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Status of the implementation of biofuels and bioenergy certification systems

Major implications, reporting constraints and implementation controls

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**STATUS OF THE IMPLEMENTATION OF
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MAJOR IMPLICATIONS, REPORTING CONSTRAINTS AND
IMPLEMENTATION CONTROL**

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1. INTRODUCTION

Supported in some cases by incentives and policy measures, biofuel production has increased continuously worldwide over the last years. In 2009, global ethanol production reached nearly 20 billion gallons¹, in more than 40 countries (RFA, 2010). In 2009, the ethanol production reached 10.6 billion gallons in the US, 6.6 billion gallons in Brazil, 1.04 billion gallons in the EU, 0,54 billion gallons in China, 0,44 billion gallons in Thailand, 0.29 billion gallons in Canada, 0,09 billion gallons in India, 0.08 billion gallons in Colombia and 0,25 billion gallons in other Countries (RFA, 2010). Global biodiesel production totalled 5.1 billion gallons world-wide in 2009, 80% of biodiesel being produced in the European Union. In the US, biodiesel production reached 650 million gallons in 2008 (Emerging Markets, 2008). The land used for biofuels was estimated in 2008 at around 20 million hectares worldwide, or around 1% of the global agricultural land, of which about 8 million hectares used for sugarcane plantation in Brazil (Gallagher, 2008, Searchinger 2008).

Biofuel production started in Brazil since the late 1970s by the National Fuel Alcohol Programme through a system of tax rebates and subsidies for ethanol production. Bioethanol now represents almost 25% of total road transportation fuel in Brazil. New biofuel mandates, like the Renewable Fuels Standard (RFS) in the United States, or the Renewable Energy Directive in the European Union and other in Latin America and Asia provide perspectives for an expanded demand for biofuels across the world. In the European Union, the Directive 2009/28/EC on the promotion of the use of energy from renewable source set mandatory targets of 10% share of renewable energy in transport for 2020 each EU Member State, and 6% reduction in greenhouse gas (GHG) emissions from road transport fuels (EC, 2009a). The estimations show that about 34.6 Mtoe of biofuel would be necessary in the EU to comply with the 10% binding target (EC, 2007). In the US, the Energy Independence and Security Act (EISA) of 2007 set overall renewable fuels targets of 36 billion gallons by 2022, with 15 billion gallons of ethanol and 21 billion gallons of advanced biofuels by 2022 (Environmental Protection Agency, 2010a). In addition to its strong bioethanol programme, the Brazil biodiesel national program was established to ensure blending 2% of biodiesel in 2008 and 5% until 2013 in the Brazilian energy mix in transport. Australia, China, India, Indonesia, Malaysia, Philippines, South Korea, Taiwan and Thailand have set national or partial mandates to blend biofuels. Latin American countries are putting into place ethanol programs to stimulate bioethanol production. China proposed biodiesel targets for 2010 to increase biofuels production to nearly 4 million tonnes by 2010. The targets of China proposed for 2020 are to produce 12 million tonnes of biofuels, to replace 15% transportation energy

¹ 1 US gallon = 3.785 litres

needs. The India's National Biodiesel Program started in 2006 and includes a target of 20% of diesel fuel by 2012, based on a *Jatropha* plantation program (Emerging Markets, 2008).

Biofuels are considered as an option to reduce greenhouse gases emissions, reduce climate change, increase energy supply diversity and security of supply, as well as an opportunity for job creation and rural development. Reducing greenhouse gases due to biofuels production through carbon sequestration during plant growth is one of the main reasons for replacing fossil fuels by biofuels. However, various concerns were lately expressed on various presumed negative impacts, including the GHG emissions reductions, especially when direct and indirect land use changes were considered.

The global biofuels targets are likely to have a strong impact on land use and agricultural markets. Although biofuels production provides new options for using agricultural crops, there are environmental, social and economic concerns associated with biofuels production. The diversity of feedstock, large number of biofuels pathways and their complexity lead to a high uncertainty over the GHG performances of biofuels, in terms of GHG emissions reductions compared to the fossil fuels, especially if land use change is involved. Additional uncertainties occur if indirect effects are considered, such as the indirect land use changes or the impact on food and feed, local energy supply, bio-materials, etc. The specific biofuels characteristics, linked to other markets, produced in large volumes and involved in a variety of complex trading patterns, will pose an enormous challenge for developing a certification system.

Biofuels certification is a response to the concerns related to the biofuels sustainability. There are several existing certification schemes related to sustainability in other fields, varying considerably in scope, as were developed for a wide range of products as a result of various concerns (Van Dam et al., 2007, BTG, 2008). Some systems cover one of the areas in biomass production, such as agriculture, forest and fair trade. They provide insight into the structures of certification systems (design, implementation constraints, cost-benefits...) as well as operational experience and effectiveness. Some schemes include sustainability criteria that could be adapted for bioenergy and biofuels certification, and provide a useful experience for the development of a biofuels certification scheme, or for benchmarking.

2. EUROPEAN UNION SUSTAINABILITY REQUIREMENTS

2.1. EU biofuel sustainability criteria

The Renewable Energy Directive 2009/28/EC of the European Union (EU-RED) includes a set of mandatory sustainability criteria as part of an EU sustainability scheme and also monitoring and reporting requirements for biofuels and bioliquids (EC, 2009a). Similar sustainability requirements were set in the Fuel Quality Directive 2009/30/EC (EC, 2009b) on the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce GHG emissions. Biofuels are required to fulfil all sustainability criteria to count towards EU targets and to be eligible for financial support. The EU Member States are responsible for checking compliance with the sustainability criteria, but the European Commission can recognise voluntary sustainability certification schemes. The EU-RED requires a Single Harmonised Scheme in the European Union and therefore Member States may not lay down requirements that go further.

The EU-RED excludes several land categories, with recognised high biodiversity value, from being used for biofuel production: a) primary forests and other wooded land; b) areas designated for nature protection or for the protection of rare, threatened or endangered ecosystems or species; c) highly biodiverse grassland, either natural or non-natural. Biofuels should not be made from material from peatland and land with high carbon stock, such as: a) wetlands; b) continuously forested areas; c) land covered by trees higher than five metres and a canopy cover between 10% and 30%.

For the biomass feedstock produced in the EU, the cross-compliance rules of the Common Agricultural Policy apply, in accordance with the requirements for good agricultural and environmental conditions. The EU cross compliance regulations refer to preservation of soil and water quality, of biological diversity, careful use of fertilisers and pesticides, and air pollution.

In the European Union, biofuels should meet a minimum requirement for GHG savings of 35% relative to fossil fuels, to increase to 50% in 2017 and 60% in 2018 for new biofuel plants. Advanced, second-generation biofuels produced from residues, non-food cellulosic material, and lignocellulosic material would be double credited towards the 10% target. Besides the sustainability criteria, the EU-RED includes rules and a methodology for the calculation of the GHG emissions and provides actual and default values. The GHG emissions shall include all emissions from the extraction or cultivation of raw materials, emissions from processing, transport and distribution and annualised emissions from carbon stock changes caused by land-use change, calculated over a period of over 20 years. A bonus of 29 gCO₂eq/MJ shall be attributed if the land was not in use or it was severely degraded land and heavily contaminated land. The GHG emissions from co-products shall be calculated in proportion to their energy content. The European Commission provided guidelines establishing the rules for the calculation of land carbon stocks, including soil organic carbon and carbon stock in the above and below ground vegetation both for the reference and the actual land use and values for different soil

types and land use categories. The European Commission shall report, by 31 December 2010, on the impact of Indirect Land Use Change (ILUC) on GHG emissions and addressing ways to minimise the impact of ILUC. The report will include a methodology for emissions from carbon stock changes caused by indirect land-use changes.

The EU sustainability scheme includes monitoring and reporting requirements. The EU Member States shall report on the impact of the biofuels and bioliquids on biodiversity, water resources, water quality and soil quality; the net GHG emission reduction and changes in commodity prices and land use associated with increased use of biomass. The fuel suppliers are required to report on the compliance with the sustainability criteria and on the measures taken for soil, water and air protection, the restoration of degraded land and the avoidance of excessive water consumption in areas with water deficit. Although there are no criteria for social sustainability included, the European Commission must report on the biofuels impact on social aspects and on the impact on the availability of food at affordable prices. The European Commission will monitor the origin of biofuels consumed in the EU and impacts of their production in the EU and third countries, land use and land use change, commodity prices and food security.

2.2. Sustainability requirements for the use of biomass sources for bioenergy

The European Commission report on the requirements for a separate sustainability scheme for the use of biomass other than biofuels or bioliquids (COM(2010)11) provided EU Member States recommendations for developing national schemes for solid and gaseous biomass used in electricity, heating and cooling. In the absence of an EU-wide sustainability scheme, the Commission recommends that national sustainability schemes for biomass used in electricity, heating and cooling, comply with the same requirements as those laid down in the Renewable Energy Directive for biofuels and bioliquids. This minimizes the risk of diverse and possibly incompatible criteria at national level, leading to discrimination in the use of raw materials based on their final use, barriers to trade and limits the growth of bioenergy. Small-scale producers and users, below 1MW capacity, are excluded from the application of sustainability criteria.

The Commission acknowledged sustainability concerns on biomass production in terms of protecting the biodiversity of ecosystems and carbon stocks. Biomass should therefore not be sourced from land converted from forest or other areas of high biodiversity or high carbon stock. Increased use of forestry or agricultural residues can possibly lead to a reduction of land carbon stock in the soil, when residues are removed from land. The Commission recommended the differentiation of national support schemes for electricity, heating and cooling installations to provide incentives to achieve high-energy conversion efficiencies.

The report set out a common methodology for calculating the GHG performance of biomass, to include the conversion of biomass to electricity, heating or cooling. It should ensure that biomass use delivers at least 35% GHG savings, rising to 50% in 2017 and 60% in 2018 for new installations.

However, EU Member States should not impose sustainability criteria to waste, which is covered by environmental rules laid down in a separate waste legislation at national and European level. Forestry related sustainability framework and cross compliance rules for agriculture ensure the biomass sustainability in Europe.

Deforestation and indirect land-use change resulting from the production of energy crops, can lead to a loss of carbon in forests and soils. Keeping records of the origin of biomass and monitoring potentially vulnerable areas can contribute to preventing certain effects. These issues are addressed most effectively at international level.

3. CERTIFICATION INITIATIVES FOR CROPS USED AS FEEDSTOCK FOR BIOFUELS

Several certification systems apply to the agricultural sector to ensure environmentally friendly or sustainable agricultural production to provide safer or healthier products (IFEU, Oeko, 2008). Agricultural certification schemes address a core set of concerns relating to sustainable farming practices, agrochemical handling and use, safety and health and food traceability, with the sustainability criteria addressing mainly environmental aspects. New initiatives face rapid development to establish sustainability certification schemes for biofuels feedstock production in tropical countries, such as palm oil, sugarcane and soybean. In spite of the higher yields and better GHG balances of biofuels from tropical countries (sugarcane ethanol or palm oil biodiesel) than biofuels from temperate regions, they bear the risk of higher negative environmental impact. Therefore, the development of certification schemes for certain biofuels feedstocks from tropical countries are essential for securing various sustainability concerns.

3.1. Roundtable on Sustainable Palm Oil

The Roundtable on Sustainable Palm Oil (RSPO) was established in 2004 with the objective of promoting the growth and use of sustainable palm oil products and for developing global standards for sustainable palm oil. RSPO carries out its activities within four working groups: 1) Standards and Certification; 2) Trade and Traceability; 3) Communications and Claims and 4) Projects. The RSPO adopted draft criteria in 2005 to ensure legal, economically viable, environmentally appropriate and socially beneficial management and operations of palm oil production. The RSPO principles and criteria, including indicators and guidance were adopted at the end of 2007 after field-testing during a pilot implementation period (RSPO, 2010).

RSPO certification has been applied since 2008 for about 1.6 million tonnes out of around 38 million tonnes of palm oil produced worldwide per year. The RSPO criteria cover major economic, social and environmental aspects, including the establishment and management of plantations and processing: 1) Commitment to transparency, 2) Compliance with applicable laws and regulations, 3) Commitment to long-term economic and financial viability, 4) Use of best practices by growers and millers, 5) Environmental responsibility and conservation of natural resources and biodiversity, 6) Responsible consideration of employees, individuals and communities, 7) Responsible development of new plantings, 8) Commitment to continuous improvement in key areas (RSPO, 2010).

The RSPO criteria are formulated in terms of process and management requirements, according to the best practice. RSPO principles and criteria focus primarily on palm oil production and do not cover the transport and processing of palm oil products. A methodology and a set of guidelines for national interpretation of the RSPO principles and criteria have been developed. National Interpretations have

been established for Colombia, Ghana, Indonesia, Malaysia, Papua New Guinea, Solomon Islands and Thailand. It allows addressing key concerns at local or regional level, and complementing national laws with a higher benchmark, if needed.

RSPO plans to develop a framework and guidelines for reducing GHG emissions, taking into account all relevant sources, including those from conversion of land, palm oil mill effluents, fossil fuel and fertiliser use. It also plans to improve the specific criteria and indicators in relation to GHG emissions and guidance on best management practices for reducing GHG emissions. RSPO will prepare a common framework for reporting, as well as a methodology for the certification of emission reductions. It will propose methods to reduce GHG emissions, particularly related to land-use change, including planting on degraded land or increasing yield and investigating ways to reduce emissions from peatlands (RSPO, 2010). The RSPO certification and supply chain certification documents, include the requirements for certification and tracking certified palm oil, incorporating palm oil characteristics into trade specifications (RSPO, 2009). The RSPO allows the use of one of the following supply chain systems: segregation, mass balance, and book-and-claim. All the supply chain participants need to register the transaction in the RSPO traceability system.

3.2. Roundtable for Responsible Soy Production

The Roundtable for Responsible Soy Production (RTRS) was established in 2006 to promote responsible soy production, processing and trade. It aims to ensure that soy is produced in a sustainable manner, with reduced social and environmental impact, while maintaining or improving the economic conditions of producers. RTRS works to develop a sustainability standard for soy production, processing, trading and use. It has published draft guidelines on economic, social and environmental responsibility. This will apply to all kinds of soybeans, including conventional, organic and genetically modified soybean (RTRS, 2010).

The principles and criteria for soy production were approved in May 2009, as a basis for a global standard. The RTRS standard released in June 2010 includes Integrated Crop Management (ICM), measures and practices in soy production. The RTRS standard contains 5 principles applicable to the soy production: 1) Legal Compliance and Good Business Practice; 2) Responsible Labour Conditions; 3) Responsible Community Relations; 4) Environmental Responsibility; and 5) Good Agricultural Practice. They will be the base of the norms to be used within a voluntary certification system for soy production (RTRS, 2009b).

Certification in each country will be based on the National Interpretation of the principles and criteria, built on the Guidance for National Interpretation developed by RTRS. National Interpretations of the RTRS generic standard will define applicable local indicators, guidelines or procedures for economic, social, environmental aspects adapted to the local circumstances (RTRS, 2009c). RTRS has carried out field tests in 2009-2010 for the verification of the principles and criteria to produce a first certifiable version. The Version 1.0 of the RTRS Standard was published in June 2010. RTRS will develop

national level macro-scale maps that will provide biodiversity information and a system, which will guide responsible expansion of RTRS soy. The national macro-scale maps shall be drawn based on a generic global methodology.

A voluntary RTRS certification scheme will be developed in compliance with the EU Renewable Energy Directive. The RTRS scheme, including a GHG calculator is expected to be ready by 1 January 2011. The RTRS supply chain traceability system will be based on a stepwise approach: 1) a system of trading certificates; 2) mass balance, compliant with the EU Renewable Energy Directive; and 3) segregation and full traceability through the whole supply chain to the end user. Operational procedures are yet to be developed for the supply chain certification and the supply chain traceability scheme (RTRS, 2010).

3.3. Better Sugarcane Initiative

The Better Sugarcane Initiative (BSI) aims to promote the sustainable sugarcane production and to reduce economic, environmental and social impacts of sugarcane production and primary processing. BSI plans to define global performance-based principles, criteria, indicators and standards in key environmental and social issues. Three working groups have been established to assess Better Management Practices covering: Environment and agronomy; Social and community; Milling and co-products (BSI, 2009a).

Based on the Version 1 of the BSI standard published in April 2009, pilot studies were conducted in Australia, Brazil, Dominican Republic, South Africa and India. The Version 2 of the BSI Standard was published in 2010, including additional documents, such as a list of relevant international conventions, a GHG emission calculation methodology and guidance for setting up an Environmental Management Plan (BSI, 2009b). After public consultation, BSI published in July 2010 the Production Standard, including principles and criteria for sustainable sugarcane production and the Chain of Custody Standard, containing a set of technical and administrative requirements for tracking along the entire supply chain, from production, conversion, processing, and trade to final use for all sugarcane products.

The BSI standard includes the following principles covering sugar production and processing, comprising economic, financial, environmental and social aspects: 1) Obey the law, 2) Respect human rights and labour standards, 3) Manage input, production and processing efficiencies to enhance sustainability, 4) Actively manage biodiversity and ecosystem services, 5) Commit to continuous improvement in key areas of the business. BSI provided environmental and social criteria and set requirements on business practices, operational efficiency and financial productivity. It proposed a scheme for the calculation of GHG emissions from sugarcane cultivation and processing to sugar and/or ethanol. According to the BSI GHG calculation methodology, the emissions associated with the direct land use change are included in the calculation. The emissions released from indirect land use change are not included, as the methods and data requirements are not available. Default and

secondary data (defined as being generated from other sources) were proposed for emissions calculation where actual data are not available (BSI, 2009b).

The BSI has developed guidance documents for certification, including recommendations on the interpretation of the principles and criteria and the requirements to ensure compliance with the standard. BSI submitted to the EU an application for the BSI certification system to ask recognition as a voluntary scheme.

4. EUROPEAN INITIATIVES FOR BIOFUEL CERTIFICATION

A large number of initiatives are developing biofuels sustainability standards, principles and criteria and biomass certification schemes. In Europe, some ongoing initiatives for biofuels certification are performed at national level, such as in the UK, The Netherlands and Germany.

4.1. Renewable transport fuels obligation

The Renewable Transport Fuels Obligation (RTFO) requires that a certain amount of road transportation fuels in the United Kingdom come from sustainable renewable sources (RFO, 2009a). RTFO has been established the Sustainability Reporting (Ecofys, 2006) and the Carbon Certification, including a methodology for the quantification of GHG savings (E4Tech, 2006). Certificates are issued when renewable fuels are supplied and fuel duty is paid on them. At the end of the obligation period, these certificates serve as evidence for meeting the renewable fuel obligation. Obligated suppliers can acquire certificates from other suppliers of renewable fuels or “buy out” their obligation by paying a buy-out price to the Renewable Fuels Agency (RFA).

Starting from April 2008, fuel suppliers have to report on the sustainability and carbon intensity of the biofuels supplied. Biofuels suppliers must provide information on the type of fuel supplied and the feedstock and country of origin. They must also report on the social and environmental standards they meet and on the GHG emission savings including direct land use changes. They can, at least initially, report that they do not have information on the sustainability of their biofuel.

RTFO sustainability reporting is based on seven environmental and social principles, and corresponding criteria: 1) Carbon conservation, 2) Biodiversity conservation, 3) Soil conservation, 4) Sustainable water use, 5) Air quality, 6) Workers rights, 7) Land rights. RTFO has set indicative targets for GHG saving achieved by the biofuel supplied in the obligation period: 40% for 2008/2009, 45% for 2009/2010 and 50% for 2010/2011. No compliance threshold has been set so far for the GHG saving for different biofuels. A GHG calculation methodology was established based on a well-to-wheel approach that includes all significant sources of emissions, using default, conservative values or actual data (RFA, 2009).

Biofuels suppliers report on land use change history, if known, which is incorporated into the RTFO carbon emissions calculation using default values from Intergovernmental Panel on Climate Change (IPCC) guidelines. The RFA will monitor and report on some wider environmental and social issues and indirect impacts, such as indirect land-use change or changes of commodity prices, including food and the implications of biofuels produced from “unknown” sources (RFA, 2009). A Carbon Calculator tool is available to fuel suppliers to evaluate the carbon emission savings for each batch of fuels. It uses detailed data depending on the type of biofuels, feedstocks and countries of origin. A new RTFO

Carbon Calculator applies the lifecycle analysis methodology laid out in the EU Renewable Energy Directive.

RTFO requires a chain-of-custody to cover the whole chain, linking the reported biofuels with certain carbon and sustainability characteristics with the corresponding feedstocks. All chains-of-custody approaches i.e. book-and-claim, mass balance, and track and trace systems, are allowed under the RTFO. If no certified chain-of-custody system is in place, a RTFO recommends the mass balance approach, according to the provisions of the RES Directive (RFA, 2009). Detailed guidelines for setting up a mass balance chain of custody were prepared and are given in the Technical Guidance.

4.2. Sustainable Production of Biomass – The Netherlands

In the Netherlands, the Cramer Committee for “Sustainable Production of Biomass” was set up in 2006 to develop a certification system and formulate sustainability criteria for the production and conversion of biomass for energy, fuels and chemistry (Cramer, 2006). The bioenergy or biofuel suppliers will have to comply with the proposed "testing framework" (Cramer, 2007). The Cramer Commission formulated in 2007 a set of principles and criteria, as presented in the report “Testing framework for sustainable biomass” (Cramer, 2007). Sustainability criteria shall apply to transport fuels, but also to the biomass used for energy generation, heating and cooling and bio-based materials. The Cramer Commission proposed six themes to address biomass sustainability, based on a triple P approach (People, Planet, Profit), considered the guiding principle for Corporate Social Responsibility: 1) Greenhouse gas emissions, 2) Competition with food, local energy supply, medicine and construction materials, 3) Biodiversity, 4) Environment, 5) Prosperity, 6) Social well-being (social, human and property rights) (Cramer, 2006).

Several aspects not covered by the sustainability criteria in the EU-RED (such as environment or social issues) should be covered by other certification systems and bilateral agreements. The Cramer Committee proposed a methodology for calculating GHG emissions, covering the whole chain and all sources from production, transport and conversion to end-use. Direct land-use changes are part of the calculation, while indirect land use changes are not. The requirements for GHG emission reduction are 35% for biofuels, to be increased to 50% from 2012, and 70% for electricity production.

The Cramer Commission proposed two levels of reporting, at company and macro levels. The issues that cannot be addressed at company level, such as availability of food and food prices, changes in land use, deforestation and change in the type of vegetation, etc., should be monitored at the macro level through a reporting system. The development of a monitoring system on the changes in land use and establishment of land use planning will be the responsibility of the Dutch Government and the authorities of producing countries. The Cramer Commission considered three different systems for the chain-of-custody: track and trace system, mass balance system and negotiable certificates. Several measures shall be implemented to address indirect land use changes: including an indirect land use change factor (ILUC factor) in GHG calculations; encouraging the use of severely degraded and

polluted land for biofuels; certification of all agricultural crops; protecting carbon-rich habitats through international agreements, etc. (CDB, 2010).

A working group of NEN, the Dutch Standards Organisation, was established for developing the Netherlands Technical Agreement (NTA) with sustainability criteria for biomass. The NTA 8080:2009 incorporated, in March 2009, the Cramer sustainability criteria for biomass into a national sustainability standard: NTA 8080:2009 "Sustainability criteria for biomass for energy purposes" (NTA, 2009a). It includes the minimum requirements to be used for the certification of sustainably produced biomass (solid biomass, liquid and gaseous biofuels) for energy production (power, heating and cooling and transportation fuels). The NTA 8081 "Certification scheme for sustainably produced biomass for energy purposes" (NTA, 2009b) provides the certification scheme, including the rules for certification, the scope of the scheme and the procedure and requirements for certification against the requirements of the NTA 8080.

4.3. International Sustainability and Carbon Certification

The International Sustainability and Carbon Certification (ISCC) project has finalised in Germany, at the beginning of 2010, an international certification system for biomass and bioenergy, covering all relevant raw materials from agriculture and forestry. This was developed in compliance with the specifications of the Ordinance on sustainable production of transport biofuels (Biokraft-NachV, 2009) and the sustainable production of liquid biofuels for electricity (BioSt-NachV, 2009).

The ISCC standard comprises six principles and corresponding criteria (ISCC 202): 1 Biomass shall not be produced on land with high biodiversity value or high carbon stock, peatland and High Conservation Value (HCV) areas; 2 Biomass shall be produced in an environmentally responsible way, including protection of soil, water and air and application of Good Agricultural Practices; 3 Safe working conditions through training and education; 4 Biomass production shall not violate human rights labour rights or land rights; promote responsible labour conditions and workers' health, safety and welfare; 5 Biomass production shall take place in compliance with regional and national laws and relevant international treaties; 6 Good management practices.

The relevant certification criteria cover: 1 sustainability requirements for biomass production; 2 requirements concerning the GHG emission savings and calculation methodology; 3 requirements concerning the traceability and mass balance. Biomass production must comply with sustainability requirements, such as: protection of areas of high conservation value; protection of areas with high carbon stock; protection of peatland; sustainable management of farms. A National or Regional Initiative (National or Regional Technical Working Group) can adapt the international ISCC standards to local conditions.

Within EU Member States that have implemented cross compliance, it is only necessary to control compliance with the requirements for the protection of areas of high conservation value, high carbon

stock and peat land, as the other principles are already covered by cross compliance. For countries that have ratified the respective ILO Conventions, it is assumed that the social requirements are fulfilled.

The GHG emission calculation methodology, ISCC 205, considers all emissions in the life cycle of the production chain, including transport and by-products using the allocation method based on energy value. It also includes emissions from land use change, in line with the Renewable Directive methodology and the IPCC 2006 Guidelines for National GHG Inventories. It was based on the ISO standards and “Common methodological framework for GHG emissions due to bioenergy” of the Global Bioenergy Partnership. ISCC requires a GHG emission reduction of 35%.

ISCC can operate as a meta-system and endorse other certification systems, if they comply with the ISCC requirements (ISCC 254). The ISCC issues two different certificates: certificates for sustainable cropping, issued to farms, and chain-of-custody certificates issued to all participants in the supply chain. National and Regional initiatives can be established under the umbrella of ISCC for the adaptation of ISCC standards according to the specific national and regional conditions. The ISCC traceability will be achieved through mass balance or physical segregation methods. The ISCC standard includes minimum requirements for the management system and information requirements for the identification of biomass along the supply chain (ISCC 203) and the mass balance calculation methodology (ISCC 203).

After the pilot testing in the EU, Argentina, Brazil and Malaysia, the ISCC System was finally recognized by the German Federal Agency for Agriculture and Food (BLE) as a certification system for sustainable biomass and bioenergies, and the first certificates have been issued 2010 (ISCC, 2010). The request for recognition as voluntary scheme by the European Commission has been submitted.

4.4. CEN Standard for sustainably produced biomass for energy applications

CEN (European Committee for Standardisation) established in 2008 the CEN/TC 383 Committee for “Sustainably produced biomass for energy applications”. CEN/TC 383 will elaborate a European standard for sustainable biomass for energy applications, such as transport, heating, cooling and electricity (CEN, 2009). CEN standards can be used as a base for certification systems. CEN/TC 383 may address possible additional sustainability themes to those defined in the EU Renewable Energy Directive: social, environmental and economic aspects, both direct and indirect. The CEN standard shall provide requirements and evaluation methodologies on biodiversity, soil, water air quality, land use change and loss of carbon stocks. The standard will also include requirements on social issues such as contribution to local employment and welfare, labour conditions, competition with food and local biomass use and land use rights. CEN/TC 383 shall also define the reporting requirements and conditions for tackling indirect effects.

Six Working Groups were established on terminology, consistency of evaluation methods and other cross-cutting issues; GHG emission and fossil fuel balance; biodiversity and environmental issues; economic and social aspects; verification and auditing, including chain of custody; indirect effects

(land use change, economic, social aspects and food). The deadlines for completing the work were set between October 2012 and March 2013 (CEN, 2009).

Principles of management standard series like ISO 9000, ISO 14000 and ISO 26000 shall be included in the CEN Standard. The GHG calculation methodology should take into account ISO 14040 for Life Cycle Assessment and ISO 14064 series for GHG accounting and verification. The introduction of minimum criteria in a European CEN Standard will help to promote the use of harmonised principles and criteria in the EU and facilitate compliance with the European sustainability regulatory requirements.

5. INTERNATIONAL BIOFUELS CERTIFICATION INITIATIVES

5.1. Roundtable on Sustainable Biofuels

The Roundtable on Sustainable Biofuels (RSB) is an initiative of the Swiss "École Polytechnique Fédérale de Lausanne" (EPFL) and other partners, to develop international sustainability standards for biofuels. The version one of the RSB Standard includes principles and criteria for sustainable biofuels production, associated guidance and compliance indicators. RSB developed several documents to provide guidance for conducting the Environmental and Social Impact Assessment (ESIA), including social guidelines, ecosystem and conservation values, soil and water guidelines.

The RSB standard includes 12 principles and criteria and requirements differentiated in minimum and progress requirements: 1) Legality; 2) Planning, Monitoring and Continuous Improvement; 3) Greenhouse Gas Emissions; 4) Human and Labor Rights; 5) Rural and Social Development; 6) Local Food Security; 7) Conservation; 8) Soil; 9) Water; 10) Air; 11) Use of Technology, Inputs, and Management of Waste; and 12) Land Rights. It also includes guidelines on best practices in the production, processing and use of biofuels for transport. A methodology will be developed to address indirect impacts, including land use change and food security issues. Two approaches are being examined to address indirect impacts: 1) the use of an indirect land use (ILUC) factor and 2) promoting practices and feedstocks that lower the risk for negative indirect impacts (RSB, 2010).

The RSB developed in 2010 a GHG accounting methodology, in cooperation with EMPA (Swiss Federal Laboratories for Materials Testing and Research). This is based on a well-to-wheel approach and includes emissions from land use change, including above and below ground carbon stock, based on IPCC 2006 Guidelines and the use of co-products, residues and wastes. RSB will also consider including the indirect land use change in the GHG accounting methodology (E4Tech, 2009). The RSB set a minimum GHG emission threshold of 50% for biofuel blends compared to the fossil fuel baseline, which shall increase over time. Each biofuel in the blend shall have lower lifecycle GHG emissions than the baseline.

The RSB adopted a "meta-standard" approach, with a generic standard. Different options for implementation are open. In the first option, the crops shall be certified by an applicable qualifying standard and not by the RSB generic standard. The second option is developing a generic certification system for all biomass feedstocks not covered by a sustainability standard. The RSB has developed a set of additional requirements, standard requirements, which includes the supply chain requirements or chain of custody, accreditation and verification requirements. The RSB chain of custody tracking models allowed include: identity preserved, segregation and mass balance. These make use of the internationally recognised standards, including ISO Guide 65, ISO 19011 and ISO 17011. The RSB biofuel certification standard is planned to become fully operational and issue the first sustainable biofuel certificates in 2011. The RSB has developed a Standard for EU market access, intended to

ensure compliance of the RSB certification system with the EU sustainability criteria as defined by the EU Renewable Energy Directive (RSB, 2010).

5.2. United States Renewable Fuels Standard

In the United States, the 2005 Energy Policy Act established a Renewable Fuels Standard (RFS), requiring blending of biofuels in transport fuels. It mandated the use of 7.5 billion gallons of renewable fuels by 2012 in the United States. The Energy Independence and Security Act (EISA) of 2007 increased the annual renewable fuels targets to 36 billion gallons by 2022, with 15 billion gallons of ethanol and 5.5 billion gallons of "advanced biofuels" by the year 2015 and 21 billion gallons of advanced biofuels by 2022. For 2010, EISA set a target of 12.95 billion gallons, of which 6.5 million gallons cellulosic biofuel and 1.15 billion gallons biodiesel (Environmental Protection Agency, 2010a).

Under the revised Renewable Fuel Standard program (known as the RFS2 program), established in 2010, the obligated parties will be required each year to provide a certain volume of biofuels. The RFS2 program covers all transportation fuel used in road, rail and marine transportation. The US Environmental Protection Agency (EPA) is in charge of the implementation of the program and to report on the full range of impacts of biofuel production. Obligated parties must demonstrate that it has satisfied its Renewable Volume Obligation (RVO) for each compliance period. If it fails to meet their RVO in a given compliance period, the deficit can be carried to the next period. An obligated party satisfies its RVO by acquiring Renewable Identification Numbers (RINs). RINs serve as direct evidence of compliance with the RFS Program and allow EPA to track renewable fuel volumes from production to end-use. The transfer of ownership of assigned RINs must be documented on Product Transfer Documents (Environmental Protection Agency 2010a).

The RFS2 requires a reduction of lifecycle GHG emissions depending on the renewable fuel category: 20% for first generation biofuels (corn ethanol), 50% for advanced biofuels (biodiesel, sugarcane ethanol) and 60% GHG emission reductions for cellulosic biofuels (lignocellulosic ethanol). However, the RFS2 thresholds do not constitute compliance levels for biofuels and they do not exclude certain biofuels if they do not meet the GHG performance thresholds (Environmental Protection Agency, 2010b). According to the EPA rules on the Renewable Fuels Standard, the GHG emissions methodology should include all life-cycle GHG emissions of all fuels, including the emissions from indirect land use change. For each renewable fuel pathway, GHG emissions include production and transport of the feedstock; land use change; production, distribution, blending and end use of the renewable fuel.

5.3. The California Low Carbon Fuel Standard

The California Air Resources Board (CARB) adopted a Low Carbon Fuel Standard (LCFS) in 2007, to reduce GHG emissions by decreasing the carbon content of transportation fuels. LCFS called for a

reduction of at least 10% of carbon intensity of fuels by 2020. This leads to a reduction of GHG emissions from transport sector in California by about 16 million metric tonnes in 2020. Eleven North-Eastern and Mid-Atlantic States have committed to developing a regional LCFS programme. They aim to create a common fuel standard to reduce GHG emissions from fuels used for transport, heating in buildings, industrial processes and electricity generation (California Environmental Protection Agency, 2009).

The LCFS does not limit the carbon intensity of individual batches or types of fuels, but imposes a cap of the carbon intensity of all fuels used for transport each year. Credits are generated from fuels with lower carbon intensity, while deficits result from fuels with higher carbon intensity than the standard. Fuel providers may purchase credits generated by other fuel providers to offset their own deficits. Fuel providers must report on the carbon intensity of their fuels (Andress et al., 2010, California Environmental Protection Agency, 2009).

The carbon intensity, calculated under the LCFS methodology on a full lifecycle basis, includes all direct emissions from production, transportation and use, as well as any other effects, both direct and indirect. CARB uses the Model “Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation” (CA-GREET) for calculating carbon intensity of various fuels. Fuel providers may choose to use the default pathways to calculate credits and deficits or may modify either the CA-GREET model inputs or generate an additional fuel pathway. The emissions associated with land-use impacts of biofuels are included in LCFS fuel carbon intensity. The Global Trade Analysis Project (GTAP) model is used to estimate the GHG emissions from land-use changes. The model evaluates the worldwide land-use conversion associated with biofuel production. The GHG emissions are calculated using an emission factor depending on the type of land conversion and the carbon storage of land (California Environmental Protection Agency, 2009).

5.4. The Council on Sustainable Biomass Production

The Council on Sustainable Biomass Production (CSBP) was established in 2007 in the United States to develop voluntary sustainability standards for the production and conversion of biomass to bioenergy and establish a certification system for sustainable bioenergy production. The CSBP aims to ensure biomass and bioenergy production in a sustainable manner while maintaining and enhance social, economic, and environmental well-being. CSBP Standard will apply for sustainable production of agricultural biomass and biomass from non-food sources, including dedicated fuel crops, crop residues, purpose-grown wood, forestry residues and native vegetation (CSBP, 2010a).

CSBP formulated a wide range of sustainability principles, criteria, and indicators applicable to agriculture and forestry: 1) Integrated resource management planning; 2) Soil; 3) Biological diversity; 4) Water; 5) Climate Change; 6) Socio-economic well-being; 7) Legality; 8) Transparency; and 9) Continuous improvement. The key categories of criteria include: 1) climate change; 2) biological diversity; 3) water quality and quantity; 4) soil quality; 5) socio-economic well-being; 6) integrated

resources management planning. The CSBP proposed two levels of certification: Silver and Gold Level. The Silver Level will be awarded for biomass production based on the principles, criteria and indicators of the standard. The Gold Standard is granted for higher level of performance, where production practices significantly enhance environmental and socio-economic conditions beyond the baseline (CSBP, 2010).

Bioenergy generation is required to reduce GHG emissions as compared to fossil-based energy. The CSBP GHG emissions calculation will consider all emissions from production inputs and cultivation practices, land conversion, from soil carbon depletion, including from crop/forest residue removal, harvesting, collection, handling, processing, and storage and transportation of biomass. CSBP aims to examine various options to address emissions from indirect land use change associated with biomass production.

CSBP will create a Biomass GHG Intensity Scoring Tool to estimate the GHG intensity of bioenergy based on a life cycle assessment approach. The tool, together with the technical guidance, aims to help producers to optimize production to meet the GHG intensity requirements. CSBP will set the silver standard at a level equivalent to the minimum reduction established by the US Federal Government for cellulosic fuels in the Renewable Fuels Standard 2 (60% reduction). For the gold standard, CSBP shall require a greater reduction in emissions than is required for RFS biofuels. The CSBP published a CSBP provisional standard for sustainable production of agricultural biomass in April 2010 to be field tested. A final CSBP Standard for biomass production and biofuel/biopower production shall be adopted by December 2012 (CSBP, 2010).

5.5. Global Bioenergy Partnership

In 2005, the Group of Eight Countries (G8) and five additional countries (Brazil, China, India, Mexico and South Africa) established the Global Bioenergy Partnership (GBEP) to promote the development of biomass and biofuels and to develop a voluntary international sustainability framework for bioenergy (GBEP, 2009a). GBEP now comprise 21 countries and 11 international organizations as partners and further 21 countries as observers, along with the Economic Commission for Latin America and the Caribbean, IFAD, IRENA, the European Commission, the World Bank the World Business Council on Sustainable Development, etc.

The GBEP Task Force on Sustainability, set up in 2008 and coordinated by the United Kingdom, seeks to build consensus on bioenergy sustainability, to identify synergies between various initiatives and encourage integration, to promote greater consistency and reduce unnecessary duplication. The Task Force aims to establish relevant, practical, science-based, voluntary sustainability criteria and relevant indicators and best practices examples regarding the sustainability of bioenergy. The GBEP criteria shall finally include a set of indicators that can be interpreted according to national circumstances and will include supporting information and descriptions of methodological approaches for measurement.

The Task Force developed the first draft of GBEP sustainability criteria and indicators, classified as core indicators (highly relevant, practical and science-based); highly relevant indicators (low practicality and/or a weak scientific basis); not highly relevant. These criteria cover a range of sustainability issues, including: 1) environmental impacts: GHG emissions, land and ecosystems, air quality, water availability, use efficiency and quality, biological diversity and land-use change, including indirect effects; 2) social impacts: food security, access to land, water and other resources, rural and social development, access to energy, labour conditions, human health and safety; 3) economic and energy security impacts: economic development, economic viability and competitiveness, access to technology and energy security (GBEP, 2009a). A number of topics shall be further refined, including biodiversity, indirect effects of land-use change, food security, government support, trade and national legal, policy and institutional frameworks.

The GBEP Task Force on GHG methodologies, led by the United States and UN Foundation, has been established in 2007 to analyse the well-to-wheel lifecycle of transport biofuels and solid biomass. GBEP aims to develop a common methodological framework for assessing GHG emissions associated with bioenergy. Four sub-groups were set to address various issues on: land-use change and feedstock production (United States); biomass processing (European Commission); fuel transportation and use (Germany); and biofuel use (Brazil). The Task Force works to review existing methodologies and to develop, a harmonised methodological framework on GHG emissions associated with bioenergy (GBEP, 2009b).

The Version Zero of a Common Methodological Framework for GHG Lifecycle Analysis of Bioenergy was released in 2009. The GHG inventory framework will serve as guidance and provide a template for LCA to be used as a tool for calculating GHG emissions and to enable Life Cycle Assessments (LCA) of the GHG emissions to be compared on an equal basis (GBEP, 2009b). The framework consists of a 10-step analysis covering the emissions from biomass feedstock production, including land use change, co-products and by-products, transport of biomass, conversion, transport of fuel and fuel use. It also includes the options for reporting LCA of fossil transport fuels and heat and electricity production systems. The framework includes the options for reporting direct land use change or indirect land use change, or a combination of both.

5.6. ISO/PC 248 Sustainability criteria for bioenergy

The International Standards Organization (ISO) will develop an international standard to address sustainability issues related to bioenergy production (ISO, 2009). A new ISO project committee, ISO/TC 248, Sustainability criteria for bioenergy, was established for this purpose and its first meeting was held in April 2010. Twenty-nine countries are involved as participants or observers, including China and the USA. “Associação Brasileira de Normas Técnicas” (ABNT) Brazil and “Deutsches Institut für Normung” (DIN) Germany provide with the secretariat and leadership of the committee.

The ISO/TC 248 Project committee on Sustainability criteria for bioenergy will address the social, economic and environmental aspects of the production, supply chain, and use of bioenergy and develop globally harmonised sustainability criteria. ISO/PC 248 will develop a global standard (ISO 13065) on sustainability of biomass and conformity assessment including the chain of custody. This will include terminology and environmental, social and economic aspects related to the sustainability of bioenergy. The standard shall contribute to tackling social and environmental issues and to helping avoid technical barriers to trade on bioenergy and making bioenergy more competitive (ISO, 2009). The ISO/TC 248 has four working groups focussing on cross-cutting issues (including terminology and verification and audit); greenhouse gases; environmental, economic and social aspects; and indirect effects.

6. BIOFUEL CERTIFICATION: GENERAL PERSPECTIVES

6.1. General requirements

The existing certification systems have various objectives, being developed for a specific sector (agriculture, forestry, ...) or specific purposes (fair-trade, environmentally sound cultivation, organic agriculture etc.). Agricultural certification schemes (such as IFOAM, GlobalGAP, SAN and FAIR TRADE) were primarily developed to ensure health and safety of given products or develop organic agriculture, while forestry standards (such as FSC, PEFC) were set to ensure sustainable management of forests. On the other hand, energy security and climate change mitigation have been the main drivers to develop sustainability principles and standards for bioenergy. Table 1 provides a general view of various existing certification schemes related to biofuels certification.

Lately, several initiatives were developed or are under development for biofuels feedstock (BSI, RTRS, RSPO), biofuels (EU-RED, RSB, ISCC, NTA 8080, UK-RTFO, US-RFS, US-LCFS) or bioenergy production (GBEP, CSBP). GBEP is in fact not willing to develop an additional standard or certification scheme, but to reach consensus on bioenergy sustainability and develop globally acceptable principles and criteria and GHG calculation framework. A meta-standard approach was adopted by several schemes (e.g. RTFO, NTA 8080, ISCC, RSB) to endorse other certification systems, covering different feedstock, if they comply with their requirements. The ISCC and RSB offer two alternatives for the meta-standard approach: in the first option, the crops shall be certified by a qualifying standard for the RSB or ISCC schemes; in the second option, the biofuels are directly certified through the ISCC and RSB generic certification.

The existing certification systems include limited environmental, economic and social aspects, depending on their main goals. They provide a broad coverage of a large number of criteria, even if some more specific issues are not addressed. For example, the issues of indirect effects, food availability, food security are only addressed in certain certification schemes, developed for biofuels sustainability. Land use change aspects started to be tackled in biofuels certification schemes, since these issues were not considered important in agricultural and forest certification. Accordingly, mass balance, energy balance are rarely addressed and sometimes addressed as energy efficiency or energy use in operation. Various schemes (RSPO, RTFO, RSB, ISCC) accept the operation of three supply chain systems: identity preserved, segregation; mass balance; and book-and-claim, while some schemes give preference to the mass balance approach (RTFO, ISCC), to comply with the provisions of the EU RES Directive. A set of additional requirements include the supply chain requirements or chain of custody, accreditation and verification requirements (RSB, ISC, NTA 8080, RSPO, RTRS, BSI).

Table 1. Existing certification schemes

Scheme	EU-RED	GBEP	RSB	ISCC	NTA 8080	RTFO	BSI	RTRS	RSPO	FSC	PEFC	GLOBAL GAP	SAN	FAIR TRADE	SAI	IFOAM	US-RFS
Scope	biofuels bioliquids	bio- energy	biofuels	bio- energy	biomass	biofuels	sugar- cane	soy	palm oil	forest	forest	agricul- ture	farms	agricul- ture	social	organic products	renewable fuels
Operation	meta- standard		meta- standard	meta- standard	meta- standard	meta- standard											
GHG	+	+	+	+	+	+	+		+	-	-	-	-	-	-	-	
Material tracking																	
Segregation				+	+	+	-		+	+	+	+	+	+		+	
Mass balance	+			+	+	+			+	+	+						
Book-and claim					+	+			+								
Energy balance		+	+/-	-	-	-	-	-	effi- ciency	-	-	energy use	-	-	-	-	
Land use change	+	+	+	+	+	+	+/-	+/-	+	-	-	-	-	-	-	-	
Indirect effects	expected	will address	will address		+	+	-	-	-	-	-	-	-	-	-	-	
ILUC	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	+
Food avai-lability, security	rep	+	+	+	+	+			+								
Competition		+	-	-	+	+	-	-	+/-	+	-	-	-	-	-	-	

Note: GBEP-Global Bioenergy Partnership; RSB-Roundtable on Sustainable Biofuels; ISCC-International Sustainability and Carbon Certification; NTA 8080-Sustainable Production of Biomass-The Netherlands; RTFO-Renewable Transport Fuels Obligation; BSI- Better Sugarcane Initiative; RTRS-Roundtable for Responsible Soy Production; RSPO-Roundtable on Sustainable Palm Oil; FSC- Forest Stewardship Council; PEFC-Programme for the Endorsement of Forest Certification schemes; GLOBAL GAP-Global Partnership for Good Agricultural Practice; FAIR TRADE-Fairtrade Labelling Organisations International (FLO); SAN-Sustainable Agriculture Network/Rainforest Alliance (SAN/RA); SAI-Social Accountability International; IFOAM-*International Federation of Organic Agriculture Movements*

In the UK, several existing certification schemes have been benchmarked against the RTFO Sustainable Biofuel Meta-Standard. Some standards were found to meet the Qualifying Environmental Standard level: Sustainable Agriculture Network/Rainforest Alliance (SAN/RA), Genesis Quality Assurance (Genesis QA), Linking Environment and Farming (LEAF), Assured Combinable Crops Scheme (ACCS), Forest Stewardship Council (FSC), Roundtable on Sustainable Palm Oil (RSPO), Roundtable on Responsible Soy (RTRS), Better Sugarcane Initiative (BSI). Several standards meet the Qualifying Social Standard level: Sustainable Agriculture Network/Rainforest Alliance (SAN/RA), Better Sugarcane Initiative (BSI), Roundtable on Sustainable Palm Oil (RSPO), Roundtable on Responsible Soy (RTRS). The results of the benchmarks of the RSB Standard and the RTFO Biofuel Meta-Standard showed that the RSB Standard for EU market access covers only partially the environmental and social criteria from the RTFO. Additional criteria and criteria must be further detailed in order to be able to meet the full RTFO Biofuel Sustainability Meta-standard level.

6.2. Environmental aspects

The various agricultural or forestry certification schemes include limited environmental, economic and social aspects, depending on their main goals. Due to these differences in priority, the sustainability principles and criteria in agricultural and forestry standards were developed differently, and they cannot ensure the sustainability concerns specific related to bioenergy standards. A number of criteria might be relevant for biofuels production and are depicted in Table 2. Additional issues needs to be included in biofuels/bioenergy sustainability certification, such as conservation of biodiversity, carbon stock, GHG emissions and land use changes, in addition to air, water and soil impacts, which were included to a different extent in agricultural and forest certification. Several schemes, such as RSPO, RTRS started to prepare national interpretations of their principles and criteria to ensure the implementation of certification at country level, according to specific conditions. Similarly, National or Regional Initiatives (or Technical Working Groups) can adapt the international ISCC standards to local conditions. For this aim, they will define applicable local indicators, guidelines or procedures for economic, social, environmental aspects adapted to the local circumstances.

Different approaches apply for tackling environmental impact. Some schemes require an environmental impact assessment to be conducted to assess the environmental impact, as defined by the relevant legislation in force, or require good farming practice to be used. RSB provides guidance for conducting the Environmental and Social Impact Assessment (ESIA), including soil, water, social, and land rights guidelines. RTRS includes Integrated Crop Management (ICM) measures and practices in soy production, while BSI provides guidance for setting up an Environmental Management Plan. BSI also includes a list of relevant international conventions that should be complied with, covering environmental and social aspects.

Table 2. Environmental aspects in different certification initiatives

	EU-RED	CSBP	GBEP	RSB	ISCC	NTA 8080	RTFO	BSI	RTRS	RSPO	FSC	PEFC	GLOBAL GAP	SAN	FAIR TRADE	SAI	IFOAM
Environmental Impact Assessment	-	+/-	+	+	+			+	+	+	+		+	+	+		
Good farming practice	+			+		+	+	+		+	+		+			+	+
Site history					+								+				
Sustainable use of resources	-	+/-									+			+			+
Carbon Conservation																	
Preservation of above / below ground carbon	+	+			+	+	+	+	-	+							
Land use change	+	+	+	+	+	+			+	+	+				+		
GHG emissions	+	+	+	+	+	+	+	+	+	+				+			
Biodiversity Conservation																	
Biodiversity	+	+	+	+	+	+	+	+			+	+	+	+	+		+
Natural habitats, ecosystems	+	+	+	+		+	+		+		+	+	+	+			+
High conservation value areas	+			+	+		+	+	+	+	+		+		+		
Native, endangered & invasive species	+	+	+	+			+		+	+	+	+			+		
GMO	-			+				+		+	+		+	+	+		+
Soil Conservation																	
Soil management, soil protection		+	+	+	+	+	+	+	+	+	+	+	+	+	+		+
Residues, wastes, by-products		+		+						+	-			+			+
Use of agrochemicals		+		+	+		+		+	+		+	+	+	+		+
Waste management				+	+	+	+	+	+	+	+		+	+	+		+
Sustainable water use																	
Water rights				+	+									+			
Water quality	+	+	+	+		+	+	+	+	+			+	+			+
Water management, conservation		+		+	+	+	+	+		+				+			+
Efficient water use		+	+	+													
Air quality																	
Air pollution	+		+	+	+	+	+	+	+								
No burning for land clearing/waste disposal			+			+	+			+				+	+		+
No burning residues, waste, by-products				+			+						+	+			

The EU-RED and certification schemes such as UK-RTFO, ISCC and NTA 8080 require that high biodiversity value land (highly biodiverse grassland, primary forests, nature protection areas), high carbon stock land (wetlands, peatland, forested areas) should not be used for biofuels/bioenergy production. For the biomass feedstock produced in the EU, the EU-RED considers that the cross-compliance rules of the Common Agricultural Policy provide assurance of compliance with a set of environmental impacts on soil, water and air. US-RFS prohibits any new conversion of natural areas for biofuel production by limiting biofuel feedstock production on existing actively managed or fallow agricultural lands and privately owned tree plantations. It also prohibits conversion of natural grasslands. Other schemes, such as RTRS will develop national level macro-scale maps with biodiversity information, drawn based on a generic global methodology.

There are several international conventions and agreements on the protection of biodiversity, rare and endangered species, etc. that could be included in the certification scheme. Several certification schemes make reference to various international conventions, such as Ramsar convention on wetlands, Convention on Biological Diversity, etc. (BSI, RTRS, RSPO, UK-RTFO) or Rotterdam Convention on pesticides and industrial chemicals and in the Stockholm Convention on Persistent Organic Pollutants (BSI, RTRS, RSPO, RSB, UK-RTFO).

A number of environmental criteria appear to be formulated in a rather different way, as well as definitions for certain areas to be protected. Thus, there is a need of harmonising approaches and formulation of criteria and definitions to make them compatible. Further harmonisation of the biofuels/bioenergy certification systems is also possible through promotion of international agreements and standardization or by requiring compliance of internationally acknowledged protocols, as provided by ISO or ISEAL. ISO has developed various Codes of Good Practices for Standardization for setting Quality Management System or Environmental Management System. ISEAL Alliance develops Codes of Good Practice for social and environmental standards systems. A number of certification schemes were developed already on the basis set by ISO and ISEAL standards (such as FSC, Rainforest Alliance, BSI and RSB). Acting in this direction, GBEP contribution is extremely useful to build consensus on bioenergy sustainability, to identify synergies between the various initiatives and encourage integration, in order to promote greater consistency and reduce unnecessary duplication.

6.3. Greenhouse gas emissions

Carbon conservation aspects are rarely addressed and GHG balance and land use competition are not included in the certification schemes for agriculture and forestry. Additional principles are included in the newly developed initiatives for biofuels/bioenergy sustainability, to cover the aspects related to carbon balance and preservation of carbon stocks. As reducing GHG emissions is a prominent goal for biofuels/bioenergy development policies, various schemes for biofuels/bioenergy have developed

principles that require certain levels of GHG reductions based on a Life Cycle Assessment (LCA). Several important aspects for GHG emission calculation, as included in various certification schemes, are shown in Table 3.

Some of the GHG emissions principles require process improvements over time (RSPO, RTRS, and SAN), while others require a specific target to be achieved (EC-RED, RSB, RTFO, BSI, etc.). The required GHG reduction levels range from 20% (US-RFS, conventional biofuel), 35% (EU-RED, ISCC, NTA 8080), and 50% (RSB) for biofuels to 70% (NTA 8080) for bioenergy, compared to the fossil fuel. Some schemes require higher emissions thresholds over time (EU-RED, NTA 8080) or indicate that these thresholds shall be revised in time (RSB). The RFS2 requires a reduction of lifecycle GHG emissions depending on the renewable fuel category, but the RFS2 thresholds do not constitute compliance levels for biofuels and they do not exclude certain biofuels if they do not meet the GHG performance thresholds, similar with the UK-RTFO. LCFS requires a reduction of at least 10% of carbon intensity of fuels but LCFS does not limit the carbon intensity of individual types of fuels, and imposes a cap of the carbon intensity of all fuels used for transport. There are differentiations in the reference year for land use changes, varying from 2005 (RSPO, SAN), 2007 (NL), 2008 (EU-RED) to 2009 (RSB, RTRS), that increases the inconsistency between different schemes.

The new initiatives for biofuels/bioenergy (EU-RED, NTA 8080, UK-RTFO, RSB, BSI and others) started to develop methodologies incorporating default values to calculate the GHG emissions over the whole supply chain. These comprise emissions from all relevant sources, fossil fuel and fertiliser use, including those from conversion of land (RSPO, BSI, NTA 8080, ISCC, RSB). Since the scope of CSBP covers biomass for heating and electricity production, besides biofuels for transport, the GHG emissions calculation will also consider the emissions from soil carbon depletion, crop/forest residue removal, harvesting, collection, processing, and transportation of biomass. Practical operational experience on GHG calculation and reporting is presently limited to the RTFO in the United Kingdom. Carbon Calculator or GHG Intensity Scoring Tools are also under development to be made available to fuel suppliers to evaluate and to identify options to best increase the carbon emission savings for fuels or bioenergy production.

While direct land-use changes are part of the calculation, indirect land use changes are not in most schemes. In the Netherlands, further measures were recommended for addressing indirect land use changes such as including an indirect land use change factor (ILUC factor) in the GHG calculations. RSB will also consider including the indirect land use change in the GHG accounting methodology. Under the Renewable Fuels Standard, as well, the GHG emissions calculation should include all life-cycle GHG emissions, including the emissions from indirect land use change. The carbon intensity, calculated under the LCFS methodology on a full lifecycle basis, includes all direct emissions from production, transportation and use, and any other effects, both direct and indirect. The Environmental Protection Agency is currently developing ILUC-values for several feedstock in the US-RFS. Similar

Table 3. GHG emission calculations in different certification initiatives

	EU-RED	LCFS	US-RFS	RSB	ISCC	NTA 8080	RTFO	BSI	RSPO	RTRS
GHG reduction requirement	+	+	+	+	+	+	+	+	+	+
Minimum savings	35%, 60% (2018)	-	20% conventional 50% advanced, 60%cellulosic	50%	35%	70% electricity 35% biofuels 50% (from 2012)	45% (2009/10) 50% (2010/11)	-	-	
Direct land use change	+	+	+	+	+	+	+	+	+	
Baseline for LUC	January 2008	-	2007	1 January 2009	1 January 2008	1 January 2007	30 November 2005	1 January 2008	November 2005	May 2009
Indirect land use change	-	+	+	-	-	-	-	-	-	-
Co-product treatment	allocation by energy content	substitution	substitution	substitution allocation (energy, economic value)	allocation energy	system extension	substitution allocation (economic value)	allocation (energy, economic value)	main product	
Annualised land use emissions	20 years	30 years	100 years (2% discount) 30 years (0% discount rate)	20 years	20 years	20 years	carbon payback 10 years		25 years	
Data aggregation level	not defined	regional level (US), country level	country level	not defined	not defined	not defined	country level	global (country specific)	not defined	

efforts are made in the EU to include ILUC in the GHG emissions calculation EU-RED requirements. A common, internationally accepted methodology as well as assumptions and default values are missing. However, there are several initiatives, such as GBEP, working toward the harmonization of methodologies to calculate GHG emission reductions.

6.4. Socio-economic aspects

Socio-economic criteria are key factors for the credibility and acceptance of sustainability certification. Socio-economic principles and criteria address various aspects from economic development to labour conditions and human and property rights. A wide range of principles and criteria were developed to cover economic and social benefits to local community, working conditions, health and safety, child labour and freedom of association, bargaining, human and land right issues etc., as shown in Table 4.

Although there are no specific criteria for social sustainability included in the EU-RED, the European Commission will report on the biofuels impact on social aspects and on the commodity price changes associated with the use of biomass for energy and any associated positive and negative effects on food security and the availability of food at affordable prices. Various initiatives refer to existing approaches that could be used to measure or monitor the social well-being of local communities. The Social Impact Assessment is required in a number of schemes (RSB, BSI, RSPO, SAN) to assess the impacts on various social aspects due to biofuels production, on the basis of social guidelines. The social and economic performance indicators of the Global Reporting Initiative are used in NTA 8080 to monitor the social well-being of local communities. The socio-economic principles proposed by some initiatives, such as the UK-RTFO, are not obligatory in implementation. UK-RTFO requires a report from the producer on its socio-economic performance, while meeting the socio-economic principles of NTA8080 is a must.

Several socio-economic issues are embedded in international agreements and conventions, which are referred to in some certification schemes. A number of ILO conventions as well as credible and internationally accepted standards can be included in the certification schemes, as minimum requirements and several schemes make reference to them (such as BSI, ISCC, RSPO, UK-RTFO, RTRS). For countries that have ratified the respective ILO Conventions, it is assumed that the social requirements are fulfilled. There is a general agreement that the ILO labour standards form a sound basis for including high acceptability, harmonized socio-economic principles and criteria. Monitoring and enforcement of social criteria is a challenging task, especially in developing countries and depends of the law enforcement in each country. The development of a common approach to measure and monitor the various socio-economic impacts is highly needed.

Table 4. Socio-economic aspects in different certification schemes

	EU-RED	US-RFS	CSBP	GBEP	RSB	ISCC	NTA 8080	RTFO	BSI	RTRS	RSPO	FSC	PEFC	GLOBAL GAP	SAN	FAIR TRADE	SAI	IFOAM
Economic development																		
Economic benefits to community				+	+		+			+	+	+						
Economic performances				+	+				+		+	+				+		
Energy efficiency				+		+			+		+				+			
Energy balance				+	+				+									
Social Aspects	+																	
Social Impact Assessment				+	+				+	+	+	+			+			
Social benefits to community				+	+	+	+								+			
Human rights					+	+	+		+						+			+
Land right issues				+	+	+	+	+		+	+	+	+		+			+
Labour conditions																		
Working conditions			+	+	+		+	+	+			+		+	+	+	+	
Contracts			+			+		+		+		+			+		+	
Health and safety			+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Freedom of association, bargaining		-		+	+	+	+	+	+	+	+	+	+		+	+	+	+
Discrimination		-	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Wages			+	+	+	+		+	+	+	+	+	+	+	+	+	+	
Workings hours			+			+		+	+			+		+	+	+	+	
Child labour		-		+	+	+	+	+	+	+	+	+	+		+	+	+	+
Forced labour		-		+	+	+	+	+	+	+		+	+		+	+	+	+
Training, capacity building			+	+		+			+	+	+	+		+	+	+		

6.5. Monitoring and reporting requirements

GHG emissions, food security, land use change are issues that are considered to be increasingly important with the increase in biomass feedstock production for biofuels/bioenergy. These aspects are not satisfactorily addressed by all of the existing certification systems. The issue of competition for food and the indirect land use change effects are difficult to include within a certification scheme, being hardly addressed for the time being by the different initiatives.

Several initiatives develop various approaches promoting various options with low indirect impact on food and land use change, combining monitoring and reporting obligations. Table 5 shows the various monitoring and reporting requirements in different certification schemes. Examples are the monitoring and reporting obligation as set in The European Union by the Renewable Energy Directive, the certification schemes from the RFTO in the UK and NTA 8080 from Netherlands. As part of its obligations under the Renewable Energy Directive, the European Commission will monitor the origin of biofuels consumed in the EU and impacts of their production in the EU and third countries, land use and land use change, commodity prices and food security. The EU Member States shall report on the impact of the biofuels and bioliquids on biodiversity, water resources, water quality and soil quality, GHG emission reduction and changes in commodity prices and land use associated with biomass production. According to the RES Directive, the development of multilateral and bilateral agreements and voluntary international or national schemes, covering key environmental and social considerations, shall be a tool to ensure the worldwide sustainable production of biofuels and bioliquids. In the absence of such agreements or schemes, economic operators must report on key environmental and social issues. In the United States, the Environmental Protection Agency (EPA) is in charge for reporting on the wide range of impacts of biofuels, such as GHG emissions, impacts on non-GHG pollutants, impacts on water, economic impacts, etc.

In the Netherlands, the Cramer Commission proposed an approach based on two levels of reporting, at company and at macro level. A monitoring system was considered necessary for issues that cannot be addressed at company level, such as availability of food and food prices, changes in land use, deforestation and change in the type of vegetation, etc. The development such a monitoring system on the land use change and land use planning will be the responsibility of the Dutch Government and the authorities of producing countries. Similarly, in the UK the RFA monitors and reports on wider environmental and social issues and indirect impacts of biofuel production such as indirect land-use change or changes to food and other commodity prices.

Table 5. Monitoring and reporting requirements in different certification schemes

	EU-RED	US-RFS	CSBP	GBEP	RSB	ISCC	NTA 8080	RTFO	BSI	RTRS	RSPO	FSC	PEFC	GLOBAL GAP	SAN	FAIR TRADE	SAI	IFOAM
Monitoring																		
Food prices	+						+	+										
Food availability	+						+	+										
LUC	+						+	+										
Requirements																		
No competition with food	+				+													
No reduction in carbon stock	+	+/-			+/-		+	+	+/-	+	+							
No production in protected areas	+				+		+	+		+	+							
Promotion																		
Waste/ residues	+				+				+									
Degraded land	+				+				+									

7. LIMITATIONS AND DRAWBACKS FOR IMPLEMENTATION

7.1. Major challenges for implementation

Certifying the sustainability of biofuels is a complex and difficult process. The implementation and verification of sustainability standards is complicated and far from straight-forward and entail a number of difficulties that have yet to be resolved. Numerous complex conversion options are involved in biofuels production using a wide range of biomass feedstocks. The biomass sources for bioenergy are even more diverse: agricultural crops and residues (e.g. cereals, straw, animal manure), forestry (e.g. logs, stumps, forestry residues and branches), wood processing (e.g. bark, wood remains, wood chips and sawdust) and organic waste (e.g. municipal solid waste, recovered wood, sewage sludge). Formulating sustainability criteria that are relevant to all biomass feedstocks is a challenge.

Biofuels can be produced from various agricultural crops, which can be used for food, feed or fibre as well. While a crop used for biofuels production might be produced in sustainable conditions, if certified, the same crop used for other purposes might be produced after the conversion of a forest or grassland. From a legal point of view, it may be difficult to make a distinction between different uses of biomass and to require compliance with sustainability criteria for one final use (biofuels), while for the other uses this is not required. Applying a double-standard policy between biofuel and food/feed/fibre production is very likely to lead to indirect effects. Farmers could cultivate food crops on new land converted to cropland and use the old cropland for biofuels, complying with sustainability criteria for biofuels crops cultivation (Searchinger 2009). In this way, conversion of land for food crop production could not be stopped. Therefore, a certification scheme established on the basis of the final use of a crop might be ineffective in securing certain sustainability concerns.

The most important biofuels sustainability concerns relates to several major impacts that can occur: biodiversity loss; impacts on water supply leading to water scarcity, poor water quality; impact on food security, food availability and increase of food prices; land use changes leading to loss of natural habitats and increased GHG emissions (Wallis et. al, 2007). Biofuels increase the competition for natural resources such as water and land and will lead to additional pressure on land use. Extra agricultural land is anyway required on a global scale due to the growth of population and welfare, even without biofuels production. Additional land will be needed for biofuels crops cultivation, which could lead to a further conversion of land for agricultural use, even with crop yield increase.

Land use change has important impacts: loss of natural habitats and biodiversity and GHG emissions from change of land use. The development of lignocellulosic biofuels is expected to use wood residues and wood biomass produced on land which is not suitable for food and feed production (Eickhout et al., 2008). Therefore, the EU Renewable Energy Directive (Directive 2009/28/EC) primary aims to address the most important potential effects of biofuels, as a way to limit the impact on international trade. It primary aims to exclude several specific areas with a high biodiversity (biodiverse grasslands) and high carbon stock (primary forests, peatlands and wetlands) as areas for biomass production, as considered the areas where biofuels impact can be more significant (EC, 2010b).

7.2. Sustainability implementation – local and global approach

There is an increasing number in sustainability certification schemes for biofuels, proposing different criteria. There is a lack of harmonization across the different initiatives, including in the areas of definitions, approaches and methodologies. A variety of criteria and sustainability requirements were formulated in different certification schemes. However, even when the criteria and requirements for compliance are similar, the indicators or definitions can differ (Matus, 2010).

An increasing number of certification initiatives might lead to beneficial competition, resulting in improvement in standards and implementation and verification tools. On the other side, proliferation of standards will lead to lower confidence and confusion among various stakeholders and finally to lower acceptance and confidence from the customers. The lack of a uniform certification scheme will lead to increasing costs and bureaucratic complexity.

The development of numerous certification schemes, with significantly different requirements, that might lead to inconsistent certification schemes with loose performance parameters and will lead to different requirements for different biofuels. There are concerns about wasting resources through duplication of efforts. In order to avoid creating unreasonable barriers, there is a need for coordination and integration across different initiatives (Matus, 2010). There is a need to develop common frameworks, definitions, approaches and methodologies (such as definitions for forest land, high conservation value areas, methodologies for GHG emission calculation, etc.).

Establishing a meta-standard, covering different biomass production sectors (such as sustainable agriculture, food production, forestry, etc.) can be a straightforward option for certification. Compliance with the meta-standard is achieved through existing standards, and hence there is no need to develop another standard. Once a certification scheme is accepted as being compliant with a meta-standard, then it would be considered as an acceptable alternative to other biofuels sustainability standards. This means that a biofuels producer would only get certified using one of the certification systems recognised by the meta-standard.

The implementation of a global scale, comprehensive certification scheme might be the only option able to secure different direct and indirect effects of biofuels / bioenergy production. The first steps toward the development of harmonised international sustainability standards have been done. CEN works to elaborate a European standard for sustainable biomass. This could include additional sustainability aspects to those defined in the EU Renewable Energy Directive, such as social, environmental and economic, both direct and indirect. ISO has also started working to develop an international standard (ISO 13065) on bioenergy sustainability production including globally harmonised sustainability criteria. GBEP works to develop a voluntary international sustainability framework for bioenergy and a Common Methodological Framework for GHG Lifecycle Analysis of Bioenergy that hopefully will contribute to reaching agreement on GHG emissions calculation.

Linking biofuels sustainability certification with climate change policies in International Agreements on Climate Change or WTO negotiation, could contribute to gain wider acceptance and avoid trade barriers. An international Biofuels Sustainability Pact with an agreement on sustainability principles would be helpful in

securing the sustainability of biofuels production at international level. An International Agreement for the Protection “no-go areas”, based on widely accepted criteria and a robust mechanism to enforce compliance can contribute significantly to the protection of highly sensitive areas.

7.3. Competition for land use and land use change

One of the most sensitive issues of biofuels production is competition for raw materials, e.g. fuel vs. food, feed, fibre or materials, and changes in land use. The competition for biomass feedstock might lead to adverse effects on prices and availability of food, feed and bio-based materials. Price increases could offer some benefits for rural development and local communities, but the price increase is likely to have negative effects on the poor that need to buy food.

Crucial questions remain to what extent the increased demand for biofuels would lead to additional land use change and to what extent biofuels certification can prevent negative land use change. The direct land use change effects of biofuels/bioenergy production can, however, be controlled by certification systems through proper enforcement and verification mechanisms. The criteria for land use competition seem to be rather complicated to define and even more difficult to verify. Land use expansion is likely to occur on most productive land in order to produce higher income for farmers, which can include high biodiverse or carbon rich land. Biofuel producers can easily evade land use criteria such as requirements to avoid lands with high biodiversity (biodiverse grasslands) and high carbon stock (primary forests, peatlands and wetlands) by using newly converted lands for food crops and using crops from existing croplands for biofuels (Searchinger 2009).

Crop production on set aside, marginal and degraded land, improved farming practices to increase yields and sustainable use of agricultural and forest residues are measures supposed to prevent the possible negative effects. However, there are concerns on the availability and use of such land, considering the need of obtaining high yields, for economic reasons. The negative effects of intensified agricultural practices (such as increased emissions from fertiliser application, water pollution and eutrophication, etc.) aiming to obtain higher yields need also to be considered. Additional measures are also needed to ensure sustainable removal rates of agricultural and forest residues from land, in order to protect soil fertility, to avoid the loss of nutrients and to prevent soil erosion. Although lignocellulosic biofuels offer certain biodiversity advantages compared with agricultural crops, there is presently no certainty about their better performance (such as lower land requirements and higher energy yield) compared to first generation biofuels (Gallagher, 2008).

Greenhouse emissions from biofuels strongly depend on the type of lands converted. Therefore, preventing land use changes requires a sustainable land management policy and verifiable land use and adequate tools that identify and prevent them. Technology progress in remote sensing and more available and accurate data for Geographical Information Systems (GIS) provided reliable and effective tools for monitoring of land use change. A global monitoring system for land use using satellite images and land use planning could be a useful tool to address displacement effects.

The different land use types have to be identified through reliable methods, based on common definition and clear methodology. There is still debate and disagreement about how to identify such “no-go” areas, as well as about how to protect and manage them in landscapes designated for agricultural development. Special attention

should be given to the identification and monitoring of "no-go areas". An international agreement on so-called "no-go areas", based on widely accepted criteria and a robust mechanism to enforce compliance can contribute significantly to the protection of highly sensitive areas. To be effective, the prohibition of certain land use changes should apply to all production and for all end-uses (i.e. not only for fuel use, but also for food, fodder, fiber, bio-materials, etc.) - otherwise could cause food crops to be cultivated in converted areas and fuel crops in sustainable areas.

7.4. Control and prevention of indirect effects

Key aspects for biofuels sustainability are the indirect effects. Some impacts, such as the impact on food security, food availability or indirect land use changes occur beyond the limits of the production site and therefore are difficult to address at farm or plantation level (Gallagher, 2008). Additional cascade effects can also occur. Indirect effects are the most complex issue, due to the fact that they can have a global dimension, act across countries, as well as markets and are governed by different policies (agriculture, environment, energy, trade, rural development...). They affect the agricultural crops or land use types to varying degrees. Biomass is part of large commodity markets with and complex interactions between the markets.

Identifying indirect effects will ultimately require a system monitoring the impact of biofuels at global level. This system should incorporate various indicators on economic, environmental, and social performance, in relation with other issues, such as increase in food/feed demand due to changes of the diet, increased prosperity in developing countries and population growth. The reporting obligation, as provided for in the EU Renewable Energy Directive (Directive 2009/28/EC), deal with the issues of competition for food and feed, local energy supply and bio-materials and other indirect effects. However, it is unclear how this reporting and monitoring obligation alone will contribute to the limitation of such effects, once identified.

The development of technologies for lignocellulosic biofuels is expected to have a large impact on the land use requirements, due to the expected higher yields compared to conventional biofuel crops (starch, sugar and oilseed) and the ability to grow on low-quality or degraded land (COWI, 2009). It is also considered that lignocellulosic biofuels will utilize agricultural and forestry residues, or biomass from Short Rotation Coppice (SRC) or Short Rotation Forestry (SRF) and therefore not displace other land uses. However, even the lignocellulosic biofuels biofuel will cause some kind of displacement. Lignocellulosic feedstock can also be cultivated on existing cropland, on forest, peatlands or grasslands as well and therefore displace food crops and increase GHG emissions (Searchinger 2009). Aquatic biomass, such as algae, offers new perspectives for biofuels production, with presumed higher yield (FAO, 2009).

7.5. Indirect land use changes

Several studies have raised concerns about the negative environmental impact of biofuel production, particularly the Indirect Land Use Change (ILUC). Whereas the improvement of the biofuel sustainability performances at the production site may be fostered by certification, biofuels certification alone is unlikely to be sufficient to avoid indirect land use changes such as conversion of forest land to arable land. For example, the experience of forest certification has shown that they were not able to stop land use change and deforestation in some sensitive

areas, such as tropical forests, outside of certified sites (Wallis et. al, 2007). Deforestation is often the result of poorly regulated trade of tropical wood and poor forest law enforcement. Additional options or policy instruments are needed for preventing indirect land use changes and endorsing sustainable land use.

Indirect land use change could be significant and is far more difficult to quantify than direct land use change. The difficulties for measuring or quantify remote or indirect impacts on land use rely in the lack of methodologies and data available for this type of analysis (Matus, 2010). A major obstacle for preventing indirect effects is to reveal a link between local feedstock production for which a producer can be held responsible and the land use change occurring elsewhere.

There are different views about how to best quantify ILUC. The estimation of the indirect land use change has also a broad range of uncertainty due to a number of parameters, such as yield trends. In addition, there are gaps in the availability of data for assessment or validation. There is a risk of double counting land use change when both direct and indirect effects are considered. The multiple approaches to assess ILUC also lead to different results. The GHG emissions associated with indirect land use change are even more uncertain, but various reports show that they are high, so the net GHG effects of the biofuels production would be either positive or negative (Searchinger, 2009).

Biofuels certification alone is unlikely to be sufficient to avoid ILUC. Several options, with reduced risks, are relevant for minimizing indirect land use changes, due to biomass feedstock production. These include, in particular, the use of waste and residues, increasing crop yields, as well as biomass cultivation on fallow land or degraded land (Gallagher, 2008, Hennenberg et al., 2008). Such lands must however not now produce food, should be of low carbon stock and low biodiversity value. A mechanism to promote biofuels at lower risk of causing negative indirect impacts is needed.

7.6. Biofuel traceability

Tracking biofuels production is challenging. Linking a batch of biofuels with its own GHG performances, implementation and verification mechanisms are major limitations for the development of the biofuels tracking system. The chain-of-custody must create a direct link between the production site and final consumption to prevent non-certified biofuels entering in sustainable biofuels chain. An additional difficulty is to incorporate the GHG balance calculation in the chain-of-custody so that the information on the GHG performances can be passed between all participants along the whole supply chain. Sustainability and carbon data should refer to the biofuels feedstock and its production site.

There are different options for such a scheme (track-and-trace, mass balance or book-and-claim) but there are different views on which system, if any, must be preferred. They all have advantages and disadvantages regarding their effectiveness and costs incurred. Good track-and-trace and mass balance experience exists with food and wood materials. However, the book-and-claim approach is currently only in application in green electricity certificates, where renewable electricity production can be easier verified at the source.

The length and complexity of biofuels pathways and diversity of feedstocks induce additional uncertainties and require more control to prevent uncertified biofuels to mix the certified ones for the track-and-trace systems, for instance. It is no clear how a book-and-claim system, for example, can provide a link between the feedstock and

the real GHG performances of the biofuel produced, including all GHG emissions from the all stages of production, transportation of biomass, processing, transportation of biofuels and distribution. Better and process specific data on biofuels GHG performances provides them additional GHG credit, compared to default values, since biofuels can perform better or worse. The mass balance system proposed by the EU Renewable Energy Directive appears to provide a balance in terms of costs and certainties on ensuring concerns offered by various tracking options.

The whole operation depends on the practical and economical applicability of the system. The control along the entire biofuel supply chain must be established. Efficient and complete documentation is required for the operation of the chain-of-custody. Complete information is necessary to be provided on the process itself, input materials, material balances, internal process, conversion factors, GHG emissions (g CO₂ eq/MJ), allocation factors and identification data for each consignment. Full documentation on the GHG performances including all transformation factors is necessary at the consignment level as well as the transfer of the documents between all participants to the supply chain.

The whole system could operate based on the quality management or environmental management systems. The control and verification procedures must be implemented by adequate auditing and conformity surveillance. The requirements for traceability could be enforced through the quality management system (ISO 9001:2008) or the Environmental Management System (EMS) developed according to the ISO 14001:2004 providing the EMS requirements and ISO 14004:2004 providing general EMS guidelines. The ISO 22005:2007 standard, Traceability in the feed and food chain – General principles and basic requirements for system design and implementation, can provide the necessary framework for the development of biofuel traceability system. Clear principles and strong requirements for the design and implementation of a traceability system are needed to trace the flow of materials, and establish the necessary documentation and tracking for each stage of production. In addition, a database system should be developed and maintained by the authority in charge for registering the certificates issued to ensure easy identification and avoid duplication. There is no operational experience on a system providing full information on the GHG performances associated to a certified product. Therefore, the implementation of the chain-of-custody system needs to be proved in practice along complex and long supply chains.

8. IMPLEMENTATION, MONITORING AND CONTROL

8.1. Implementation and enforcement

Implementing sustainability certification for biofuels raises major challenges. Besides the strong, enforceable sustainability criteria, strict requirements should be set regarding the structure and operation of the certification systems to avoid weak implementation and verification practices. Implementation and verification require a detailed set of procedures to be developed and implemented as part of the sustainability standard. There is a large experience related to the operation of various certification schemes for agriculture and forestry that can be used as good examples for the implementation of verification and control mechanisms.

Certification schemes have the potential to secure certain sustainability goals through proper implementation and enforcement. The nature and the formulation of sustainability criteria influence the ease and quality of implementation and enforcement. The vague and general criteria, without proper measurable indicators, will be harder to enforce (Searchinger 2009). There is also some risk that the sustainability criteria will not be interpreted in an equivalent way at national level, and will not be applied with the same rigour.

The quality of institutional frameworks (e.g. legislation and law enforcement) may vary among different countries (COWI, 2009). Strong law enforcement for agricultural practices and land use and land use change may limit negative environmental impacts. Some third countries lack a proper legal framework related to agriculture and forest management providing certain assurance for the sustainable management of forest and agriculture. As compliance with national or local regulations can be accepted in some cases as fulfilling criteria for sustainability certification, poor law enforcement can become problematic. Poor law enforcement may lead to reduced effectiveness for certification, which requires more rigorous measures for implementation and control. This leads to increased costs for certification to secure certain sustainability concerns and to prevent land use changes and deforestation.

There is also a danger that double standards might be put in place: international standards for international biofuel markets vs. local standards for the local needs. Therefore, an additional level of international assurance is needed against global negative impacts (Wallis et. al, 2007). To avoid indirect effects and to ensure uniform application of land use change criteria, a cross-sectoral approach will be necessary, covered by a harmonised, global sustainability scheme.

8.2. Verification of compliance

Biofuels suppliers must show that the sustainability criteria have been met. The EU Renewable Energy Directive proposed a framework for verification of compliance with the environmental sustainability criteria, based on the use by economic operators of a mass balance system and on submission of reliable information by these operators to the Member State. Compliance with the sustainability requirements can be proven in one of three ways: (1) voluntary certification schemes; (2) bilateral or multilateral agreements with third countries and (3) national verification methods established by the Member States.

The proof of compliance can be done through voluntary certification schemes that were recognised by the Commission. The voluntary scheme should cover some or all of the sustainability criteria of the Renewable Energy Directive and possibly some other sustainability issues that go beyond those requirements. Bilateral and multilateral agreements concluded between the European Union and third countries containing provisions on biofuels sustainability criteria may also serve as proof of compliance for the biofuels feedstock originated from that country (EC, 2010a). Bilateral and multilateral agreements shall address measures taken for the nature conservation for soil, water and air protection, indirect land use changes, restoration of degraded land, the avoidance of excessive water consumption and to the social sustainability issues. Another option for proving compliance is by providing the national authorities with info, in compliance with a national system that includes the requirements set by the Member States. "Non-typical" measures may include have different forms such as maps showing that certain geographical areas are compliant or not compliant with the criteria, calculation tools for assessment of greenhouse gas emissions or regional greenhouse gas emissions values associated with a particular feedstock (EC, 2010a).

A critical issue to the credibility of certification is implementation and verification. The credibility of the certification scheme depends on the nature of the principles and indicators included, but also of the verification and control procedures (COWI, 2009). The certification system must be effective and efficient for securing the major impacts of biofuels, and resistant to fraud and other irregularities. The certification schemes should meet high standards of reliability, transparency and comply with strong implementation and verification requirements. The use of ISO guidelines for the standard setting process, accreditation and certification activities or the implementation of an Environmental Management System can serve as a minimum guarantee for the adequate operation of the system and is necessary for a more harmonised and integrated approach.

8.3. Requirements for EU domestic biomass feedstock

The current legal framework related to agriculture and forest management gives certain assurances for the sustainability of EU domestic biofuels. Forest management is regulated at national level, with policy guidance through the EU Forestry Strategy and the Ministerial Conference for the Protection of Forests in Europe (MCPFE). The forest legislation includes specific regulation for forestry operations and for sustainable forest management. For example, while deforestation and forest degradation continue at a global level, European forest land is increasing (COM(2010/0011/EC).

The biofuels produced from agricultural raw materials originating in the EU require compliance with agricultural environmental requirements and standards for EU farmers, just like all other crops. In the EU, sustainable agricultural production is regulated through the environmental cross-compliance requirements of the Common Agricultural Policy (CAP). Cross-compliance compulsory requirements link direct payments to farmers to the environmental and other requirements set at EU level. Farmers must comply with the statutory management requirements, the legislative standards in the field of the environment, food safety, animal and plant health and animal welfare.

There are requirements of good agricultural and environmental conditions related to soil protection, maintenance of soil organic matter and structure, avoiding the deterioration of habitats and water management.

The cross-compliance rules provide for preservation of habitats, biodiversity, water management and use and mitigating climate change. Higher standards, for good agricultural practices, can also apply for voluntary agro-environment schemes (within rural development measures), where farmers may receive a payment for providing environmental services which go beyond basic mandatory legal standards. There are management, controls and sanctions systems established for cross-compliance.

Unlike the other biofuels sustainability criteria, verification of cross compliance is not addressed in the EU Renewable Energy Directive. Important aspects are the monitoring of compliance of agriculture production with the provisions on the aid schemes established under the integrated system. Control of cross-compliance requirements are carried out on the basis of the already existing Integrated Administration and Control System (IACS) for direct payments for agriculture. This harmonised level of monitoring was set up for all Member States by a control system including detailed criteria and technical procedures for carrying out administrative controls and on-the-spot checks in respect both of the eligibility criteria established for the aid schemes and the cross-compliance obligations. The existing control systems for agriculture can be used as well for ensuring that farmers supplying raw materials for biofuels fulfil these requirements.

8.4. Mapping and monitoring sensitive areas

Identification and mapping of no-go areas for biofuels production, as defined in the RED Directive, i.e. high conservation value areas (HCV), primary forests, peatlands, wetlands or highly biodiverse grasslands areas are necessary. As provided in the Directive 2009/28/EC, the Commission can recognise areas established for the protection of rare, threatened or endangered ecosystems or species recognised by international agreements or included in lists drawn up by intergovernmental organisations or the International Union for the Conservation of Nature – IUCN (such as the Red List of Threatened Species). Mapping no-go areas requires both definitions of the features to be mapped and the acquisition of the necessary data. Data availability and quality remains a challenge, especially in third countries for some highly sensitive areas.

The protection of some of these sensitive areas is covered by international conventions (Convention on Biological Diversity-CBD, or Convention on Wetlands of International Importance-the Ramsar Convention), by the EU (Natura 2000, Birds Directive and the Habitats Directive) and national legislation on protected areas. Various international agreements and conventions (such as Ramsar or CBD) provide relevant databases on the location of recognized protected areas. Global spatial datasets on Critical Ecosystems, Biodiversity Hotspots, Key Biodiversity Areas, Ramsar, UNESCO World Heritage Sites, Protected Areas catalogued by IUCN, and for national nature conservation zones as well as Wetland Databases are available. The World Database on Protected Areas (WDPA) is a comprehensive global spatial dataset on protected areas. A global database integrating all sensitive areas could be used for checking biofuels production sites.

More data from remote sensing is necessary to complete the available databases concerning high biodiversity and protected areas. Especially in some tropical countries there is a lack of data on protected and sensitive areas, where the potential impacts and sustainability concerns are stronger and the risk of land use change is higher. The level of details and monitoring needs might differ from site to site and from country to country, especially for some areas in tropical countries.

8.5. Land use planning

Monitoring land use changes in comparison with comprehensive land use plans can be a suitable tool for limiting the changes associated with biofuels production. Land use planning produces systematic assessment of land resources and provides the best options for land and water resources use plans. The objective of the land use planning, as a broader, integrated tool for resource management, is to implement sustainable land use changes and prevent unintended land use changes. A land use plan includes supporting information on the land resources, land use, topography, soil data, vegetation, climate, population, infrastructure, economic aspects, etc. Land use mapping can be built at the adequate spatial resolution to be used as reference for future comparison and detection of land use changes. The advancement in Remote Sensing (RE) technology in terms of spatial, temporal, spectral and radiometric resolutions provides large opportunities for land use planning and management of natural resources (Venkataratnam, 2001, Liaghat and Balasundram, 2010, Patil et al., 2002). Remote sensing provide information on land use, vegetation cover etc, for the preparation of resource maps (soils, land use/cover, water etc.). Based on data obtained through remote sensing, land planning is produced providing site specific recommendations for development of water, agriculture and forest management, as well as for nature conservation (Patil et al., 2002).

Land use planning can therefore contribute to preventing conflicts between competing uses of land for food, feed, fibre or fuel, which can be used for ensuring sustainability of biofuels production (Bringezu et al., 2009). Land use planning can be applied at various levels: international, national, regional or local. For each level there is need for a land use strategy and policies that include priorities and operational planning to implement these policies. Strategic planning and land use recommendations on biofuels crop cultivation can be formulated through a set of policy guidelines and requirements, to ensure sustainable land use and to avoid land use changes.

8.6. Use of remote sensing

Monitoring and control are needed to provide evidence of changes in land use and land cover related to biofuels cultivation. Monitoring may involve Earth observations of sensitive sites through remote sensing, regular field surveys, data acquisition and comparison with historic data on land use. The European experience in the field of use of high-resolution satellite imagery for control of the implementation of the Common Agriculture Policy could be relevant.

Remote sensing provides monitoring tools for land use and land use changes, deforestation in sensitive areas, such as tropical forests, and biodiversity conservation, including information necessary to identify no-go areas for biofuel crop cultivation (Fritsche et al., 2009). Remote sensing is increasingly used for gathering of information on the land use and land cover through the aerial, satellite and spacecraft observations of the earth surfaces using visible and non-visible radiation. Remote sensing techniques can play an important role for agricultural crop identification, acreage and production estimation, which is valuable for biofuels crop identification and monitoring (Patil et al., 2002).

Remote sensing can provide support for mapping and establishing a land use/land cover baseline as required in the sustainability certification as first step for combating land use change. Continuous monitoring of land use and especially of sensitive and protected areas is afterwards necessary for detection and spatial quantification of change in land cover linked with biofuel crops cultivation (Rosenqvist et al., 2003). GIS techniques can provide the tool for the integration of remote sensing data on land resources with socio-economic data and identification of the environmental aspects or various constraints at the local level (Patil et al., 2002).

Validation, monitoring and updates of GIS data with a sufficiently high resolution are necessary. Systematic acquisition of data on a periodic basis is essential for monitoring land use and land use change. Integrating fine and coarse spatial resolution data can provide global overview and better detail in sensitive areas. Once identified, the extent of the changes in these areas could be investigated further using finer spatial resolution data. However, there are some limitations arising from the capability of remote imagery to distinguish important features (such as grassland types) and from inadequate or incomplete field sampling.

8.7. Data acquisition and processing

Remote sensing makes it possible to collect data on distant or inaccessible areas. Satellite images provide better and more accessible data at spatial resolutions ranging from sub-metre to few kilometres. Aerial photography and satellite images are other sources for collecting data. Remote sensing replaces costly and slow data collection on the ground, ensuring in the process that areas or objects are not disturbed. The advancement in remote sensing allows obtaining better data with higher resolution that increase accuracy for mapping.

GIS accuracy and ability to analyze spatial information depends upon source data. Remote sensing data cannot provide the detailed information on the biodiversity, quality of ecosystems, or social aspects. Field visits and ground verification are therefore necessary to validate land use data (Liaghat and Balasundram, 2010). International space agencies can contribute to collect adequate remote sensing data through dedicated observation plans within a global, coordinated effort to protect certain areas.

Data analysis and interpretation are the critical processes for the collected remote sensing data. Remote Sensing data from air photographs and satellite imagery can be interpreted visually or analysed by computers. Due to the large area covered and high resolution required, remote sensing databases are huge and image processing is time-consuming. Disaggregated data (such as climate data, topography, soil characteristics, land use, sensitive areas, etc.) can be stored and retrieved by location and afterwards used for spatial analysis. Data is processed and analyzed with computer software for image analysis, which enable generating geographic information from satellite and airborne sensor data, and identifying land attributes which can be mapped. Georeferencing is crucial to making aerial and satellite imagery involving matching up of points in the image to produce accurate spatial data.

9. CONCLUSIONS AND RECOMMENDATIONS

There is a lack of harmonization, across the different certification initiatives, including in the areas of definitions, approaches and methodologies. The numerous certification schemes, with significantly different requirements, that might lead to inconsistent schemes with loose performance parameters with different requirements for different biofuels. There is a need for coordination and integration to develop common frameworks, definitions (such as definitions for forest land, high conservation value areas, etc.), approaches and methodologies (GHG emission calculation, etc.).

Considering the lack of harmonization across the different certification initiatives, including in the areas of definitions, approaches and methodologies, increased EU participation in international initiatives on developing sustainability certification schemes is a must. EU should join the efforts with GBEP and IEA Bioenergy to develop an international sustainability framework for bioenergy, GHG methodology and ILUC impact assessment.

Whereas the improvement of the biofuel sustainability performances at the production site may be fostered by certification, certification is probably not able to avoid certain indirect effects, such as the impact on food security, food availability or Indirect Land Use Changes (ILUC). Indirect effects can have a global dimension, act across countries as well as markets, and are governed by different policies (agriculture, environment, energy, trade, rural development...).

In order to prevent the various indirect effects, sustainability standards should ideally be applied globally to all agricultural commodities. The efforts to make biofuels for transport sustainable should be complemented with the same efforts to make agriculture and forestry sustainable. Certification schemes should include all production and for all end-uses (i.e. not only for fuel use, but also for food, fodder, fiber, bio-materials, etc.) as the tool to ensure global sustainability.

The estimation of the indirect land use change has a broad range of uncertainty due to a number of parameters, such as yield trends, and various approaches and methodologies and gaps in data availability and validation. Additional measures are needed to deal with specific requirements, such as GHG emissions, ILUC, food security and food availability, increase of food prices and indirect land use changes. Considering the high complexity, uncertainty and lack of strong scientific support on the ILUC effects of biofuels, ILUC should not be included in certification schemes. ILUC should be addressed, if necessary, by other mechanisms.

A critical issue to the credibility of certification is implementation and verification. Certification schemes have the potential to secure certain sustainability goals through proper enforcement and verification mechanisms. Besides the strong, enforceable sustainability criteria, certification schemes should meet high standards of reliability, transparency and comply with strong implementation and verification requirements.

The quality of institutional frameworks (e.g. legislation and law enforcement) influences the ease of implementation. Strong law enforcement for agricultural practices and forest management, robust and coherent legislation on land use and land use change may limit negative environmental impacts. Poor law enforcement

may lead to reduced effectiveness of sustainability certification, which requires certification more rigorous measures for implementation, monitoring and control.

The current legal framework for agriculture and forest management provides certain assurances for the sustainability of EU domestic biofuels. The biofuels produced from agricultural raw materials originating in the EU require compliance with agricultural environmental requirements and standards for EU farmers. There are management, controls and sanctions systems established for cross-compliance, which can be useful for biofuel crops monitoring.

Identification, mapping and continuously monitoring of no-go areas with remote sensing and GIS-based analysis tools are of a prime importance. Data availability and quality remains a challenge, especially in third countries for some highly sensitive areas. The protection of some of these sensitive areas is covered by international conventions, by the EU and national legislation on national protected areas. An International Agreement for the Protection “no-go areas”, based on widely accepted criteria and a robust mechanism to enforce compliance can contribute significantly to the protection of highly sensitive areas. For the implementation of such agreement, one or several institutions might be in charge with mapping and continuously monitoring no-go areas and remote sensing and integrating with GIS-based analysis tools.

Monitoring and control are needed to provide evidence of changes in land use and land cover or deforestation in sensitive areas, such as tropical forests, related to biofuels cultivation. Monitoring land use changes in comparison with comprehensive land use planning can be a tool for limiting changes associated with biofuels production. Strategic planning and land use recommendations on biofuels crop cultivation can be formulated through a set of policy guidelines and requirements, to ensure sustainable land use and avoid undesired land use changes. Land-use planning and monitoring systems should target sustainable land use irrespective of the use of land and the final use of biomass produced.

Monitoring may involve Earth observations of sensitive sites through remote sensing, regular field surveys, data acquisition and comparison with historic data on land use. Remote sensing can provide support for land use mapping and establishing a land use/land cover baseline, as first step for combating land use change. Remote sensing should be used for the monitoring and spatial quantification of changes in land use/land cover due to biofuel crop cultivation. For example, the European experience in the field of use of high-resolution satellite imagery for control of the implementation of the Common Agriculture Policy could be relevant.

Linking biofuels sustainability certification with climate change policies in International Agreements on Climate Change or WTO negotiation could contribute to gain wider acceptance and avoid trade barriers. An international Biofuels Sustainability Pact with an agreement on sustainability principles would be helpful in securing the sustainability of biofuels production at international level. The implementation of a global scale, harmonised certification scheme might be the only option able to secure different direct and indirect effects of biofuels / bioenergy production.

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Abstract

Biofuels certification is a response to the concerns related to the biofuels sustainability. There are several existing certification schemes related to sustainability in other fields, varying considerably in scope, as were developed for a wide range of products as a result of various concerns (Van Dam et al., 2007, BTG, 2008). Some systems cover one of the areas in biomass production, such as agriculture, forest and fair trade. They provide insight into the structures of certification systems (design, implementation constraints, cost-benefits...) as well as operational experience and effectiveness. Some schemes include sustainability criteria that could be adapted for bioenergy and biofuels certification, and provide a useful experience for the development of a biofuels certification scheme, or for benchmarking.

The report analyses the status of implementation of several European and Non-European certification schemes in connection with the EU current legislative framework. Several of these schemes are undergoing the recognition process, but none of them has been already recognized at the moment.

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