Chapter 6
The Role of Sustainability Requirements in International Bioenergy Markets

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Abstract As the main driver for bioenergy is to enable society to transform to more sustainable fuel and energy production systems, it is important to safeguard that bioenergy deployment happens within certain sustainability constraints. There is currently a high number of initiatives, including binding regulations and several voluntary sustainability standards for biomass, bioenergy and/or biofuels. Within IEA Bioenergy studies were performed to monitor the actual implementation process of sustainability regulations and certification, evaluate how stakeholders are affected and envisage the anticipated impact on worldwide markets and trade. On the basis of these studies, recommendations were made on how sustainability requirements could actually support further bioenergy deployment. Markets would gain from more harmonization and cross-compliance. A common language is needed as 'sustainability' of biomass involves different policy arenas and legal

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settings. Policy pathways should be clear and predictable, and future revisions of sustainability requirements should be open and transparent. Sustainability assurance systems (both through binding regulations and voluntary certification) should take into account how markets work, in relation to different biomass applications (avoiding discrimination among end-uses and users). It should also take into account the way investment decisions are taken, administrative requirements for smallholders, and the position of developing countries.

6.1 Introduction

Biomass (solid, liquid and gaseous) is considered to play a key role in future energy supply (Chum et al. 2012). It can contribute to the reduction of greenhouse gas emissions, increasing the energy supply diversity and security, and provide opportunities for local communities, overall a more sustainable fuel and energy supply, in environmental, economic and social terms.

However, to meet its promises, we need to ensure that biofuel and bioenergy deployment happens in a way that respects the three pillars of sustainability, i.e. the reconciliation of environmental, social equity and economic demands, both for domestic and imported biomass. The spectacular growth of biofuel production between 2005 and 2008, driven by country mandates, targets and incentive systems, has triggered a discussion on potential sustainability risks of biofuels. On the one hand, biofuels provide new opportunities for agricultural markets and rural communities; on the other hand, there are environmental, social and economic concerns about the production of biomass feedstocks for biofuels. The discussions on sustainability of biofuels, food versus fuel, and land use change often overshadow potential positive effects such as greenhouse gas (GHG) reduction and economic advantages for communities and countries. The discussion of using solid biomass for bioenergy

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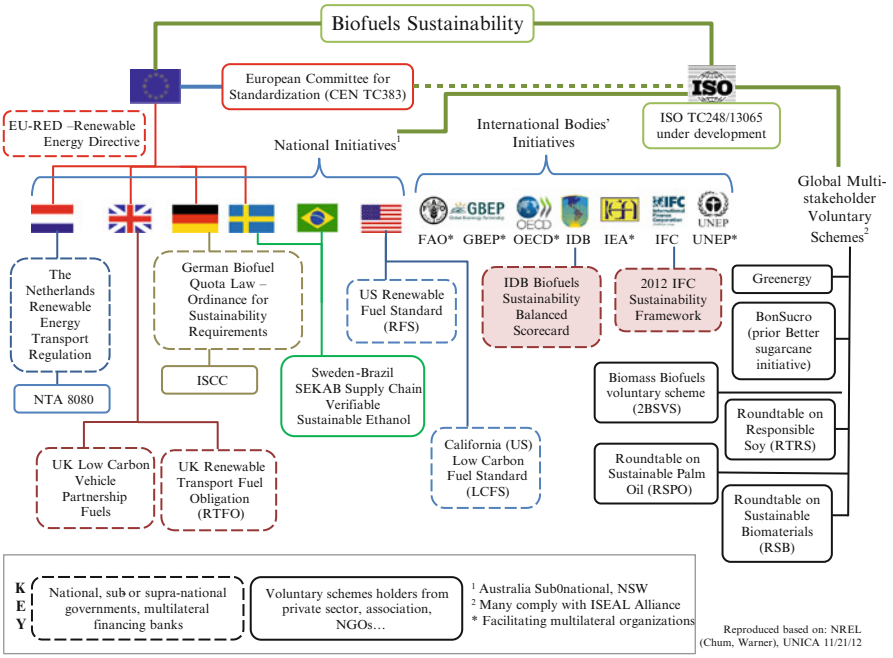

Fig. 6.1 Illustration of some government-led initiatives (in *dashed boxes*) and of sustainability standards in relation to liquid biofuels that were developed over time by a variety of entities (*full boxes*) (Many are organized through voluntary schemes by multiple stakeholders. Others, not displayed, exist for forestry and agriculture, specifically. Scorecards are also used to provide check lists of project submissions to financing by multilateral organizations)

(mainly for electricity and heat generation) follows with some delay the discussions around biofuels for transport. While the debate on biofuels focused on issues of food versus fuel and land use change, the risks for biodiversity and carbon stock loss in forests are prevalent concerns in the debate on solid biomass.

The sustainability of biomass/bioenergy/biofuels can be governed at multiple levels through:

- subnational, national or regional legislation and regulations,
- international conventions and processes,
- jurisdictional guidelines (mandatory or voluntary),
- certification schemes, and
- business systems – Corporate Social Responsibility & Environmental Impact Assessment.

In general one can distinguish between obligatory (regulated) and voluntary systems, which can complement each other. Overall, a large number of initiatives – mainly in the form of regulations and certification schemes – have been developed to ensure the sustainability of land management and biomass production systems, also in relation to markets of biofuels and bioenergy carriers. Figure 6.1 shows an example overview of initiatives which have developed to ensure sustainability of biofuels.

Without going into the details associated with this figure, in general, we see governance initiatives placed on three levels:

- National/regional initiatives developed by regulators; the main examples are regulations in the EU (Renewable Energy Directive), in separate EU Member States (like the Netherlands, UK, Germany, Sweden), and the United States (Renewable Fuel Standard 2) and Brazil;
- Initiatives developed by international bodies such as FAO, GBEP, UNEP, IFC, IDB[1]; and
- Multi-stakeholder voluntary schemes, typically developed by companies and NGOs.

In addition to dedicated biofuel and bioenergy governance systems, various voluntary certification schemes have been in existence since the early 1990s, which aim at ensuring sustainable forest or agricultural management or fair trade. These systems complement most initiatives that were developed for sustainable bioenergy.

6.2 Sustainability Requirements in Legislation

The interest in biofuels and bioenergy production and investment has been largely driven by policies of national governments, both in developed and developing countries, designed to reduce greenhouse gas (GHG) emissions and to reduce dependency on fossil fuel imports. Bioenergy has since long been a significant part of the energy mix in some countries, and was commonly considered an attractive opportunity also for meeting rural development objectives and for job creation associated with the growth of a new industry. However, the recent years' rapid increase in the use of conventional food crops for biofuels, and the proposed linkages to socioeconomic and environmental impacts, spurred an intensified debate about the sustainability of bioenergy. This debate triggered a range of initiatives to develop sustainability standards and certification schemes to account for and monitor sustainability issues intended to reduce the negative unintended consequences of bioenergy expansion.

A number of countries have already been actively engaged in the development of sustainability standards and certification schemes for biofuels and bioenergy, including Australia, Belgium, Canada, Germany, Japan, Korea, the Netherlands, New Zealand, Sweden, Switzerland, the United Kingdom, the United States, and a number of developing countries such as Argentina, Brazil, China, India, the Philippines, South Africa and Thailand. An overview of such initiatives can be found in several publications like Scarlat and Dallemand (2011); van Dam et al. (2010) or O'Connell et al. (2009), but it should be emphasized that since many initiatives have been developed very recently, it is difficult to give a comprehensive overview of them. Countries have adopted policies that encourage the production

[1] FAO = the Food and Agriculture Organization of the United Nations; GBEP = Global Bioenergy Partnership; UNEP = United Nations Environment Programme; IFC = International Finance Corporation (World Bank Group); IDB = Inter-American Development Bank.

and use of bioenergy, mostly related to biofuels, and have set sustainability requirements for production, processing and trade of biofuels, bio-liquids and/or solid and gaseous biomass which must be fulfilled in order to meet present national targets and/or to be eligible for financial support.

The policies that have the greatest impact on large international bioenergy markets are those developed in the European Union and the United States (Pelkmans et al. 2012). A brief overview is presented in the following section.

6.2.1 European Union

The main legislative driving force for sustainability of biofuels and bioenergy in the EU is the Renewable Energy Directive (Directive 2009/28/EC, hereafter called 'RED'). The aim of this legislative act is to achieve by 2020 a 20 % share of energy from renewable sources in the EU's final consumption of energy and a 10 % share of energy from renewable sources in each Member State's transport energy consumption (EC 2009). The RED has set specific minimum sustainability standards for ***biofuels*** (for transport) ***and bioliquids*** (for electricity and heat production) and requirements for their verification that should be met in order to receive government support or count towards the mandatory national renewable energy targets. The sustainability criteria are:

- greenhouse gas (GHG) savings of at least 35 % compared to fossil fuel (to be increased up to 50 % from 2017 and 60 % for new installations from 2018),
- no raw material from land with high biodiversity value, such as primary forest, nature protection areas, highly biodiverse grasslands *(unless it can be shown that biomass extraction is part of a management regime compatible with – or a requirement for – high biodiversity)*,
- no raw material obtained from converted[2] high carbon stock land (continuously forested areas, wetlands or peatlands),
- raw material coming from European agriculture needs to be produced following 'good agricultural practices' as described in the Common Agricultural Policy (CAP).

The compliance to these biofuel sustainability requirements needs to be checked by Member States or through voluntary schemes which have been approved by the European Commission (EC).[3] The EU Member States must also report to the EC on biannual basis on the impact of biofuels and bioliquids on biodiversity, water resources, water and soil quality, GHG emission reduction and changes in commodity

[2] Converted according to the RED = land that had the status of continuously forested areas, wetlands or peatlands in January 2008 and no longer has that status.

[3] Since 19 July 2011, the EC has recognised voluntary schemes for biofuels, applying directly in the 27 EU Member States: ISCC, Bonsucro, RTRS, RSB, 2BSvs, RBSA, Greenergy, Ensus, Red Tractor, SQC, Red Cert, NTA8080, RSPO. http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

prices and land use associated with biomass production. The RED in itself did not include any definite set of definitions, criteria and indicators related to terms such as "primary forest" and "highly biodiverse grasslands" requiring that these be further examined and defined as part of a comitology process at EU level.

On 17 October 2012, the EC published a proposal to limit global land conversion for biofuel production, and raise the climate benefits of biofuels used in the EU.[4] The proposal contains four major changes:

- Incorporation of biofuels produced from food crops (cereals, sugar and vegetable oil) would be limited to 5 % in terms of energy content out of the target of 10 % of renewable energy in transport by 2020,
- New biofuel plants (post 1st July 2014) should deliver minimum greenhouse gas savings at 60 % compared to fossil fuels emissions,
- Additional support is introduced for "advanced" biofuels produced from non-food feedstocks, such as waste, straw and non-food crops, by weighting more favourably their contribution towards the 10 % renewable energy target,
- The estimated GHG emissions associated with indirect land use changes (iLUC) needs to be reported by Member States and fuel suppliers based on using fixed factors.[5] The high iLUC value for oil crop biofuels puts a high constraint on the role of biofuels from oil crops after 2020.

The EC also expresses the view that in the period after 2020 biofuels produced from food and feed crops, which do not lead to substantial greenhouse gas savings (when iLUC emissions are included), should not be subsidised.

So far the RED sustainability requirements do not apply for ***solid or gaseous biomass*** used for electricity or heat production. However, feedstocks used for the production of solid and gaseous bioenergy carriers (notably lignocellulosic biomass) are expected to also be used for the production of '2nd generation biofuels', which will have to comply with the requirements set for biofuels and bioliquids. It is therefore expected that common requirements or some form of harmonization will be needed.

In February 2010, the EC published a Communication[6] stating that for the moment, there would be no binding criteria at the European level. However, the EC provided a number of recommendations for Member States in order to ensure greater consistency and to avoid unwarranted discrimination in the use of raw materials. Basically, it recommended the use of a similar methodology as that for biofuels for installations larger than 1 MW, with the same sustainability requirements on biodiversity and

[4] COM(2012)595, Proposal for a Directive of the European Parliament and of the Council amending Directive 98/70/EC relating to the quality of petrol and diesel fuels and amending Directive 2009/28/EC on the promotion of the use of energy from renewable sources. October 2012.

[5] Current iLUC emission factors are 12 g CO2eq/MJ for cereals, 13 g CO2eq/MJ for sugars and 55 g CO2eq/MJ for oil crops (for reference, the fossil fuel comparator is 83.8 g CO2eq/MJ). Biofuels made from feedstocks that do not lead to additional demand for land, such as those from waste feedstocks, should be assigned a zero emissions factor.

[6] COM(2010)11, Report from the Commission to the Council and the European Parliament on sustainability requirements for the use of solid and gaseous biomass sources in electricity, heating and cooling. February 2010.

high carbon stock land and a common GHG calculation (with adapted reference as the end use needs to be included as well). The EC is in the process of assessing the implementation of its recommendations to Member States, and the opportunity to have binding EU-wide criteria for solid and gaseous biomass. EC recommendations are expected to be released in 2013.

6.2.1.1 Selected Examples

Germany In 2006, the German Ministry launched a project aimed at defining the basis for sustainability requirements for biofuels. The result was the proposed Biomass Sustainability Regulation (BSR). The draft BSR was released in late 2007, but with the RED in development at EU level, the initiative was abolished. Nevertheless, in the early stages Germany decided to follow the RED requirements and it was the first country to implement the sustainability requirements of the RED in their own legislation. Germany also supported the development of a scheme called ISCC (International Sustainability and Carbon Certification). This system was the first to be recognized at the national level to fulfil the RED requirements (in 2010). A second system, the REDcert, was also recognized later in Germany (Lieback and Kapsa 2011). In 2015 Germany will change from volume quota to CO_2-quota for biofuels. This will put higher emphasis on the GHG balance of biofuels (to be certified), with important economic impact.

Belgium Belgian authorities (at regional level) introduced sustainability criteria into their supporting scheme for renewable electricity in 2006. In the Flemish region, certain biomass streams (e.g. wood (waste) that is still suitable for recycling in board or pulp and paper industry) are not entitled to receive green power certificates as a feedstock for the production of renewable electricity. Also, the energy used for transporting and pre-treatment of the biomass, is deducted from the green power certificates. In the Brussels and Walloon regions, a greenhouse gas balance and reduction compared to the best available natural gas system is calculated to determine the amount of green certificates. All calculations must be validated through an audit by an independent organisation.

United Kingdom Since April 2008, under the UK RTFO (Renewable Transport Fuel Obligation), the Renewable Fuels Agency (RFA) requests fuel suppliers to report on the specific type and origin of biofuels, the compliance of biofuel crops with existing environmental and social sustainability criteria, and the greenhouse gas emission reductions achieved by using biofuels. While there are no strict consequences of not meeting the sustainability criteria, public disclosure may be an important driver for the reporting commercial companies. A similar procedure was implemented for renewable electricity in 2011. From 2011, a well-founded report on the RED sustainability criteria is required for installations larger than 50kWe; from 2013, generators of 1MWe and above will need to actually satisfy the sustainability criteria. This staged approach will also be considered by the Renewable Heat Incentive (RHI).

The Netherlands The Netherlands examined sustainability criteria for all forms and applications of biomass. In 2007, the Cramer Commission published a list of sustainability principles for the use of biomass for energy (fuels, liquids, solid and gaseous). These principles are partially covered in the RED sustainability criteria. The Netherlands are building further on their experience with the Corbey Commission. Based on the *Cramer* principles, the Dutch normalisation institute NEN, developed standards NTA 8080 and 8081 for sustainable biomass for energy purposes (NTA 8080 2009). This is a voluntary system and already used by commercial actors to demonstrate the sustainability of their biomass. The NTA 8080/81 was recently approved by the European Commission as a voluntary system for biofuels and bioliquids. In October 2012, large Dutch biomass users have signed a *Green Deal*. The participating companies will report annually to the government the amounts of biomass they use and how sustainability is demonstrated via certification or verification systems.

6.2.2 United States

US Renewable Fuel Standard (RFS2) The RFS2 defines the volume of different biofuels that have to be blended with conventional fuel between 2006 and 2022 according to the US Energy Independence and Security Act of 2007. The total volume of biofuels mandated in the Renewable Fuels Standard will increase to 36 billion gallons (136 million m^3) in 2022. Each year, obligated parties such as refiners and importers of gasoline and diesel and blenders are required to meet volumetric targets for four broad categories of biofuels: (1) conventional renewable fuels; (2) bio-based diesels, (3) advanced biofuels, and (4) cellulosic biofuels. These biofuel categories are defined based on the nature of feedstock/technology used in production and minimum GHG reduction thresholds obtained. These requirements favour the development of highly efficient biofuel technologies, including 2nd generation biofuels. The definition of 'renewable biomass' in the RFS2 limits the types of biomass as well as the type of land from which biomass may be harvested to produce compliant renewable fuels. The law sets a limit of 15 billion gallon (57 million m^3) for conventional renewable fuel.

All renewable fuel producers must report and maintain records concerning the type and amount of feedstocks used for each batch of renewable fuel produced. Additionally, the producer must report to EPA on a quarterly basis concerning the source of the feedstocks. Renewable fuel producers are required to obtain from their feedstock supplier, and maintain in their records, documents which certify that the feedstock meets the definition of renewable biomass and renewable fuel, describe the feedstock, and identify the process that was used to generate the feedstock.

To track achievement towards the mandate for renewable fuel, EPA established a system of tradable Renewable Identification Numbers (RINs). Upon blending with gasoline, the RIN is detached from producer and used by the blender as proof of traded renewable fuel or sold to another obligated party. EPA also sets the required volumes of biofuels each year.

The California Low Carbon Fuel Standard (LCFS) State-level legislation in the US, such as the California's Low Carbon Fuel Standard, is also largely based upon reporting requirements using default carbon intensity values established per type of biofuel, although other technologies such as electric vehicles can be used. The California Low Carbon Fuel Standard (LCFS) is a standard that aims to reduce GHG emissions from the transportation sector in California by at least 10 % by 2020, using a technology-independent life cycle approach. These emissions include not only tail-pipe emissions but also all other associated emissions from production, distribution and use of transport fuels. The calculations include indirect land use change (iLUC). The California Air Resources Board (CARB) calculated current carbon intensities of various fuel pathways and sub-pathways and listed them in lookup tables. Each additional facility and pathway approved is then found in the registered facility information, which is added to other already registered fuels. The LCFS convened a working group relative to the iLUC factor and this factor will be modified in legislation in the future.

6.2.3 Latin America

In order to address potential negative environmental and social impacts of bioenergy production, several sustainability initiatives have been established in Latin America during recent years. Such efforts have been initiated by stakeholders from the industry, as well as by Latin American governmental bodies. Most sustainability initiatives addressing feedstock production for food, feed and biofuels operate on a voluntary basis. Some are embedded in legislation, particularly in Brazil. Some examples:

- Brazilian agro-ecological zoning for sugarcane – On a national level in Brazil, there is an agro-ecological zoning for sugarcane, including specific requirements regarding appropriate soil and climate, with no or low irrigation requirements, and low slopes for mechanized harvesting and reduced atmospheric emissions. Investors who do not respect this zoning are not eligible for getting loans from public institutions. A similar system is currently being developed for palm oil.
- The Sao Paulo State Green Ethanol programme – An applied tool of the Green Ethanol programme is the agro-environmental sugarcane zoning in the State of São Paulo. This tool is a map with several layers identifying potential sugarcane expansion areas and protected areas.
- The Social Biodiesel Programme in Brazil – The objective is to redistribute wealth, fight against rural poverty and to improve living conditions for poor farmers in north-eastern Brazil. Biodiesel companies that use and buy feedstock at fair prices from smallholders and family farmers gain tax benefits from the state. The programme did not meet its ambitious targets to promote family farmers and alternative feedstock so, as a result, the Brazilian biodiesel market is currently dominated by large-scale soy production.

Sustainability requirements for biofuels and bioenergy in legislation have been steadily implemented in the past years. These are now starting to have the anticipated effects in the field and on international markets.

In general, these (supra)national regulations address the environmental and ecological issues related to biofuel production, such as (1) the climate change mitigation potential of biofuels by requiring a certain percentage in reduction of lifecycle GHG emissions compared to a fossil-based fuel, and (2) preservation of existing organic carbon stores and biodiversity by stating that biofuel production should not cause conversion of land with high carbon stock or high biodiversity value.

Social issues are covered in a different (and somewhat more limited) way, e.g. by setting reporting requirements on social sustainability addressing food availability and price, as well as workers' rights and land access and ownership rights.

The advantage of these national/regional standards is that they are well tailored to local/regional issues. However, initiatives are not always comparable with regards to the overall structure, definitions used, specific sustainability requirements, reporting methodology and reporting requirements; for example, there are differences in the type of biomass/biofuel/bioliquids included, time frame, GHG emission reduction requirements, the GHG emission reduction calculation methodology and the way iLUC is incorporated. As a result, this situation can be confusing to actors in the marketplace and lead to barriers for international trade.

6.3 Voluntary Certification Systems

6.3.1 Introduction

Sustainability certification exists for a wide range of products, addressing good resource management and responsible entrepreneurship. These are generally performance-based schemes aiming to achieve a certain standard, and include a number of principles, criteria and indicators designed to verify compliance. Certification systems have become available for almost all feedstock and products covering parts of, or the complete, supply chain – from production and processing to trade of biomass and biofuels. Some of these systems exist on a national level, and others are internationally recognized and applicable. Certification schemes enable actors along the supply chain and involved with trade to attest that land management and biomass production and procurement practices comply with regulations and requirements regarding sustainable biomass or bioenergy. Due to the fact that these systems have been developed with different interests and priorities (e.g. by governments, NGOs, companies), the scope, approach and complexity vary from scheme to scheme. Certification systems have a number of similarities in terms of coverage of sustainability issues/principles, but there is a variation in the way compliance with standards is measured, i.e. different sustainability criteria and indicator systems and monitoring procedures exist.

A variety of schemes has become operational for the production, processing and trade of biomass, with the most prominent ones relevant for bioenergy markets being:

- **Forest certification systems:** The first implemented forest certification scheme was the Forest Stewardship Council (FSC). The FSC sets international principles

for sustainable forest management, and local stakeholders develop region-specific standards. Other schemes followed, with PEFC as one of the larger recognised international certification organizations, endorsing national-level schemes based in more than 30 countries. In general, each of these PEFC schemes differs in how sustainable forest management is defined, but our review indicates they seem to have somewhat similar chain-of-custody standards, although some differences can be found. The PEFC has not mandated one set of international principles but does have a mechanism for evaluating if schemes seeking PEFC endorsement are in compliance with a 'harmonized' set of standards (Stupak et al. 2011). While FSC and PEFC schemes are used to certify the sustainable management of forests from which bioenergy feedstocks are harvested, neither were originally developed for biofuels/bioenergy applications. These schemes also do not include binding limits for GHG emissions, nor do they include the complete production chain or quality of air issues. They do address water and soil quality/conservation, and include biodiversity and workers and land rights.

- **Agricultural certification systems:** Most of these systems are designed for the certification of organic products to be used for a wide range of end-uses (food, feed, energy), like SAN/RA and GlobalGAP. Some focus on a specific crop, like RTRS (soy), RSPO (palm oil) and Bonsucro (sugar cane). As for forestry certification, these agricultural schemes include environmental, economic and social aspects; soil conservation is addressed in all schemes; and air quality is only covered in RSPO and social aspects (workers' rights and land rights) are not included in GlobalGAP. The crop specific schemes, RTRS, RSPO and Bonsucro, have recently been extended to also include specific biofuels or bioenergy related issues, i.e. GHG emissions and carbon conservation, so that they are recognized as voluntary scheme for biofuels by the European Commission.
- **General biofuel/bioliquids certification systems:** A number of dedicated certification schemes for biofuels/bioliquids exist (e.g. ISCC, RSB, REDCert, 2BSvs). Most of them have been developed to show compliance with the European RED requirements. These are more generic standards which cover a wide range of feedstocks to be used for biofuels or bioliquids. They cover the same aspects as the crop dedicated agricultural schemes, although the approach differs; for example, these schemes require a specific GHG reduction target compared to fossil fuel instead of general GHG improvement requirements. On the other hand they generally exclude requirements on e.g. fertilizer applications, tillage, labour conditions and so on.
- **Wood pellet certification systems:** The first private standards for wood pellets for energy production included the Green Gold Label (GGL) and the Laborelec system, which were developed to comply with (anticipated) national legislation and customers demand. These are mainly Chain-of-Custody (CoC) standards for product verification. They allow the use of other schemes to comply with the sustainability criteria set out in the standard (e.g. FSC, PEFC, including e.g. CSA, SFI). Currently a consortium of large pellets buyers have formed an initiative called 'International Wood Pellet Buyers' (IWPB) to streamline their quality and sustainability requirements to facilitate trade within the sector (IWPB 2012).

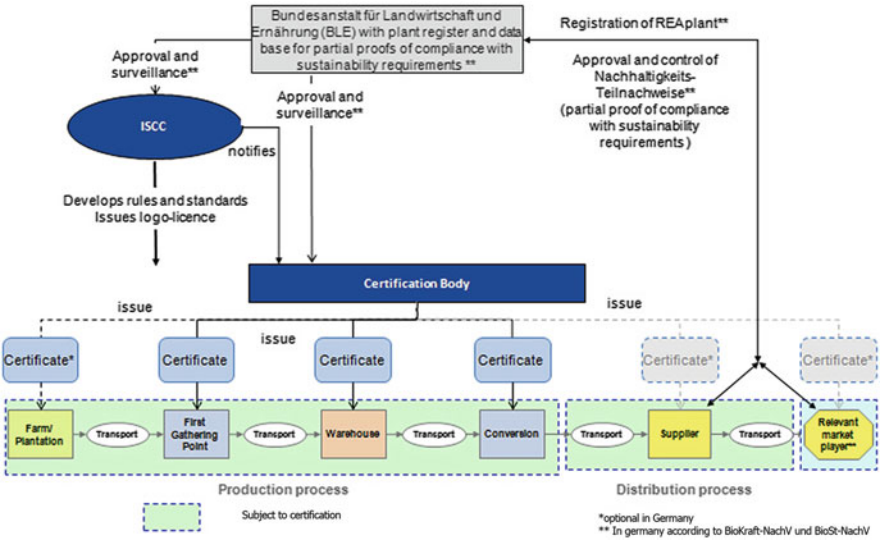

Fig. 6.2 Overview on processes and responsibilities in the ISCC scheme (Note that the involvement of a government body BLE is untypical and generally not the case for other voluntary systems) (ISCC 2012)

Certification enhances the relationship between different stakeholders as a result of verification and certification requirements. It requires stakeholders to communicate with each other on different levels, both during development and improvement of the certification schemes and the implementation (CoC requirements and audits), and thus improves awareness. Figure 6.2 indicates relationships and CoC processes in the ISCC scheme.

Certification affects various market actors differently. The supply side is pushed towards certification to improve trade and gain credibility from the demand side, i.e. buyers and other organisations like NGOs. Both groups of stakeholders thus catalyse the development and implementation of certification schemes.

6.3.2 Implementation of Relevant Schemes

The IEA Bioenergy inter-task study 'Monitoring sustainability certification of bioenergy'[7] looked at the implementation process of sustainability certification of bioenergy. A list of relevant and representative schemes was selected, also on the basis of relevant trade flows for biofuels/bioenergy. The most important feedstocks in terms of trade flows for energy are ethanol from sugarcane (mostly from Brazil), biodiesel

[7] Results available at http://www.bioenergytrade.org/publications.html. See also Goovaerts et al. 2013, Stupak et al. 2013, Goh et al. 2013 and Pelkmans et al. 2013.

Table 6.1 Selected certification schemes for analysis in the IEA Bioenergy inter-task study (Goovaerts et al. 2013)

Sector	Schemes
Forestry	FSC (Forest Stewardship Council)
	PEFC endorsed schemes, such as SFI, CSA-SFM, ATFS[a] in North-America, PEFC Finland, Sweden, Germany or France in the EU, CertFor (Chile), CerFlor (Brazil), FCR (Russia)
Agricultural crops	GlobalGAP (worldwide standard for Good Agricultural Practice)
	SAN/RA (Sustainable Agriculture Network/Rainforest Alliance)
	CSBP (Council on Sustainable Biomass Production) in the United States
	Bonsucro (sugarcane)
	RSPO (Roundtable on Sustainable Palm Oil)
	RTRS (Round Table on Responsible Soy)
Biofuels (general)	ISCC International Sustainability and Carbon Certification)
	RSB (Roundtable on Sustainable Biofuels)
	2BSvs (Biomass Biofuel Sustainability voluntary scheme)
Wood pellets (for energy)	GGL (Green Gold Label, developed by RWE-Essent)
	Laborelec
	IWPB (International Wood Pellet Buyers consortium)

[a]*PEFC* Programme for the Endorsement of Forest Certification Schemes, *SFI* Sustainable Forestry Initiative, *CSA* Canadian Standards Association, *ATFS* American Tree Farm System

from soy (mostly from Argentina or North America), biodiesel from palm oil (mostly from southeast Asia) and wood pellets (mostly from North America and Russia).

Evaluated schemes are listed in Table 6.1.

Governance and stakeholder involvement are crucial to ensure that certification schemes gain acceptance by the wide variety of stakeholders concerned with the sustainability of bioenergy. Most schemes are developed through a multi-stakeholder process, and are governed by a Board of Members, which (at first sight) equally represents all stakeholder groups. Although the general approach of these initiatives is very similar, the schemes differ in the way specific issues are dealt with and how they operate.

Chain-of-Custody systems All the sustainability certification initiatives have developed a Chain-of-Custody (CoC) standard, or intend to develop one (i.e. IWPB), but differ in which methodology should be applied and which parts of the chain are covered by the CoC certificate. All schemes provide procedures and guidelines on the specific requirements to comply with the CoC standards. Some schemes outline specific requirements for different actors within the supply chain. The physical segregation system[8] and the mass balance[9] system are the most commonly used

[8] Certified products are physically segregated from non-certified products at every facility along the supply chain.

[9] The amount of certified product sourced and sold by each supply chain actor is tracked. However, the certified product and associated documentation do not need to be sold together. The certified product can either be segregated (site level or tank level mass balance) or not (company level mass balance).

CoC systems. These are the traceability systems that are regarded as less prone to error and favoured by regulators because they provide direct incentives for fuel providers to ensure that the fuels they purchase and deliver meet sustainability requirements (Dehue et al. 2008).

All general biofuel (ISCC, RSB, 2BSvs) and crop-specific schemes (except for Bonsucro) refer to the tracking of sustainably produced products along the whole supply chain. All other certification schemes have partial CoC systems, excluding the farmer or biomass production and only include the operators handling or processing the certified product (wood products in the case of GGL, Laborelec, FSC and PEFC, and agricultural products in the case of GlobalGAP and SAN/RA).

Information handling The CoC tracking is based on continuous information about each stage of the supply chain taken by products from primary production at the forest, farm or crop site to the final user. It includes each stage of processing, conversion, transformation, manufacturing, trading and distribution where progress to the next stage of the supply chain involves an exchange of legal and/or physical control to ensure transparent transfer and traceability of certified feedstock/biofuel. In general, this information includes the volume, source of feedstock, type of feedstock and applicable certification number, together with sustainability data. Most CoC systems focus on the sustainability of feedstock production, and for biofuels all GHG emissions along the entire production chain must be included. Information on certificates and sustainability characteristics is generally transferred via online/electronic systems (i.e. 2BSvs, ISCC, RSB, RSPO) or through product declaration documents that are passed to the next operator in the supply chain (e.g. Bonsucro).

Assessment procedures In all schemes, each participating economic operator must be certified by a regularly accredited certifying body, and is subjected to an annual audit by an (independent) third-party auditor. Audit procedures appear similar in their intent, but there may be significant differences depending on the role that self-assessment, desk audits and field visits play, respectively. In certain cases of multi-site or group certification, only a sample of the entities involved in the certification are visited to verify that all conditions are met. The duration of most certificates varies from 1 to 5 years, after which the operation must be fully re-certified.

Recognition Standards often apply to similar or overlapping sectors, and for producers simultaneous certification according to more schemes, or recognition by multiple standards at the same time, can be an advantage. The costs of going through multiple audits can often be prohibitive for producers whose resources are limited. Thus, many standards have begun exploring ways to coordinate certification, thereby reducing the economic and administrative burden for economic operators. Improved consistency and collaboration for standards that are overlapping in either content or functions can lead to increased efficiency for standards themselves, and it can help scale up the use of certification generally, by making standards more available. Many schemes are recognized by other schemes or EU Member States. It is noteworthy to mention, for example, that many forestry and agricultural schemes are accepted by biofuel/bioenergy schemes as proof of sustainable wood production and agricultural biomass production. Recognition by other schemes,

and especially by governments or the European Commission contributes to the credibility and assurance of a scheme. Mind that there is a risk of downgrading of sustainability/less transparency when certificates are recognized by other schemes along the chain (van Dam et al. 2012).

In general, it can be concluded that the voluntary sustainability schemes we examined tend to bring more credibility, accountability and transparency to the supply chain. They all address sustainability issues although they differ in the way these issues are addressed, e.g. differences in criteria and indicators, methodologies, audits, and level of transparency used. However, it must be noted that this complexity may create marketplace confusion and trade barriers.

6.4 Market Impacts

The existing bioenergy markets and trade are largely influenced by market characteristics and public policies. The market is shaped by a diverse group of factors such as resource availability and feedstock prices. These market elements are intertwined with intervention of a variety of national and regional policies, weaving a complex trading web. The implementation of sustainability requirements may have significant impact on the existing market and trade dynamics. This considerable complexity suggests a need to gain more insight into the interrelation between this wide range of factors and trading patterns to investigate the impact of sustainability requirements and certification.

In principle, there can be multiple effects of sustainability requirements on biomass production, availability and supply and trade, including (i) certain producing areas or resources can become excluded from specific markets (which can in turn enhance opportunities and market access for other potential suppliers), (ii) costs of production and feedstock supplies may increase, and (iii) certification can act to increase coherence along the supply chain and facilitate the realization of benefits (both ecological and socio-economic) associated with increased market access. Such mechanisms have been described for a few regions and resources (e.g. Smeets and Faaij 2010). Changes in trade flows are of particular interest when it comes to international (and intercontinental) bioenergy trade. The effectiveness of sustainability requirements may be undermined by leakage effects, i.e., producers decide to target new markets with less stringent requirements instead of improving their operations so as to comply with sustainability requirements on the markets where they have been present.

6.4.1 Trade Dynamics for Liquid Biofuels

The trade dynamics of liquid biofuels and solid biomass are significantly different. The liquid biofuels markets are rather mature markets and are closely related to agriculture commodities. Therefore, the markets are highly dynamic and complex

and the actual impact of sustainability governance is not obvious. The liquid biofuels market is largely influenced by feedstock prices, which are closely related to food and feed commodities market, as well as crude oil prices (Lamers et al. 2011). For most of the crops, weather has been the determining factor for the supply, and hence the feedstock prices. Sustainability governance has reduced the size of certain supply chains, such as Argentinean soy-based biodiesel (SME) and southeast Asian palm oil based biodiesel (PME), especially since 2011, as only biofuels certified as sustainable are now accepted in the EU. This is mainly caused by the default GHG saving values set by the EC, which are below threshold for some SME and PME supply chains. So the influence of sustainability governance on these specific biofuels has been significant. However, to date, it has not affected the overall supply of sustainable biofuels, as fuels which fall under the double counting mechanism in the EU (such as waste-based biofuels) have increasingly dominated the market.

Additionally, the US has also developed a parallel market that effectively captures the Brazilian ethanol with a price premium (although Brazil's sugar-based ethanol production in 2011–2012 was more costly than US corn-based domestic supply). For this reason, obtaining sustainability certification to access the EU market has not been a priority for Brazilian producers. Brazil itself is currently facing a shortage of ethanol due to drought and poor investment in its cane belt (Reuters 2012). However, the ethanol trade between Brazil and the EU might recover in the near future, and the Brazilian Government, together with the private sector is fully engaged on the discussions for ethanol certification for European market (Dornelles, Brazilian ethanol exports and certification. Brazilian Ministry of Mining and Energy, personal communication, February 2013). We conclude that overall, for liquid biofuels, at the current mandate level, other factors have outweighed the sustainability governance in affecting trade dynamics, namely feedstock prices and local economic realities in individual markets. However, the influence from sustainability governance most likely will grow with the mandate level in the near future. The recent EC proposal to put a 5 % limit on food based biofuels (in an effort to address iLUC concerns) may depress the food crop-based biofuel trade and have a major impact on trade flows.

6.4.2 Trade Dynamics for Solid Biomass

The market is less complex and trade dynamics are more straightforward for solid biomass for energy, in particular wood pellets. The main market is the EU, and the primary drivers of development are national support policies, mainly for the promotion of renewable electricity production. Wood pellets are more expensive than coal, and this is not likely to change in the short term. Government subsidies determine the demand for solid biomass for energy, and subsidies typically come with sustainability requirements. It is still too early to make any conclusions about the effects of new sustainability requirements within, for example, the UK and

the Netherlands, as utilities are still reacting to the policies. It is also important to consider that most wood pellet procurement strategies involve long-term contracts. Therefore, trade flows are unlikely to change on short notice. There is also a tendency for utilities to carry out vertical integration[10] for solid biomass operations.

Due to the nature of the market, solid biomass consumers, in particular wood pellet buyers, are cooperating to harmonize the existing certification schemes and systems (cfr. the IWPB initiative). Beyond sustainability considerations, harmonization of technical aspects and quality specifications is also one important consideration which requires coordination and harmonization. By putting effort in integrating diverse existing systems and regulations requirements, these actors aim to create a commodity market for solid biomass.

Due to the vertical integration and harmonization effort, sustainability certification is less likely to become a trade barrier for solid biomass in the future. Some sourcing areas might be excluded due to sustainability considerations in the processing section of supply chain rather than the harvesting. For example, Russian pellets were not accepted by the Dutch and Belgian utilities due to the use of natural gas for drying, which lowered the overall GHG savings.

The other important consideration would be the logistics issue (considering the emissions created through the transportation of solid biomass). However, trade conflicts in terms of solid biomass are different from liquid biofuels, such as the import of ethanol under different CN codes to get a lower tariff. Finally, the possible introduction of sustainability criteria on an EU level may be a major factor influencing solid biomass trade flows. Especially if strict thresholds for GHG emission reductions are introduced, or strict definitions of primary forests are introduced, a number of currently exporting regions such as Canada and Russia could be affected. Considering the current developments, we judge that the solid biomass market will likely continue to grow without dramatic changes in trade flows, but demand highly relies on government policies.

6.5 Issues Related to Sustainability Governance

6.5.1 Policies and Regulations

Need for long-term policies The developments in biofuels markets show clearly that uncertainty and ongoing changes in policies and regulations cause markets to stagnate. Prominent examples include the uncertainties about sustainability criteria for solid biomass in EU, the lengthy ongoing debates over iLUC risks for biofuels, and uncertainty about future policy supporting advanced biofuel mandates in the US. It should be kept in mind that stakeholders are making investment decisions

[10] Vertical integration means that energy producers try to control certain parts of the supply chain, e.g. through investments in plantations or pellet facilities.

now which establish long-term contracts, whereas governments may evaluate their policy year by year. Sustainability requirements are evolving and discussions on topics like iLUC for biofuels or carbon accounting for solid biomass are creating high uncertainties for companies, which in the future may need to comply with sustainability requirements that are unknown today.

In order to move the bioenergy sector as a whole towards more sustainable practices a legislative system that provides certainty over time is needed. A long-term policy strategy is considered an important driver to improve performances by defining clear objectives and creating a system of incentives (e.g. tax reliefs, subsidies). For their part, the regulations should lay down requirements which add credibility and encourage the development of transparent and comparable systems that are used by all stakeholders. Requirements which are costly and time-consuming and offer little added value (or reflect basic requirements covered by other regulations) should be avoided. Complications and restrictions can make tracing chain-of-custody too costly or create trade barriers for "certified" products. When changes need to be implemented because of new insights, these should be implemented through a transparent and incremental approach to avoid and minimize shock and market instability.

Different country approaches Policies and requirements differ from one country/region to the other due to different regional/country priorities, problems, government structures and processes. While sustainability criteria for biofuels (for transport) and bioliquids (for stationary energy) in the EU are directly related to the RED requirements and valid on EU-wide level, there are currently no obligated criteria for solid biomass on EU level. The main importing countries of solid biomass (UK, Netherlands, Belgium) have started to develop their own national sustainability requirements. At the same time, industrial and market business-to-business schemes are being developed. This has led and will lead to certification and verification schemes (voluntary and mandatory) that are not necessarily complementary or compatible. From a market/trade (and probably also policy) perspective, it may be preferable and more efficient to have a more aligned approach, possibly through a common international framework of (minimum) standards. This may not only lead to more international coherence and address the current proliferation of country/regional specific policies and requirements, but may also encourage the further internationalisation/globalisation of biomass/biofuel/bioenergy certification. More coordination would likely also make the interaction with the scientific community more effective, since scientists would not need to participate in numerous committees that essentially handle the same issues.

Discrimination between different end uses of the biomass and leakage issues Biomass for energy can be produced from various crops, which can also be used for food, feed or materials production. Currently only the use for biofuels needs to fulfil sustainability requirements on EU and US level. Similar commodities with similar environmental, social and GHG impact do not need to fulfil such requirements. Stakeholders producing biomass either for biofuels, for stationary energy, or for other applications (food, materials), are currently facing discrimination in conditions

for being allowed to deliver their biomass. Farmers delivering corn to a transport biofuel installation need to be in compliance with the obligated sustainability criteria. The same farmer providing his corn to a biogas installation (combined with electricity production) doesn't need to fulfil these criteria, nor when he delivers his product to the food and feed markets.

An important issue is the willingness and cooperation of the biomass producers, especially from agriculture (for biofuels) and forestry (for solid biomass). If additional auditing is needed for agricultural products going to biofuels (as compared to other agricultural markets), or for solid biomass used for energy (as compared to the wood material market), this may diminish the willingness of the agricultural and forestry sector to deliver feedstock for bioenergy markets, unless there is a price premium for these certified products, which is hardly the case currently. Furthermore, diverting products with guaranteed sustainability to energy markets may not yield the intended sustainability benefits if it leads to displacement (leakage effects), when at the same time non-sustainable products supply the markets from which these sustainable products were diverted.

Criteria for sustainable production of liquid, solid and gaseous biomass should ideally be based on common concepts and be applicable to all uses of biomass. The producers of raw materials (such as forestry products, grains and oil seeds) do not necessarily know what the end uses will involve and most agricultural and forest commodities are processed into many different co-products. If everyone applied consistent sustainable land management criteria, risks of potential indirect effects and displacement (leakage) could be minimized. Sustainability criteria should be implemented in a practical way, bearing in mind that (a) practices should strive to permit sustained productivity from natural sources, (b) criteria should promote continual improvement toward meeting multiple goals of society (environmental, social and economic), and (c) these goals and priorities will change in response to changing needs, climate and other contextual conditions.

Need for common language In order to be consistent and transparent, including on a cross-sector level, there is a need for global/common definitions and processes on how the sustainability concept should be translated into practice, i.e. how to measure and weight sustainability dimensions and which criteria and indicators should be included. It is therefore very important to find a common language on "what is sustainable and how should sustainability be verified and documented", and using systems based on the same terminology.

A global initiative is needed to work towards global governance of land use principles and guidelines (e.g. a Multilateral Environmental Agreement) and to define a common language regarding implementation and verification. A uniform approach could gain credibility, acceptance and market penetration, and might be able to avoid different verification outcomes. This approach would allow for more efficient structures, save costs due to better management practices, ease administration tasks involved and make it unnecessary for industrial initiatives to create new standards. Costs derived of being part of a broader effort could be offset by access to much greater markets.

6.5.2 Voluntary Certification and Their Link to Policy and Legislation

Complimentary to policy Voluntary certification systems have become an important element in the mix of public policies and corporate strategies to promote the sustainable production of biomass. However, they will not be sufficient on their own. The history of forest certification has shown that it is unlikely that voluntary certification will be able to stop the production and use of non-sustainable biomass. Furthermore, other forms of governance, including legislation, are needed to address concerns that require regulation of resource use on larger scales, such as watershed planning, ecological zoning and rural development plans balancing nature conservation and socioeconomic development objectives. Also aspects such as iLUC and landscape-level carbon balances may be better addressed based on other instruments. For instance, on the longer term a global GHG emissions cap that regulates both fossil and biospheric carbon emissions could be one option providing flexibility. Countries may then decide to use a certain share of their permitted emission space to develop a bioenergy industry (resulting in some level of LUC emissions) to secure long-term domestic energy supply, or to generate export revenues.

Certification systems should not "try to do everything" and should be designed to effectively interact with other governance systems. Generally, legislation is intended to be (and needs to be) simple to apply, and it should sit at a relatively high level (i.e. create uniform regulations that can be applied at a national or international scale). Certification may serve as an on-the-ground tool that enables all actors involved in the supply chain to show compliance with legislative requirements and goals and create market incentives that recognize top performers. Additionally, these systems can decrease the administrative burden on governments by supporting the monitoring and control of implementation. Voluntary certification schemes generally are more adaptable and flexible than regulatory initiatives. Many of them revise their standards regularly. The International Organisation for Standardization (ISO), for example, reviews ISO standards every 5th year. Certification schemes can thus serve as innovative bodies to explore how sustainability requirements can promote improved performance over time by taking into account continuous scientific development and improvement of practices and based on this revise requirement levels in dialogue with stakeholders. They should complement regulations to improve awareness, facilitate discussion about the implications of certification and provide a forum for sharing information among stakeholders. However, consistent legislation and regulations supported by internationally agreed standards need to be implemented in conjunction to reach scale and create unified protection across systems, regions and countries, and reduce concerns of leakage.

Regional approaches When looking at the regional and international level, it is clear that some regions – in particular Europe and North America – already have a wide range of policies (legislation, regulations and guidelines) as well as implementation and control mechanisms in place to reasonably safeguard sustainable biomass production and regulate regional markets (although this is being challenged,

sometimes rightfully so, by environmental groups). Here we are specifically referring to regulations that apply to bioenergy, forestry and agricultural management practices and other complementary regulations such as nature and environment protection regulations, land use and related planning acts.

Problems can arise in countries that lack strong, effective governance structures (i.e. lack of enforcement and control mechanisms) or where corruption is a problem. In these countries, context-specific approaches are needed to reduce the potential negative impacts of increasing the production and use of biomass. Chain of custody certification schemes offer a potential tool for improving the sustainability of biomass production as these systems include requirements designed to improve environmental and social practices and require regular third-party auditing and verification, and are able to operate across borders.

Capacity building Many developing countries are lagging behind with regard to implementation of sustainability governance because of financial, institutional and technical capacity. The implementation of sustainability systems – as conceived by developed countries – generally will require a much bigger leap for developing countries to reach a critical threshold because of the lack of technology and capital. Such requirements for data, analysis, technology or systems that are available in some nations, but not others, could create "non-tariff barriers" to international trade. The experience from forestry has shown that the adoption of certification schemes like FSC in developing countries can take decades. Based on the experiences of certification and sustainable management of resources in developed countries, it will be important to share information and technology and support capacity building to permit developing countries to participate productively in expanding certified global markets for sustainable bioenergy. As an example, the Global Bioenergy Partnership's Working Group on Capacity Building for Sustainable Bioenergy is fostering sustainable biomass and biofuels development and deployment, particularly in developing countries where biomass use is prevalent.[11]

6.5.3 Development and Implementation of Certification Schemes

Proliferation of schemes The proliferation of certification schemes in the past years has led to competition between different schemes. This may lead to improvement in the development of standards and tools for verification and monitoring. It may also provide insight into the relative effectiveness of different schemes for sustainability certification (design, implementation constraints, cost-benefits) as

[11] See http://www.globalbioenergy.org/programmeofwork/working-group-on-capacity-building-for-sustainable-bioenergy/en/ and a framework agreed to by GBEP participants on indicators to guide and measure the government programs and policies in the development of biomass and bioenergy http://www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/Indicators/The_GBEP_Sustainability_Indicators_for_Bioenergy_FINAL.pdf

well as operational experience. The experience gained in developing schemes could also help to explore alternative models to meet sustainability goals.

On the other hand, the variety of sustainability initiatives and standards –with current lack of coherence and transparency, and considerable overlaps– may lead to confusion, lack of confidence and acceptance among the stakeholders including consumers. This may limit the effectiveness of sustainability governance, lead to a loss of clarity about the purpose, reduce participation, and cause distortion of the market. The risk is also that companies aim to use the commercially cheapest and least demanding certification scheme. 'Greenwashing' could undermine the credibility of schemes in general. With regard to the ease of scheme implementation, a good balance is needed between complexity and accessibility. If too many or overlying complex indicators are implemented, the certification process becomes too demanding, costly and difficult to manage and thus not attractive for users. Too little detail will lead to different interpretation of the principles and will raise doubts about the ability of the scheme to assure that the product and process meet the requirements of the scheme.

Consistency and recognition The main aim in the long term should be that terminology, definitions and methods converge to permit more consistency and transparency. Transboundary and trans-sector recognition would enable companies to expand market coverage without extra certification and related administrative and cost restraints. There are two types of recognition: (i) mutual recognition in the case of schemes that include the same or similar requirements (up to some level) and are implemented in an equal manner, and (ii) unilateral recognition in the case of schemes that complement each other (e.g. focus on different types of feedstock, parts of the chain and/or regions). In this way, stakeholders are not confronted with a multitude of audits and requirements depending on the type of schemes used along the supply chain or the end-use. For example, forestry or agricultural schemes could adapt to provide the necessary information required by other schemes for chain assessment, e.g. in terms of GHG emissions or land use change, or different schemes would be able to use the same chain of custody approach. There is already some movement towards recognition. Forestry schemes are accepted by ISCC; PEFC endorses numerous schemes globally. Also, RSB is in the process of recognizing other schemes. The agricultural scheme SAN by the Rainforest Alliance was benchmarked against RSB standards, and recognized by RSB as meeting them. It is important to state that this is only done when requirements are really similar between systems.

There is a need for more consistency in tools, models and guidelines used for implementation and verification. This would ensure that companies being certified are not evaluated in a manner that leads to different results for the same issue depending on the scheme or certification body. Many schemes have comparable objectives and common requirements regarding the design and setting up of infrastructure to manage these schemes. The sectors should build on experiences from forest and agricultural certification that have decades of experience in dealing with such problems.

Administrative burden and costs Certification places large demands on documentation and administrative procedures that can be costly and in particular may

present a barrier for smallholders. Some schemes already allow group or stepwise certification as a way to gradually meet the requirements and make the investments needed to meet these requirements. This way it is possible to improve towards full compliance in a pace manageable for the producers. Governments could help in promoting and initiating group certification and lowering the administrative complexity to engage more smallholders in certification, and also control that there is sufficient momentum towards full compliance.

The administrative burden can increase if different schemes are used in the same supply chain, covering particular parts of the supply chain. To alleviate this barrier, coordination and recognition (unilateral and mutual) can be a vital measure to reduce administrative requirements, as was stated before.

6.6 Conclusions

International trade is an important component in the rapidly expanding bioenergy products markets. Some countries can rely on local resources, but many rely on imports due to insufficient local supply. As the main driver for bioenergy deployment is to enable society to transform to more sustainable fuel and energy production systems, sustainability safeguards are needed, either through binding regulations and/or voluntary systems, both for domestic and imported biomass.

There is currently a high number of initiatives and a proliferation of schemes. Markets would gain from more harmonization and cross-compliance. A common language is needed as 'sustainability' of biomass involves different policy arenas and legal settings. Standardization has proven to be very important (in other sectors) to create transparent markets and thereby facilitate rational production and trade.

Design of sustainability assurance systems (both through binding regulations and voluntary certification) should take into account how markets work, in relation to different biomass applications (avoiding discrimination among end-uses and users). It should also take into account the way investment decisions are taken, administrative requirements for smallholders, and the position of developing countries. Policy pathways should be clear and predictable, and future revisions of sustainability requirements should be open and transparent.

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