  - For perennials, operators should take into account the growth phase when performing the calculations under 1a and 1b.
  
  - For perennials, a scheme owner can provide additional guidance to set the baseline to accommodate for these different phases and to make sure the same life-phase is used when comparing yields with similar producers.

- **New plantations.** New plantations will not have an historical yield trend line. If a new plantation wants to apply for LIIB certification it has four options:
  
  - Realise the plantation on “unused land” and apply under that project category;
  
  - Realise the new plantation through integration and apply under that project type;
  
  - Apply for the yield increase category after 5 years of operational harvesting, using the above rules;
 Apply for the yield increase category at the start. In this case the baseline yield for the current year \( Y_{b,t=0} \) is set at the 80th percentile\(^8\) of the area harvested under similar conditions as defined in the baseline methodology (see figure below).

\[ \begin{array}{c}
1 \\
5 \\
10 \\
20 \\
30 \\
40 \\
50 \\
60 \\
70 \\
80 \\
90 \\
95 \\
98 \\
99
\end{array} \]

**Figure 3:** When a new plantation wants to apply for the yield increase category at the start, its baseline is set using the 80th percentile yield of producers in the region under similar conditions.

- **GMO and organic farming.** Farmers that use non-GMO crops where the use of GMO crops is allowed can include “non-GMO” in the definition of “similar producers” in step 1b of the baseline, and may calculate the baseline for the applicable category, if separate data exist. This prevents the baseline for non-GMO crops being based on the yields achieved by GMO-crops. Similarly, farmers that practice organic farming can include “organic farming” in the definition of “similar producers” in step 1b of the baseline. This prevents the baseline for organic farmers being based on the yields achieved by non-organic farmers.

- **Baseline for smallholders:** for smallholders, historic yields might not be available for the full five years required for the baseline (e.g. due to lack of a management system). A scheme owner may decide to simplify the baseline calculation for smallholders to facilitate their participation in the scheme. For instance, when smallholders do not have historic yield data of the last five years (see 1a under baseline methodology), a scheme owner could allow setting the baseline using a combination of a crop yield prediction model and historic data for only the last three years (instead of five years). In such a situation triangulation of information sources is important to avoid dependence on one (subjective) source as the impact of the baseline on the amount of LIIB production is very large. In cases where no historic data is available at all and a group of smallholders wants to start with the certification processes, it is important that yield data is collected and recorded reliably during the preparation phase. By the time the smallholder is certifiable, acceptable yield data should be available to set the baseline.

---

\(^8\) A percentile score is a relative score compared to peers. In this case, the yields of producers in the same region under similar conditions are ranked. If a company knows its percentile score then they know how it compares with others in the norm group. For example, if you scored at the 80th percentile, then this means that you scored the same or better than 80% of the individuals in the norm group.
Box 4 - Effectiveness and transaction costs for yield increase projects

Effectiveness

The free-rider potential consists of yield increasing projects that would also have occurred in the absence of biofuel demand. The exact size of this potential is difficult to estimate but the following observations can be made:

- The free-rider potential is limited by the fact that projects must be notified prior to implementation. Yield increasing measures that have already been implemented for other reasons cannot obtain certification if they did not notify the scheme owner of their project before implementation;

- The Mass Balance chain of custody restricts the usable free-rider potential because the free-rider potential will be geographically dispersed and it will be uneconomical to pick the free-rider projects from each region and funnel these all to biofuels in a Mass Balance (which would require all these geographically dispersed feedstocks, or their derived biofuels, to flow through the same production, processing or storage site);

- The baseline is set conservatively by taking the highest yield of either the project site or the average yield of similar producers. This prevents a free-rider potential for sites that already have a high yield and for sites that performed below the industry average in previous years.

Transaction costs

Data requirements for both the baseline and the monitoring include actual yields of the project site. This information will normally be available. Additional information needed is the average yield of producers with similar conditions. The time needed for this will depend on the availability of studies and statistics. In the worst case, information needs to be collected from a sample of producers.

The methodology does not contain complex analysis such as a barrier analysis or investment analysis. Determining the trend line for producers with ‘similar’ conditions is the most complex part. Note that once this has been established for one project, other projects in the same region using the same crop, can make use of the same data, thereby lowering the costs per project.
Box 5 – Smallholder oil palm yield increase in Indonesia

In the Indonesian pilot, two smallholder oil palm plantations were considered for study: the Siak smallholder oil palm plantations (Riau, Sumatra) and the Ophir scheme (West Pasaman, Sumatra). Each case study offered different features:

a) The Siak plantings currently yield very poorly (<10 t/ha fresh fruit bunches) indicating a great potential for yield improvement, and are located close to peat/swamp areas of lowland forest areas with high conservation value. Preventing further expansion of the plantations through agreements with the community made it a very interesting case study for WWF Indonesia;

b) The Ophir plantations are run by well-organised smallholder cooperatives which have good records over the past 27 years. They already achieve yields above 20 t/ha fresh fruit bunches indicating little opportunity for yield improvement.

The pilot was carried out by Wageningen University (WUR) and WWF Indonesia. The Siak plantings were selected due to the strong potential for yield improvement. The greatest gains are to be made from poorest performing plantations. Although smallholder cooperatives at Siak were said to keep records of yields, only scarce information on past yields of the plantations could be obtained, preventing a rigorous baseline from being made. Yield data was supposed to be recorded by the state owned company responsible for supporting the smallholders. However, there appeared to be tension in the relationship between this company and (some of) the smallholder groups. The lack of (access to accurate yield data is likely to benefit certain stakeholders, which are resisting more transparency. Expert inspection by WUR of the Siak smallholder oil palm plantings indicated a strong potential for yield improvement throughout the area, even in the best-performing blocks, with many blocks producing very little at present. We expect that, provided farmers carry out the recommended fertiliser programme and field upkeep techniques, yields will increase steadily over the next three years and reach >20 tonne per hectare by 2014.

Local smallholder leaders in Siak were enthusiastic to implement the yield-improving measures, and cooperated during a training which led to the establishment of demonstration and control plots in July 2011. A cost-benefit analysis clearly indicated that yield improvement in the Siak smallholder plantings would be highly profitable, but would require considerable investment in fertiliser and extra labour, with a likely time-lag of at least 12 months before yield improvements would be realised.

A follow-up visit in January 2012 demonstrated patchy follow-up by the local smallholders. Although they
remained enthusiastic, record keeping remained problematic and, the improved practices had clearly not been implemented uniformly. Yield improvements cannot be measured in the field over such a short time period even when records are kept accurately due to variability in climate necessitating monitoring over a longer period. Improvements were observed in other kelompoks (groups within the cooperative) outside the demonstration plots, for example, the adoption of correct pruning methods.

The smallholders indicated that the major barrier to implementation of improved management was the additional investment required. Kelompok management understands correct practices and monitoring of the activities performed by their labourers appears not to be the main issue.

Lessons learned

To make the step from extensive to intensive oil palm cultivation requires a major change in the approach to plantation management and financial backing to finance the yield increasing measures. This means that the smallholder cooperatives have to act together. The central issue is that the smallholders do not want to invest more to buy the required inputs of fertilizers and to pay for the additional labour to implement the correct management practices. Although the Ophir case was not studied, it provides evidence that smallholder cooperatives can maintain productive plantations if well organised. This case does not offer the same possibilities for yield improvement, as yields are already good, but offers key lessons in smallholder cooperative development. Development of guidelines for step-wise implementation of yield-improving measures could assist in making yield intensification more attractive and achievable for smallholder cooperatives. Sustained engagement with local smallholder groups is required to realise yield intensification. Training and support would need to focus on building capacity on record keeping and financial management for the smallholder cooperatives, in addition to technical training in best management practices. Since some parties are likely to resist more transparency on yield data, appropriate communication is important. The permanent/regular presence of an expert on site overseeing the implementation and assisting in developing the required organisational structures is recommended.

Conclusion of the auditor

The original plan was to audit a project in which minimising indirect impacts of bio-fuel production is through yield intensification in smallholder oil palm cultivation. The project partners found that there was not sufficient evidence and data available from the selected sites that a meaningful audit could be performed. Instead, DNV commented on the field-testing methodology in a perspective of usefulness in addition to what is required to the RED and certification schemes like the RSB, and the verification challenges. It was concluded: Yield increase as a methodology is feasible and can be incorporated easily into the current certification schemes given:

- The baseline methodology is standardised for the crop in question;
- The measurement of crop production is standardised;
- Data quality levels are defined;
- There is a system in place to bridge the gap when certain producers need time to obtain the necessary data.
3.4 Biofuel feedstock integration projects: Sugarcane-cattle integration

This section describes the proposed methodology for sugarcane-cattle integration projects. Other integration models are possible and would require a modified methodology. The aspects covered in this section are: system boundary, project acceptance requirements, baseline methodology, and monitoring methodology. The section describes special situations that may occur and how these are proposed to be dealt with.

3.4.1 System boundary

The system boundary area consists of all fields that supply the mill with sugarcane for processing. These fields, depending on business and management decisions of the mill, can be owned by the same company the mill belongs to, be rented by the mill, belong to independent suppliers, or be subject to any other partnership relations the mill has established for buying or producing its feedstock (the sugarcane).

3.4.2 Project acceptance requirements

Projects need to meet the following requirements:

1. Projects must have been notified to the scheme owner (project application) before implementation of the integration model and the project application must have been confirmed by the scheme owner;
2. Projects must provide the required data for the audit in the ‘Sugarcane-cattle integration calculation sheet’ developed by the University of São Paulo (available on the LIIB website);
3. Projects must supply at least 20% of the total digestible nutrients (TDN) intake of the cattle from sugarcane residues.

The project team of the University of São Paulo (USP) has developed a spreadsheet that includes all the necessary calculation procedures and conversion factors for this methodology (‘Sugarcane-cattle integration calculation sheet’, see Sparovek et al., 2012b). Most of the data requested for the spreadsheet are data that are part of the business and are required for compliance to national laws or for general accounts.

The ‘Sugarcane-cattle integration calculation sheet’ also provides guidance on how to determine the TDN intake from sugarcane residues.

3.4.3 Baseline methodology

The survey by USP (Sparovek et al., 2012a) showed that sugarcane cattle integration has been phased out from the market as Business as Usual in Brazilian sugarcane mills. For the time being, cogeneration of electricity continues to be the preferred option for surplus bagasse treatment, and the use of sugarcane by-products to feed cattle is a non-conventional business option. Only nine
sugarcane mills of a total of 420 in Brazil (<2%) apply the integration concept. For this reason, the baseline is defined as a mill that does not apply the integration concept and does not produce any animal feed.

3.4.4 Monitoring methodology

All the calculations for the monitoring methodology are supported by the ‘Sugarcane-cattle integration calculation sheet’ (Sparovek et al., 2012b). The calculation steps are:

1. Convert sugarcane by-product ingredients of the rations (i.e. animal feed) produced by the mill and the by-products sold for animal feed into TDN (in kg);
2. Convert TDN into the number of standard Animal Units (AU) that can be produced with that amount of nutrients;
3. Convert the resulting sum of AU, using correction factors, into the area needed to produce the same amount of AU in the Brazilian Agricultural Frontier region (BAF), where ILUC occurs;
4. The amount of ethanol the mill can produce on this area is certified as low indirect impact biofuel (LIIB-compliant Ethanol), taking into account the actual production ratio of sugar and ethanol.

The volume of LIIB-compliant ethanol is calculated using the following Equation:

\[ V_{\text{LIIB ethanol}}_{t=x} = \text{Eq}_{\text{ar}} \times P_{\text{et,t=x}} \times \frac{\text{Cane}_{\text{et}}}{\text{Cane}_{\text{sug}}} \]

Equation 3

Where:

\( V_{\text{LIIB ethanol}}_{t=x} \) = Volume of LIIB compliant ethanol in year x (in m³)
\( \text{Eq}_{\text{ar}} \) = Equivalent ILUC avoided area (in ha/year) (calculated using ‘Sugarcane-cattle integration calculation sheet’; the animal feed ingredients and mill production data, including amount of cane processed and sugar and ethanol produced, need to be known to calculate this);
\( P_{\text{et,t=x}} \) = Ethanol yield per hectare in year x (volume in m³/ha)
\( \text{Cane}_{\text{et}} \) = Cane processed for ethanol (in tonnes)
\( \text{Cane}_{\text{sug}} \) = Cane processed for sugar (in tonnes)

This equation returns the number of cubic metres of ethanol per year that could be produced on the Equivalent “ILUC-avoided” area if all this area would be converted exclusively into ethanol. The correction for sugar production is necessary because the mills produce both products (sugar and
ethanol) simultaneously from the sugarcane. This equation was adapted from the BONSUCRO certification protocol. The suggested improvement was to calculate the correction factor based on the mill’s performance instead of using a constant of 0.6 (as suggested by BONSUCRO). The amount of certified production shall not exceed the amount of physical product (e.g. ethanol) produced.

3.4.5 Special situations

- **By-product sold by the mill as feed** can be taken into account in two ways.
  - If the end-user provides the same documentation as the mill for its own feedlot, and is also inspected, the rations are considered equivalent to the mill’s.
  - If the end-user is not audited during the visit, no correction factors will be applied to the TDN and additional production, in this case, should not exceed 20% of the total ILUC avoided area. If the byproducts sold and not audited are more than 20% of the total avoided ILUC only the amount corresponding to 20% of the total will be considered as additional.

Box 6 – Effectiveness and transaction costs for sugarcane cattle integration projects

**Effectiveness**

The free-rider potential consists of sugarcane cattle integration projects that would also have occurred in the absence of biofuel demand. The size of this potential is expected to be very small relative to the demand for (EU) fuel ethanol from sugarcane.

The penetration rate of sugarcane cattle integration is very low (2%), also compared to the expected EU demand for sugarcane ethanol. Sugarcane cattle integration is currently only applied by nine mills of the 420 in Brazil.

The free-rider potential is further limited by the fact that projects must be notified prior to implementation and the Mass Balance chain of custody as explained for the yield increasing measures.

**Transaction costs**

Most data requirements for both the baseline and the monitoring are readily available, e.g. the area of the sugarcane estate, ethanol and sugar production quantities, amount of sugarcane residues fed to cattle, total milk/beef production.

The methodology does not contain complex analysis such as a barrier analysis or investment analysis. While several calculation steps need to be made for the monitoring of the actual performance and calculating the amount of certified production, all these calculations are straightforward and should require little effort to make or verify using the XLS sheet.
Box 7 – Sugarcane cattle integration in Brazil

In the Brazilian pilot, two sugarcane mills that apply integration were studied;

a) Usina São José da Estiva: Despite the fact that the mill is equipped for cogeneration, and thus has an alternative use for the total surplus bagasse, the feedlot facilities and production are maintained. With a capacity of 16,000 heads per year the feedlot is integrated into the mill’s operation. The rations are produced in the mill with sugarcane process byproducts. The manure produced in the feedlot is used as organic fertilizer in the sugarcane fields, replacing an important amount of chemical fertilizers. This option reduces GHG by replacing mineral fertilizers and allows lower production costs. The feedlot is Eurepgap certified, and was recently awarded first prize in a national feedlot ranking initiative.

b) Pitangueiras mill: The confinement of the Pitangueiras mill was much smaller than at Estiva and the management controls and procedures also much simpler. The conclusion of the test at Pitangueiras was that all information needed could have been provided and adequately documented if the mill’s managers had had more time to aggregate it and provide copies of the controls. None of the required information was inexistent or not able to be documented. So, even smaller and simpler mills than Estiva can adapt to the protocol.

The pilot was carried out by University of São Paulo. Using the real data from the Estiva mill for the 2011 season the equivalent ILUC avoided areas was 12,126 ha and the volume of LIIB ethanol with low ILUC risk was 84,865 m³. In 2010 Estiva mill processed 26,472 ha of sugarcane fields resulting in 144,860 m³ of ethanol. Thus, in 2010, Estiva by running its own large scale feedlot could trade 59% of the ethanol produced as ethanol with low ILUC risk.

In 2006, Brazil produced 369,933,108 tonnes of sugarcane for sugar and ethanol production, according to the Brazilian Agricultural Census. If the total amount of surplus bagasse (after deducting the amount required for the mill’s own operation) would be used in sugarcane cattle integration systems, the equivalent area of avoided ILUC would be 3.6 Mha, or 67% of the 5.4 Mha of the sugarcane cultivated in 2006; according to the suggested methodology.

Even considering a more realistic 20% share of the surplus bagasse moving into sugarcane cattle integration systems, the result would be 1.0 Mha of corresponding reduction of ILUC areas, producing a volume of LIIB compliant ethanol of 6.7 billion litres. Brazilian exports of ethanol in the season 2010/2011 were 1.2 billion litres. These figures show the large potential of the methodology and certification protocol in avoiding ILUC and supplying markets on a large scale.

The suggested methodology focuses on the more frequent case of using sugarcane by-products to feed beef or milk cattle. Despite the potential of feed production also for pork and to some extent poultry, the relation to ILUC is only proven for cattle. Cattle in Brazil are basically produced on pasture. The byproducts, in this case, would avoid the need for pasture, thus reducing the pressure for land conversion at frontier regions.
**Conclusion of the auditor**

The information required to calculate the amount of LIIB ethanol is feasible to collect and verify from both large and small mills. The data would also be a natural part of the verification system for certification audits, and the LIIB methodology could possibly become part of a certification regime when the methodology is completed and the source of production data for an area is determined.

Trial audits of LIIB were performed at two sugarcane mills that had integrated cattle and sugarcane (sugar and ethanol) production in the state of São Paulo, Brazil. The information needed to be able to complete the methodology and to be able to audit was available at the production sites, or could be made available. The methodology needed some adjustments to be useful in a certification framework, but the basis for the calculations was captured in the spreadsheets. The methodology could be integrated as part of a certification scheme.
3.5 ‘Unused land’ projects

This section describes the proposed methodology for projects on ‘unused land’. The aspects covered in this section are: system boundary, project acceptance requirements, baseline methodology, and monitoring methodology. The end of this section describes special situations that may occur and how these are proposed to be dealt with.

3.5.1 System boundary

The system boundary is the total area associated with the biofuel feedstock production that is no longer available for other provisioning services. This includes the area used for plantation(s), infrastructure, corridors, processing facilities, etc.

3.5.2 Project acceptance requirements

Projects need to meet the following requirements:

1. Projects must have been notified to the scheme owner (project application) before implementation on unused land and the project application must have been confirmed by the scheme owner;

2. The biomass project developer needs to demonstrate that the land is unused; i.e. the site has not been used for its provisioning services\(^9\) in the last three years;

3. The site is located in a region with an excess potential of unused arable\(^10\) land that 1) is equally or more suitable for the crop of the project than the project site, and 2) meets the land use requirements of the EU RED (see section 3.2).

Additional guidance for acceptance requirement 2 and 3 is provided below.

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\(^9\) The Millennium Ecosystem Assessment (2005) distinguishes four categories of ecosystem services: provisioning services, regulation services, cultural services and supporting services. Provisioning services are defined as harvestable goods such as fish, timber, bush meat, genetic material, etc.

\(^10\) Note that the definition FAO uses for arable land deviates from the one used here (i.e. potentially cultivable land). FAO defines arable land as land under temporary agricultural crops, temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). Data from FAOSTAT for "arable land" hence do not indicate the amount of land that is potentially cultivatable.
Additional Guidance

**Demonstrating “unused land” status**

A biomass project developer must demonstrate that the land they intend to use is not used and was not used in the last three years for providing provisioning services (e.g. harvestable goods such as crops, timber, bush meat, etc). This may be done in one of the following ways:

1. The project developer may apply the Responsible Cultivation Area (RCA) methodology (Ecofys, 2010, *Responsible Cultivation Areas - Identification and certification of feedstock production with a low risk of indirect impacts*) to identify areas that are unused and that can be used for environmentally and socially responsible energy crop production.

2. The ‘unused land guidance’ (Ecofys, 2012) provides guidance to determine ex-post (after the event) whether the project area was unused.

3. Alternatively, “unused land” can be demonstrated using, for instance, satellite images, government records, and/or land rights records.

Note that when a biomass project is already implemented and the project developer did not notify the scheme owner before project implementation (acceptance requirement 1), it would not meet the mandatory acceptance requirements to qualify for LIIB.

**Demonstrating “excess potential”**

The rationale for requiring that there exists “excess potential” of similar unused arable land in the region is that this will provide an additional assurance that there is a low risk of future competition for land with other sectors (e.g. food).

Two options are provided to project developers to demonstrate the excess potential requirement:

1. The biomass project developer can demonstrate that the project is located in an area with a growing availability of unused arable land. Examples could include regions in the EU where the area of idle agricultural land is increasing;

2. The biomass project developer can demonstrate the site is located in a region with a large area of unused arable land that is a) equally or more suitable for the crop of the project, and b) meets the land use requirements of the EU RED.

   - The ‘region’ is defined as the administrative area (e.g. NUTS2 in Europe) in which the project site is located and adjacent administrative areas.
   - A ‘large area of unused arable land’ is deemed large enough if it equals at least three times the area of the project site.
   - To determine the availability of the excess potential, at least step 1 and 2 of the RCA land identification process (Ecofys 2010, *Responsible Cultivation Areas - Identification and certification of feedstock production with a low risk of indirect impacts*) should be
performed. This can be done as part of the RCA process for demonstrating unused land status (see above, "Guidance demonstrating ‘unused land’ status). To assess the suitability of land for the project crop, existing studies by recognised institutions can be used or a specific inventory for the project can be made. Such an inventory would normally take into account at least the following characteristics: topography, soil quality and climatic conditions.

### 3.5.3 Baseline methodology

Generally, the baseline for ‘unused’ land projects is zero (if the land was not used for other provisioning services before the project was implemented).

When limited provisioning services are displaced these provisioning services must be established and documented for the baseline description in the Plan of operation.

### 3.5.4 Monitoring additional production

Monitoring consists of measuring and recording the actual production of the project. All biofuel feedstock production is eligible for LIIB certification.

\[
V_{LIIB,t=x} = Y_{t=x} \times A
\]

Equation 4

Where:

- \(V_{LIIB,t=x}\) = Volume of LIIB compliant biomass in year \(x\) (volume in \(m^3\) or mass in kg)
- \(Y_{t=x}\) = Yield in year \(x\) (volume in \(m^3/ha\) or mass in kg/ha)
- \(A\) = System boundary area (ha)

### 3.5.5 Special situations

1. **Shifting cultivation**: Areas that are used in a shifting cultivation system are considered to provide provisioning services, even if the rotation time is more than three years. Shifting cultivation systems are typically subsistence farming systems whereby a plot of land is abandoned after one or a few years and another plot is cleared and cultivated until the pattern repeats itself. Shifting cultivation is often associated with slash-and-burn practices. Generally, after a long period of time (e.g. 10-30 years) the first plot is used again. Areas that are used for nomadic grazing are also considered to provide provisioning services.
2. **Displacement of limited provisioning services given adequate alternatives are provided:**

This conditional exception is meant to allow for the use of land that already provides limited provisioning services as long as sustainable alternatives for these provisioning services are implemented. An example of where this would be allowed is the collection of grass for roof thatching in areas where ample grass is available also after the implementation of the bioenergy project. Where limited provisioning services were supplied by the area in the last three years, projects shall be permitted, if sustainable alternatives are implemented for the displaced provisioning services that comply with all the requirements listed under “project acceptance requirements” and the requirements of the scheme owner on direct impacts. In such a case, it is important to determine how the livelihoods of the people who depend on such services are affected by their displacement. The provisioning services and their alternatives must be described in the LIIB plan of operation (including monitoring systems). Importantly, **it is up to a scheme owner to decide whether displacement of limited provisioning services is acceptable** and the sustainable alternatives are adequate. The following elements are important:

   a. Alternatives need to be implemented with the free, prior and informed consent of the people affected;

   b. Ideally, the alternatives are implemented within the project boundary to facilitate engagement and monitoring;

   c. The Fraction of Land Cultivated (FLC) within a certain area provides a measure to define "limited". FLC depends on the number of years that once cleared the land is cropped (C), and after the land is abandoned, the number of years that the land is fallow (F). FLC is calculated using the following formula $FLC = C / (F + C)$. For instance, $F = 10$ years and $C = 4$ years, $FLC = 29\%$; $F = 10$ years and $C = 2$ years, $FLC$ is $16\%$; $C = 4$ and $F = 2$, $FLC = 66\%$. Different land use and farming systems can be classified based on FLC. Ruthenberg (1980, p.14-18) defines shifting cultivation systems as systems where FLC is smaller than 33%. We suggest using as threshold <10% FLC.
Box 8 - Effectiveness and transaction costs for unused land projects

Effectiveness

The free-rider potential consists of new plantations/farms on land that 1) meets the land use requirements of the RED, 2) did not provide provisioning services in the last two years, and 3) that would also have occurred in the absence of biofuel demand. The size of this potential is difficult to estimate but the following observations can be made:

- The gross free-rider potential could be large considering the amount of new land that is taken into use as cropland each year. However, the actual free-rider potential will be much smaller because 1) not all this land was previously unused, 2) not all of it meets the RED direct land use requirements, 3) not all of it will be taken into production for energy crops, and 4) not all of it will be located in regions that actually produce feedstocks for biofuels;

- The effective free-rider potential is reduced further by the fact that projects must be notified prior to implementation and the requirement for Mass Balance chain of custody as explained for the yield increasing measures;

- Even if free-rider projects would register, abundant land with similar characteristics is still available in the same region. It is therefore uncertain whether this would actually lead to unwanted indirect impacts. After all, additional expansion, e.g. for food production, is still very well possible in the same region on land that meets the requirements of the RED.

Transaction costs

The data requirements for the baseline and the monitoring are small and are readily available, i.e. the actual production levels of the new plantation. Additional information that will need to be gathered mainly relates to the “excess potential” of similar land in the region. In regions with a growing availability of such land, this can partly be based on existing agricultural statistics, although compliance with the RED requirements is not captured in existing statistics. In regions in which the potential is not growing but in which a large potential remains (option 2), data will need to be collected on the availability of land with similar characteristics. Such information could also be provided by studies from e.g. governments or NGOs that indicate what areas would be suitable for expansion of biofuel production with a low risk of unwanted indirect impacts, thereby reducing the administrative burden for project developers.

The methodology does not contain complex analysis such as a barrier analysis or investment analysis. Especially the baseline and the monitoring are simple for this solution type. The most complex part is demonstrating the excess potential of similar land in the region.
Box 9 – Unused land in Mozambique

The pilot in Mozambique focused on biofuel feedstock production on land not currently in use, or used with low intensity. To investigate whether unused land could be identified, the Responsible Cultivation Area (RCA) methodology was used. The pilot was carried out by WWF Mozambique.

In the RCA methodology, an area is considered suitable for “responsible cultivation” if it is ensured that the area 1) can be used for environmentally and socially responsible energy crop cultivation and 2) such energy crop cultivation would not cause unwanted indirect impacts.

The methodology uses a four-step process to identify RCA’s. The process starts on a high level with coarse and readily available information to quickly identify the most promising areas. Next, a more detailed assessment is performed on these areas to further refine the pre-selection of promising areas. In the third step, fieldwork is carried out with the purpose of verifying the results of the first two steps on the ground and to fill remaining knowledge gaps. In step four, all the collected information is evaluated to determine whether (a part) of the area classifies as an RCA.

The RCA methodology was developed by WWF International, Ecofys and Conservation International (Ecofys, 2010).

The pilot study found that there was no “unused land” on the research sites in Zambezia province. The original project idea was to facilitate the establishment of a jatropha plantation following the identification of unused land that complies with the requirements of the LIIB methodology. However, the results of the pilot were different from expected. Due to a number of reasons, including expected population growth, the initial research concluded that the selected area does not comply with the LIIB requirements. The research projects significant pressure on land in central Mozambique due to increasing demand for food, hence the team concluded that the biofuels produced in this area will not avoid indirect impacts.

Conclusion of the auditor

The original plan was to audit a project where “unused land” had been identified in Mozambique that was suitable for Jatropha production.

The project found that the land identified by the desk study was not suitable for production of Jatropha and not unused. Therefore, it was decided not to execute a field audit in Mozambique. Instead, DNV commented on the field-testing methodology from the perspective of usefulness in addition to what is required to the RED and certification schemes like the RSB, and the verification challenges.
It was concluded that additional clarification and guidance on what unused land constitutes was needed. This has been adopted in the methodology and guidance through the RCA methodology and unused land guidance provided. In practice, land that can also be used for biofuel feedstock/biomass production is almost never completely unused. That does not mean that the land is not available for use for biofuels production, or suitable for use, or could be used if the area in question has an excess of arable land beyond what is needed for food production or the development of the area. It is recommended to elaborate the methodology further to accommodate for ‘underused’ land.

Sketch of typical situation with different types of land use in Mamala area in May 2011
3.6 End-of-life feedstock projects

The methodology for end-of-life products (i.e., waste streams) deviates from the methodologies for energy crops (as described in Sections 3.3 - 3.5). For the land based solution types the focus is on feedstock production without displacing other provisioning services of the land. For end-of-life products, the focus is on the alternative uses of the end-of-life product stream and the potential impacts of displacing the end-of-life product stream from its original use to bioenergy. Thereby the risk is not always restricted to ILUC but also includes, for example, indirect GHG emissions, resulting from a substitution of the biogenic residue stream by a fossil feedstock in the sector that originally used the biogenic residue stream.

3.6.1 System boundary

The system boundary is defined as the region where the end-of-life product stream is generated. Note that the system boundary is not determined by the region where the end-of-life product is used. A region might be at the sub-national, national, or supra-national (combination of countries) level.

3.6.2 Project acceptance requirements

Projects only need to meet the following requirement:

1. The feedstock–region combination must be listed on the scheme owner's positive list for "end-of-life products with a low risk of unwanted indirect impacts".

Prior notification through the project application is not required. The reason for not requiring project notification is that the scheme owner has conducted an assessment of the potential indirect impacts of using a particular end-of-life product from a given region and has found it to have low risk of indirect impacts.

3.6.3 Guidance on the positive list of residues and wastes with a low risk of unwanted indirect impacts

It is important to note that the positive list is compiled and managed by the scheme owner, i.e. it is the scheme owner who determines which end-of-life products fall under the positive list and the share or fraction of each feedstock type that is LIIB-compliant (see discussion below). In evaluating whether a feedstock-region combination (and which share) should be put on the positive list, the scheme owner will use the following criterion:

- The residue or waste stream originating in the region is not used for alternative uses, other than waste disposal methods including waste incineration and landfill disposal;
Situations in which a portion of the end-of-life product stream generated in a region is partially used and partially disposed of are discussed below.

In order to determine whether a particular end-of-life product should be included in the positive list of “feedstock-regions” for a sustainability scheme, the scheme owner should follow a general methodology. The following methodology is suggested:

A. Identify and clearly define the end-of-life product stream (e.g. used cooking oil);

B. Identify the "Region": A region can be at the sub-national (e.g. a metropolitan area, a state or province), national, or supra-national (e.g. several countries, E.U., ECOWAS region) level. A region is a geographical area where general conclusions (on use, disposal, regulation, etc.) may be drawn for a particular end-of-life product stream. It might be easiest to conduct an assessment for a small region; on the other hand, the larger the region, the more bioenergy facilities the feedstock-region assessment will apply to;

C. Perform an assessment of the use(s) and disposal method(s) of the end-of-life product stream in the region. The assessment should ideally be done broadly enough, i.e. at national or supra-national level, to understand the larger picture of use and trade of that particular waste stream. The assessment should result in quantitative information on the breakdown of uses and disposal for the end-of-life product stream: What is it currently being used for? Are there any uses that are unlawful in that region? How much of it is being disposed of? What is the disposal method? It is also important that this assessment investigate historic use to identify specific trends and understand possible developments in the near future. Legislation and policy can have a big impact on the uses and should be taken into account. To do this assessment, the scheme owner may conduct an outreach effort:

   a) Conduct interviews with (non-exhaustive list): Biofuel operator(s) using the end-of-life product stream; industry associations; environmental organizations, civil society organizations; government agencies; expert/scientific organizations, etc.;

   b) Conduct stakeholder outreaches or public consultations on the subject.

D. Partial use. In certain instances, a particular end-of-life product stream in a given region may be used (e.g., recycled, recovered and transformed, etc.) and some of it may be disposed of (incinerated/land filled). If a certain % (<100%) of a feedstock-region meets the requirement to be included in the positive list (outlined in this section under “1”), then this % must be specified by the Scheme Owner in the positive list (termed S\textsubscript{positive list} below). Any stream for which this % is less than 25% may not be added to the positive list. Any given project can only claim LIIB compliance for this % of the total biofuel production. If, for example, 80% of the residue stream meets the requirements, a project developer may make a LIIB claim for 80% of the biofuel produced;

E. Elaborate a detailed table of uses for the end-of-life product originating in the defined region: Identify the % of the product stream going to potential use(s) and the % that is disposed of (incinerated or land filled);
F. Report: create a report outlining the findings above;

G. Subject the report to expert peer review.

It is recommended that the assessment be standardised and that schemes periodically evaluate the listed feedstock-regions. A re-assessment is suggested every three to five years for each feedstock-region. The scheme owner can review the positive list of residues and wastes and can decide to remove products from the positive list if they no longer meet the above criteria. Projects that have already been accepted are not affected by such decisions.

Ideally, different scheme owners implementing the LIIB methodology would come to a common understanding and agreement on the positive list of feedstock-regions and applicable %.

### 3.6.4 Baseline methodology

No baseline needs to be defined for projects under the end-of-life product approach.

### 3.6.5 Monitoring methodology

For the monitoring of the actual performance, the amount of biofuel produced from the feedstock-region combination for which the project is registered needs to be recorded. The unit can be annual production (in mass or in volume at a standard temperature).

It is important that the measurement is standardised based on common market practices (e.g., based on transaction and sales records). The measurement of the production needs to be verifiable and consistent over time.

A project developer (biofuel producer) may only make LIIB-compliance claims on the % feedstock-region specified in the positive list.

The volume of LIIB compliant material is calculated using the following Equation:

\[
V_{LIIB,t=x} = P_{t=x} \times S_{positive\ list}
\]

**Equation 5**

Where:

- \(V_{LIIB,t=x}\) = Volume of LIIB compliant biofuel in year \(x\) (volume in m\(^3\) or mass in kg)
- \(P_{t=x}\) = Total production in year \(x\) from end-of-life feedstock under consideration (volume in m\(^3\) or mass in kg)
- \(S_{positive\ list}\) = Share of the end-of-life product stream in the region eligible (%)
3.6.6 Special situations

1. **Multiple residues or waste streams.** A biofuel production facility may use one or more feedstocks listed as a 'feedstock-region';

2. **Illegal use of a residue or waste stream.** In some instances, the waste might be used in unlawful ways. Illegal use of a waste does not constitute a "use" for the purpose of the evaluation carried out under Section 3.6.3;

3. **End-of-life product has not yet been assessed.** In case a scheme owner has not yet conducted an assessment of the potential indirect impacts of using a particular end-of-life product within a given region, project developers have the option to apply to the scheme owner for making the assessment;

4. **Wastes and residues in the EU.** The EU RED allows biofuels produced from wastes and residues to count double towards the EU RED's renewable energy targets. Member States determine which materials are eligible for double counting. Currently, most Member States do not have a higher order use criterion and allow double counting of all waste/residue materials. The LIIB methodology is more stringent and takes into account alternative uses in order to avoid indirect impacts. Hence, when a certain waste or residue is on a Member State’s positive list for double counting, this does not necessarily mean it is LIIB compliant under the end-of-life category.

5.

**Box 10 – Used cooking oil biodiesel in South Africa**

The pilot in South-Africa focussed on biofuel production from end-of-life products, and concretely from used cooking oil (UCO) in South Africa. The LIIB methodology for this type of projects focuses on the potential effects of relocating the residue stream from the original (alternative) use to biofuel production. This pilot was executed by RSB and Biogreen.

**Conclusion of the auditor**

A trial audit of LIIB for end-of-life products was performed at Biogreen in Cape Town, South Africa. Biogreen produces biodiesel from used cooking oil. The LIIB methodology requires that the product be made from an end-of-life product (residue or waste) that is on the scheme owner’s positive list, and this was assumed to be the case during the audit. The audit was to determine if there was verifiable information available regarding the source and amount of bioenergy produced from the feedstock-region combination. The sources of used oil and the amount of biodiesel produced were recorded by the producer, and thereby would be normally be easily auditable, although during the actual audit technical issues hindered checking if the computer system matched the paper trail.

The development of positive lists by the scheme owner will make the LIIB methodology easy to audit during a normal management system or biofuel certification audit, and should add little expenses to the normal audit costs. Note that under the LIIB methodology, it is the role of the scheme owner to define which end-of-life products fall under the positive list and which share \( S_{\text{positive list}} \) above is applicable.
References


Conservation International (2010a), Identification of Responsible Cultivation Areas in Pará Brazil, pilot report.

Conservation International (2010b), Identification of Responsible Cultivation Areas in São Paolo Brazil, pilot report.

Dehue B. (2006), Palm Oil and its by-products as a renewable energy source, potential, sustainability and governance.

DNV (2012), Certification Module of Low Indirect Impact Biofuels LIIB - Trial Audit: Sugarcane-Cattle Integration Project Brazil, DNV, Høvik.

DNV (2012), Certification module of low indirect impact biofuels comments on “Yield increase” method, DNV, Høvik.


DNV (2012), Certification Module of Low Indirect Impact Biofuels LIIB – Trial Audit of Biodiesel from Used Cooking Oil, DNV, Høvik.

Ecofys (2008), Land use requirements of different EU biofuel scenarios in 2020: Contribution to the Gallagher review on the indirect effects of biofuel production, Report prepared for the UK Renewable Fuels Agency.

Ecofys (2009), Summary of approaches to accounting for indirect impacts, Report prepared for RSB.


Ecofys, Winrock (2009), Mitigating indirect impacts of biofuel production: Case studies and Methodology, Report prepared for the UK Renewable Fuels Agency.

Edwards, Mulligan, Marelli (2010), Indirect Land Use Change from increased biofuels demand: Comparison of models and results for marginal biofuels production from different feedstocks, JRC Institute for Energy, Ispra.
Low Indirect Impact Biofuel (LIIB) Methodology

EPFL (2012), Certification for Low Indirect Impact Biofuels Project - Pilot Test Report: Production of Biodiesel from Used Cooking Oil, EPFL, Lausanne.


RFA (2008), The Gallagher review of the indirect effects of biofuel production, Publication by the Renewable Fuels Agency.


WWF (2010), RCA pilot reports, consisting of three parts:

- Budiman A., Smit H. (2010), Identification of Responsible Cultivation Areas in West Kalimantan Indonesia - Phase I: Preliminary Assessment, A report prepared by WWF with support of Ecofys;
- Smit H., Budiman A., Yaya A. (2010), Identification of Responsible Cultivation Areas in West Kalimantan Indonesia - Phase II: Desk-based analysis, A report prepared by WWF with support of Ecofys;

Appendix A - Cost of certification to LIIB methodology

The LIIB project aims to develop a methodology to certify low indirect impact biofuel production. Four different solution types have been developed that could be used by biofuel and biofuel feedstock producers to certify biofuels with a low risk of causing indirect impacts. The LIIB methodology has been designed to be a user-friendly and cost-effective means of certifying “low risk” biofuels and biofuel feedstocks, avoiding the need for the operator to perform expensive and complex “additionality tests”.

A.1 Analysis of costs of LIIB certification

This Appendix includes the comments made by certification body DNV specifically with regard to the additional cost of certification against the LIIB methodology. The comments below are extracted from DNV’s pilot reports for the pilot tests carried out in the LIIB project. They refer specifically to the extra cost of obtaining LIIB certification if performed as part of another biofuel or bioenergy sustainability certification process.

Other relevant costs of producing low indirect impact biofuels, which relate to the implementation of production models with a low risk of indirect impacts (e.g. implementation of best management practices), are not addressed in DNV’s comments below. With respect to this point, the following observations may be made, however: Often the revenues from the additional feedstock production (e.g. though yield increases, etc.) are able to cover the initial investments needed. Earlier work indicated, for instance, that cultivation on unused Imperata grassland in Indonesia and sugarcane cattle integration in Brazil is economically feasible. Key barriers to implementing these solution types often relate not to the cost, but instead to non-technical and non-economic aspects such as customary practices or organisational issues. The palm oil yield increase pilot in Indonesia concluded that net income of smallholders would significantly grow as yields increase above BAU, although initial investments would be needed. The large share of UCO biodiesel in Europe and worldwide also demonstrates economic feasibility of biofuel from wastes. In some cases, however, LIIB production might not be able to cover all costs. For example, production on degraded land, might require additional investments in terms of inputs and transport costs.
A.2 Extra cost of certification to LIIB methodology if performed as part of a sustainability certification process (DNV comments, extracted from pilot reports)

LIIB category: Biofuel from Waste
The development of positive lists will make this LIIB methodology easy to audit during a normal management system or biofuel certification audit, and should add little expense to the normal audit costs, i.e. less than one additional hour.

LIIB Category: Feedstock production from Increased Yields
Most of the data needed to meet the LIIB certification will already be part of any sustainable biofuel certification scheme. The main effort for the producer will be establishing the record systems needed for certification. The data needed for the baseline calculations in the LIIB methodology needs to be standardised, and the assumption is that the data used for this will be in line with the production systems. The extra validation will be based on the yield improvement calculations, which could be an integral part of the certification audit. In the initial audit there will need to be approximately an extra 2-3 hours to validate the data within the context of a certification audit. In later audits the extra validation should add less than an hour extra in the certification process.

LIIB category: Feedstock production on Unused Land
The added cost to a sustainable biofuel certification audit that includes an “unused land” module is not currently feasible to estimate, until the audit requirements in the methodology are revised. If the methodology requires additional documentation and auditing of land use outside the project area, then an extra day for auditing would be required.

LIIB Category: Feedstock production from integrated sugarcane and cattle
The audits took, in principle, one day. More time was spent at Usina Estiva, but much of this time was spent understanding the operation and learning about Brazilian sugarcane production and the governmental control systems. This module includes the auditing of data that is not currently included in the RSB or other biofuel standards, i.e. cattle and feed data. If this audit was performed as a part of a sustainable biofuel audit, then an additional half to one day would be needed for the first audit and approximately 2-4 hours extra in later audits. The extra time needed would depend on the size of the mill and the quality of the data available.

A.3 Conclusion on costs of certification of LIIB methodology
The information required for the LIIB methodology is, in general, feasible to collect and verify. A significant part of the data collection needs are comprised in any sustainability certification standard and would thus not represent significant additional data gathering requirements. In addition, some of the data (such as yield data) are often gathered by operators regardless of whether they undergo certification – though this is not always the case.
Overall, the additional cost of LIIB certification, if performed as part of another biofuel or bioenergy sustainability certification process, represent a small increase in cost with respect to the costs of certification against direct effects (e.g. land use requirements of the RED; RSB certification, etc.).

The challenges for certification in the LIIB project related mainly to situations where:

a) Data was not available (i.e. in Indonesia the team could not collect reliable yield data, amongst others due to the absence of proper management systems from smallholders). In that case, this would also prevent them from getting certified under a voluntary scheme for direct effects (e.g. RSPO); and

b) Proper documentation was missing (i.e. for the unused land approach tested in Mozambique additional guidance was needed on what qualified as sufficient evidence to demonstrate unused land. Unfortunately the results of the Mozambique pilot were different from what the project partners expected. Due to a number of reasons, including expected population growth, the research concluded that the selected pilot area does not comply with the LIIB requirements for unused land. The research predicts significant pressure on land in central Mozambique due to increasing demand for food, hence the team concluded that the biofuels produced in this area will not avoid indirect impacts).
Appendix B - Project Application Document

This Appendix contains a template for the Project Application Document. It is used by the project developer to notify the intention to develop a LIIB project to the scheme owner, prior to project implementation.

1. Date of application

2. Location & contact

   Company information

   2.1 Company name
   2.2 Address
   2.3 State/Region & Country
   2.4 Contact person
   2.5 Telephone number
   2.6 Email

   Project site information (if different)

   2.7 Company name
   2.8 Address
   2.9 State/Region & Country
   2.10 Contact person
   2.11 Telephone number
   2.12 Email

3. Solution type

   3.1 Solution type applied for
   - Yield increase
   - Integration
   - ‘Unused’ land
   - End-of-life
4. Project description

Please provide a detailed description of the project. Include at least a description of feedstock, size of the operation, and description how the project will realise additional production:
Appendix C - Plan of Operation

This Appendix contains a template for the Plan of Operation. The project developer uses the Plan of Operation to present a detailed project description and information on the project’s system boundaries, how the project complies with the requirements for project acceptance for that project type, the baseline and the monitoring procedures. Please refer to chapter 3 for explanation on the process of the LIIB methodology and section 3.3 - 3.6 specifically for additional guidance depending on the applicable solution type.

The plan of operation is validated by a Certification Body during an audit. The Certification Body will check the accuracy of the information included in the plan and will determine whether the biomass project meets the acceptance requirements, whether the baseline has been set correctly and whether appropriate monitoring systems are in place to register additional production above the baseline.

Note: a Project Developer may provide information/calculations in an Annex.

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<td>2.7 Company name</td>
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</tr>
<tr>
<td>2.8 Address</td>
<td></td>
</tr>
<tr>
<td>2.9 State/Region &amp; Country</td>
<td></td>
</tr>
<tr>
<td>2.10 Contact person</td>
<td></td>
</tr>
<tr>
<td>2.11 Telephone number</td>
<td></td>
</tr>
<tr>
<td>2.12 Email</td>
<td></td>
</tr>
</tbody>
</table>

### 3. Solution type

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 3.1 Solution type applied for | □ Yield increase  
□ Integration  
□ ‘Unused’ land  
□ End-of-life |

### 4. System boundary

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>4.1 Scope of LIIB project (include GIS coordinates if available, and/or maps, etc.)</td>
<td></td>
</tr>
<tr>
<td>4.2 Size of the project (ha) (not applicable to end-of-life projects)</td>
<td></td>
</tr>
</tbody>
</table>

### 5. Project acceptance requirements

5.1 For each acceptance requirement: indicate the information collected to demonstrate compliance. Indicate whether the information used is (i) primary data, including description of how the data is gathered, (ii) secondary data, including the source. See section 3.3 - 3.6 for the relevant acceptance requirements

<p>| | |</p>
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</table>
6. Baseline

6.1 Calculation of baseline and description of how the baseline was established. Document how each parameter was measured. Indicate whether the information used is (i) primary data, including description of how this info was gathered, or (ii) secondary data, including the source.

- For yield increase projects, at a minimum, provide information on the following parameters:
  - Y_{b,t=0} = baseline yield for current year (in mass or volume)
  - Y_{t=0} = yield at project site during each of five previous years & average;
  - Detailed calculation of expected yield of similar producers in the current year according to 3.3.3.(1b)
  - \gamma_r = average annual yield growth rate for the last 10 years for similar producers (expressed in % per year)
  - Y_{b,t=x} = baseline for years 1-10 (in mass or volume per year)

- For sugarcane-cattle integration projects, the baseline is defined as a mill that does not apply the integration concept and does not produce any animal feed, hence the baseline is zero.

- For "Unused Land" projects baseline is zero (if the land was not used for other provisioning services before the project was implemented). When limited provisioning services are displaced these provisioning services must be established and documented.

- Not applicable to End-of-life projects.

7. Special situation

7.1 Indicate whether you fall under a "special situation" and explain

8. Monitoring methodology

6.1 Describe how each monitoring parameter is measured. Note, monitoring parameters and baseline parameters and their units need to be in agreement.

The monitoring parameters are as follows:

- Yield increase projects:
  - V_{LIIB,t=x} = Volume of LIIB compliant biomass in year x (volume in m$^3$ or mass in kg)
  - A = System boundary area (ha)
  - Y_{t=x} = Yield in year x (volume in m$^3$/ha or mass in kg/ha)
  - Y_{b,t=x} = Baseline in year x (volume in m$^3$/ha or mass in kg/ha)

- Sugarcane-cattle integration projects
  - V_{LIIB ethanol,t=x} = Volume of LIIB compliant ethanol (in m$^3$)
  - Eq_{av} = Equivalent ILUC avoided area (in ha/year) calculated using 'Sugarcane-cattle integration calculation sheet'. For this the following data is needed:
    - Animal feed ingredients and quantities (kg)
### Low Indirect Impact Biofuel (LIIB) Methodology

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Definition</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_{et,t=x}$</td>
<td>Ethanol yield per hectare in year $x$ (volume in m$^3$/ha)</td>
</tr>
<tr>
<td>$C_{et}$</td>
<td>Cane processed for ethanol (in tonnes)</td>
</tr>
<tr>
<td>$C_{sug}$</td>
<td>Cane processed for sugar (in tonnes)</td>
</tr>
<tr>
<td>$V_{LIIB,t=x}$</td>
<td>Volume of LIIB compliant biomass in year $x$ (volume in m$^3$ or mass in kg)</td>
</tr>
<tr>
<td>$Y_{t=x}$</td>
<td>Yield in year $x$ (volume in m$^3$/ha or mass in kg/ha)</td>
</tr>
<tr>
<td>$A$</td>
<td>System boundary area (ha)</td>
</tr>
</tbody>
</table>

**Unused Land projects**

<table>
<thead>
<tr>
<th><strong>Parameter</strong></th>
<th><strong>Definition</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{LIIB,t=x}$</td>
<td>Volume of LIIB compliant biomass in year $x$ (volume in m$^3$ or mass in kg)</td>
</tr>
<tr>
<td>$Y_{t=x}$</td>
<td>Yield in year $x$ (volume in m$^3$/ha or mass in kg/ha)</td>
</tr>
<tr>
<td>$S_{positive}$</td>
<td>Share of the end-of-life product stream in the region eligible (%)</td>
</tr>
</tbody>
</table>

### 9. Projected LIIB-compliant material during Project Acceptance Period

**9.1 Indicate the projected amounts of LIIB-compliant material for the entire project acceptance period. The projected amounts may be revised based on experience. Please note this in the Management of Change section.**