



# Mapping Sustainability Criteria for the Bioeconomy

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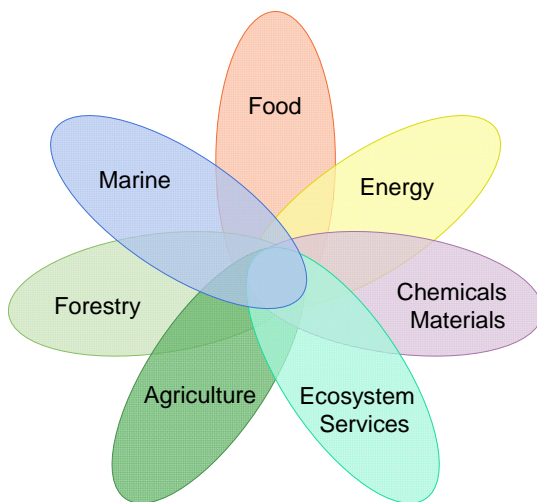
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# 1. INTRODUCTION

The bioeconomy is high on the political agenda. In 2012, the European Union and the United States proclaimed their intentions to grow their bioeconomies (European Commission, 2012; The White House, 2012). More than 30 countries have laid down their intentions to increase production of biological renewable resources (Bosch et al., 2015).

According to a definition provided by the European Commission, the bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. Thus, it includes agriculture, forestry, fisheries, food and pulp and paper production, as well as parts of chemical, biotechnological and energy industries, Figure 1 (EC, 2014).



**Figure 1. The fields of the bioeconomy (EC, 2014)**

The concept of bioeconomy is supposed to enhance a sustainable production of renewable resources into end products (European Commission, 2015) with the purpose of keeping the countries competitive, innovative, and prosperous (EuropaBio, n.d.). Bioeconomy is the transition to find possible alternatives to the petro-chemical industry. It is expected that in the coming decades an increasing proportion of chemicals, plastics, textiles, fuels and electricity will come from biomass. Because of the large scope and different drivers, the sustainability of the bioeconomy is expected to impose major sustainability challenges in relation to social, economic, and environmental aspects.

However, the main question is what sustainable means, how to assess it and which sustainability criteria should be used. According to Bosch et al. (2015), there is no consensus on what 'sustainable' means and current biomass sustainability assessments are a patchwork of voluntary standards and regulations with a lack of comparability.

A multitude of standards and certification schemes and other sustainability assessments in relation to production and use of biomass exist and operate at different scales and are led by both private and government entities. Recently, International Trade Center (ITC) launched the ITC Standards Map that provides information of over 170 standards/certification schemes that addresses sustainability in the global supply chains, which makes comparability easier. In addition to voluntary certification schemes, current policies and regulations are also setting standards and uses sustainability criteria. A broad variety of sustainability criteria have been developed and applied by

stakeholders either voluntary or mandatory regarding the type of biomass, processes, and end products. Sustainability criteria are formulated and used in the EU directives “The Renewable Energy Directive” (RED) and “Fuel Quality Directive” (FQD) (European Commission, 2015) to regulate the usage of biomass for energy production. Together they strengthen the concept of bioeconomy by controlling and promoting the usage of renewable resources for the production of bioenergy. In addition to these directives, EU’s common policies on fisheries and agriculture (CFP and CAP) are also promoting sustainable production.

According to Bosch et al. (2015), it is in everybody’s interest to harmonize sustainability standards and governments should agree on criteria and define metrics for assessing biomass sustainability which is aligned with UN’s Sustainable Development Goals that are to be decided in now in September 2015. The question is which sustainability criteria and initiatives exists in Europe for biomass for different purposes and is there a need for more harmonized sustainability criteria?

The main aim of this report is to provide an overview of the sustainability criteria linked to the production and processing of biomass for the bioeconomy, based on a qualitative survey by SCAR SWG members . This will include an overview of sustainability criteria and initiatives in the different countries and a summary of the general views with regard to sustainability criteria for the bioeconomy and the need for more standardized and coherent approach to sustainability criteria within the bioeconomy.

Eleven SCAR SWG members have answered the survey, including Denmark, Finland, Flanders, Germany, Ireland, Italy, Netherlands, Spain, Sweden, France and United Kingdom. These eleven completed questionnaires are analysed and translated into tables to give an overview (see Figure 2).



**Figure 2. A map showing the countries of the eleven SCAR SWG members who responded to the questionnaire.**

As background information we first describe the main regulatory context for biomass and present some voluntary certification schemes.

## 2. POLICY AND REGULATORY CONTEXT FOR BIOMASS

Globally and at the EU level the concept of sustainable consumption and production gains major attention. Sustainable use and production of biomass is recognized as an important mean to obtain that, and Rio+20 reinforced all parties to fully implement their commitments under the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity and the United Nations Convention to Combat Desertification. In the recent UN-report 'Global Sustainable development report (UN, 2015) is highlighted '*what to be sustained*':

### ***In relation to nature***

- *Take urgent action to combat climate change and its impacts.*
- *Conserve the oceans and marine resources for sustainable development.*
- *Protect and restore terrestrial ecosystems.*
- *Combat desertification.*
- *Halt and reverse land degradation and halt biodiversity loss.*

### ***In relation to life support***

- *Ensure sustainable consumption and production patterns.*
- *Sustainably use the oceans and marine resources for sustainable development*
- *Promote sustainable use of terrestrial ecosystems.*
- *Sustainably manage forests.*

*UN (2015)*

EU, besides formulating its own agenda, generally adhere to the global concern on sustainability of bio resources and related environmental impact, while acknowledging that there is a lack of an internationally agreed definition or universal principles for green economy. This includes a lack of clarity around what green economy policy measures encompass and address sustainability issues and how they integrate with national priorities.

Important EU regulations and support schemes in relation to production of biomass are 1) The Common Agricultural Policy- including green payment; 2) Common Fisheries Policy; and 3) Rural Development Programme. In broad terms these policies include a certain basic protection of the natural resources considered in a horizontal view – how to manage the natural base without particular attention to what the produced biomass is used for.

Other recent EU policies in this context includes:

- The Flagship initiative ‘A resource-efficient Europe’ <http://ec.europa.eu/resource-efficient-europe/> which aims to shift towards a resource-efficient, low-carbon economy to achieve sustainable growth.
- The Bioeconomy strategy adopted 2012 (European Commission, 2012) which is foreseen to contribute significantly to the objectives of the Europe 2020 flagship "A Resource Efficient Europe". The Bioeconomy Strategy and its Action Plan (Innovating for Sustainable Growth: A Bioeconomy for Europe, COM 2012) aim to pave the way to a more innovative resource efficient and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes, while ensuring environmental protection. It is here recognized that global challenges demand global solutions. Thus, the Bioeconomy Strategy supports a global approach to more sustainable resource use. This will include developing an internationally shared understanding of biomass sustainability and best practices to open new markets, diversify production and address long term food security issues.
- The EU climate and energy package 2020-2030 (<http://eur-lex.europa.eu/legal-content/DA/TXT/PDF/?uri=CELEX:52014DC0015&from=EN>) that foresee to include non-quota sectors like agriculture in achieving the reduction goals of CO<sub>2</sub> emissions.
- The EU Biodiversity strategy 2020, that acknowledge the responsibility of EU to alleviate the global biodiversity crises (<http://ec.europa.eu/environment/nature/biodiversity/comm2006/2020.htm>) and acknowledge the responsibility of EU to alleviate pressure on biodiversity emanating from the EU

Taken together a range of policies in relation to biomass **production** exists that to some extent address the global formulated challenges.

Various *mandatory* directives are aimed to control the usage of biomass to the production of bioenergy in the EU, and are as follows:

**The Renewable Energy Directive, RED (2009/28/EC)** (European Commission, 2015)

With an overall policy for the production and promotion of energy, the aim is to achieve at least 20 % of energy consumption and 10 % of transport fuel is based on renewable resources in EU by 2020. To fulfill the 10 % renewable energy target the member states of EU is only allowed to count 7 % of 1<sup>st</sup> generation biofuels (produced from sugars, oil crops, etc.) and hereby allowing 2<sup>nd</sup> and 3<sup>rd</sup> generation biofuels to count more. Individual countries can apply stricter rules.

After 2020, the governments will only financially support 2<sup>nd</sup> and 3<sup>rd</sup> generation biofuels

**Fuel Quality Directive, FQD (2009/30/EC)** (European Commission, 2015)

The aim is a reduction of greenhouse gas intensity of fuels used in vehicles by 6 % in 2020 and to regulate the sustainability of biofuels towards a greenhouse gas reduction by minimizing undesired

impacts from the production of biofuel. The greenhouse gas emission for biofuels must be 35 % lower than the replaced fossil fuel, 50 % in 2017, and from 2018 at least 60 % for new installations. Raw materials for biofuel cannot be extracted from land of high biodiversity or high carbon stock.

Thus, these policies regarding biomass for energy purposes focus on the quantified environmental impact of the biomass produced following a life cycle approach rather than regulating how and under what circumstances it is produced.

Similarly, to achieve a sustainable food consumption and production in Europe, a *voluntary* initiative has been designed and co-chaired by the European Commission and Food supply partners, termed **“The European Food Sustainable Consumption and Production (SCP) Round Table”** (FOOD-SCP, n.d.) with the following key objectives:

- To identify scientific reliable and uniform environmental assessment methodologies for food and drink products, including a product category specification based on significant impacts across the entire product life cycle.
- To identify suitable communication tools to consumers and other stakeholders.
- To promote and report continuous environmental improvement along with the food supply chain and engaging in an open dialogue with its stakeholders.

As a further development of the SCP Roundtable initiative and in the context of “Building the Single Market for Green Products - facilitating better information on the environmental performance of products and organisations’ (COM, 2013), the European Commission at present is in a process, in cooperation with many businesses, to develop methods to measure the environmental performance of products. These methods are described in The Product Environmental Footprint (PEF) Guide. The background was that existing life cycle-based standards do not provide sufficient specificity to ensure that consistent assumptions and measurements are made to potentially enable comparable environmental claims. The PEF is a multi-criteria measure of the environmental performance of goods and services from a life cycle perspective. PEF studies are produced for the overarching purpose of seeking to reduce the environmental impacts associated with goods and services, taking into account supply chain activities (from extraction of raw materials, through production and use, to final waste management). However, as mentioned, another aim is to be able to benchmark (environmentally) a product produced by different organizations and possibly in the longer term only allow environmental claims on products when based on these rules, and to use such information regarding decision on green procurement.

At the moment a number of pilots organized by DG Environment have been started in 2014 including 11 foods, feed, and drink products (e.g. feed, dairy products, meat, wine). The pilots, consisting of various stakeholders have the tasks to develop PEF’s in a process that includes public consultations and reviews by the Steering Committee of the PEF project.

In conclusion, harmonized EU- policies exist when it comes to management of land and sea resources and includes to some extent an overall protection of these natural resources. However, no harmonized framework exist when it comes to assessment of sustainable consumption – how our consumption of products based on biomass impact on central sustainability issues.

### 3. VOLUNTARY STANDARDS AND CERTIFICATION SCHEMES

To increase the sustainability of international trading products as a part of the bioeconomy, additional voluntary initiatives and certification schemes have been developed, and are either driven by private companies, public authorities, or a combination of both. The main initiatives and certification schemes regarding the trade of different agricultural food products are presented in Table 1 below (adapted from Bosselmann et al., 2015 and Knudsen et al., 2014). More information of the different certification schemes can be found at the website of ITC Standards Map (ITC, 2015) or on the websites of the different schemes:

<b>Table 1. Overview of some certification schemes and voluntary initiatives regarding trading of products</b>	
<b>Schemes</b>	<b>Aim</b>
ASC (Aquaculture Steward Council)	<ul style="list-style-type: none"> <li>To manage the global standards for responsible aquaculture (ASC, n.d.)</li> </ul>
Danube Soya Initiative	<ul style="list-style-type: none"> <li>To promote the cultivation and processing of GMO-free soya within the Danube region (Danube Soya, 2015)</li> </ul>
Fairtrade	<ul style="list-style-type: none"> <li>To promote a fair trade of food and agricultural products (Fairtrade, 2011)</li> </ul>
FSC (Forest Stewardship Council)	<ul style="list-style-type: none"> <li>To promote responsible forest management with environmental, social and economic benefits by certification (FSC, n.d.)</li> </ul>
PEFC (Programme for the Endorsement of Forest Certification)	<ul style="list-style-type: none"> <li>To promote Sustainable Forest Management (SFM) through independent third-party certification (PEFC, 2015)</li> </ul>
Global G.A.P. (Good Agricultural Practices)	<ul style="list-style-type: none"> <li>To create voluntary standards for the certification of the agricultural products and the corresponding processes (GlobalGAP, n.d.)</li> </ul>
MSC (Marine Stewardship Council)	<ul style="list-style-type: none"> <li>To promote sustainable fishing and seafood traceability by certification (Marine Stewardship Council, n.d.)</li> </ul>
Organic label	<ul style="list-style-type: none"> <li>To assure the consumer’s trust in the purchase of products in regard to organic standards and regulations (European Commission, 2014)</li> </ul>
ProTerra Foundation	<ul style="list-style-type: none"> <li>To promote practices that enhance food</li> </ul>



	security and environmental protection (ProTerra, n.d.)
Rainforest Alliance	<ul style="list-style-type: none"> <li>To conserve biodiversity and to improve livelihoods by certification of tropical products (Rainforest Alliance, 2015)</li> </ul>
RSPCA (The Royal Society for the Prevention of Cruelty to Animals)	<ul style="list-style-type: none"> <li>Animal welfare (RSPCA, n.d.)</li> </ul>
RSPO (Round Table on Sustainable Palm Oil)	<ul style="list-style-type: none"> <li>Sustainable production and processing of palm oil (RSPO, 2014)</li> </ul>
RTRS (Round Table on Responsible Soy)	<ul style="list-style-type: none"> <li>To achieve a responsible production and trade of the soy by creating certification schemes (RTRS, 2014)</li> </ul>
RSB (Roundtable on Sustainable Biomaterials)	<ul style="list-style-type: none"> <li>Provide and promote the global standard for socially, environmentally and economically sustainable production and conversion of biomass (RSB, 2015).</li> </ul>
SAI (Sustainable Agriculture Initiative Platform)	<ul style="list-style-type: none"> <li>Food and nutrient security</li> <li>Responsible water management</li> <li>Enhanced biodiversity in farm practices</li> <li>Reducing the farm level of waste</li> <li>To create a forum for harmonization of metrics used in different certification schemes to facilitate the producer (SAI, 2010)</li> </ul>
Unilever Sustainable Agriculture Code	<ul style="list-style-type: none"> <li>To reduce the environmental burden of the products of the company by 50 %</li> <li>To enhance health and well-being of over 1 billion people</li> <li>To increase the livelihood of people throughout the supply chain (Unilever, 2015)</li> </ul>

Public authorities of the different member states have acted differently to support the certification schemes and voluntary initiatives. Some of the common initiatives or actions from the public authorities regarding support and promotion of international sustainable supply chains are as follows (Van Oorshot et al., 2014):

- To create working groups involved in the process of setting standards in the procurement of imported forest or agricultural products
- To stimulate the interest of creating partnerships with regard to sustainable markets
- To enhance CSR (Corporate Social Responsibility) activities
- To create green deals with the purpose of formulating goals and obligations and to remove existing barriers

Netherlands is one of the leading countries in promoting and supporting international sustainable supply chains (Van Oorshot et al., 2014). This is reflected in their actions and experiences with the soya and palm oil chains, where the Biodiversity Policy Programme of the Netherlands have created sustainability goals in the importation of primarily soya, palm oil, and tree (Knudsen & Hermansen, 2014). Furthermore, the authorities of Netherlands do actively support RTRS and RSPO in terms of financial support to the platforms.

## 4. RESULTS FROM THE QUALITATIVE SURVEY

### 4.1 General view on sustainability criteria for the bioeconomy

In the questionnaire, the SCAR SWG members were asked to give their general views on:

- **A need for a more consistent, standardised approach** to sustainability criteria in the bioeconomy - and how to proceed (Table 2)
- Identify areas where **sustainability criteria are not compatible** between different end uses of the same biomass (Table 3)
- Identify linkages or **interrelations between voluntary and mandatory** sustainability criteria – and lessons learned (Table 4)
- Whether the sustainability criteria used are **mainly qualitative or quantitative** – and quality and availability of data (Table 5)
- **How to deal with sustainability** in the bioeconomy (Table 6)
- **Additional or new approaches** to sustainability criteria (Table 7)

The answers, ideas and views are presented in short in the following Table 2-7

The general view on whether a standardized approach to sustainability criteria across the different fields of the bioeconomy is required is summarized in Table 2 for the eleven countries included in the survey. Furthermore, to provide a major overview table 2 includes a “Yes” or “No” statement, which is linked to the more detailed answer of the question. A summarized approach on how to implement more consistency of sustainability criteria is also outlined in Table 2.

<b>Table 2. A need for a more consistent, standardised approach to sustainability criteria</b>			
<b>Country</b>	Do you see a need for a more consistent, standardized approach to sustainability criteria across the different fields of the bioeconomy?		If so, how do you suggest to proceed to make this become reality?
<b>Denmark</b>	Yes	<ul style="list-style-type: none"> <li>• Demand for a more consistent, standardized approach to sustainability criteria across different fields of bioeconomy</li> <li>• A uniform sustainability criterion for the production of all types of biomass would increase transparency for the consumer and the producer of biomass, causing a more efficient market for bio-based products</li> <li>• Major differences between forestry and agriculture which requires a special attention on storage management in forestry</li> </ul>	<ul style="list-style-type: none"> <li>• Many ongoing initiatives, be they voluntary, market based, or linked to regulation, can contribute to the implementation of a more standardized approach</li> <li>• A mapping of sustainability criteria within the bioeconomy is a good first stepping stone for more thorough analyses of sustainability criteria applied within the bioeconomy To prevent barriers for the developments of the bioeconomy market it is essential not to set the bar too high if not followed by incentives or regulation (such as mandatory targets)</li> </ul>
<b>Finland</b>	No	<ul style="list-style-type: none"> <li>• The sustainability of bioeconomy can be ensured by current criteria</li> <li>• It would be impossible to have a standardized approach to sustainability criteria for bioeconomy in EU due to differences between countries</li> <li>• Different kinds of criteria are needed for the different fields of bioeconomy</li> <li>• Suggestion of a development of existing legislation, guidelines, systems, and criteria</li> </ul>	

		before considering new ones	
<b>Flanders</b>	Yes	<ul style="list-style-type: none"> <li>• A standardized approach to sustainability criteria is needed</li> <li>• A coherent framework is required to enable cascading use.</li> <li>• The sustainability criteria for biofuels and bioliquids have to comply with the criteria set out in the Renewable Energy Directive in order to be eligible</li> <li>• Europe should have harmonized and binding sustainability criteria for all uses of biomass to avoid market distortions</li> </ul>	<ul style="list-style-type: none"> <li>• The sustainability scheme developed for the criteria for biofuels and bioliquids could be useful when building the framework for a sustainable bioeconomy</li> <li>• To align with PEF and OEF pilots in the environmental aspect of sustainability</li> <li>• To create a level playing field</li> </ul>
<b>Germany</b>	Yes	<ul style="list-style-type: none"> <li>• To level the playing field, the production of use of bio-resources would all need to be governed by a sustainability criteria</li> </ul>	<ul style="list-style-type: none"> <li>• Demand for a differentiated level of sustainability among fields of the bioeconomy</li> </ul>
<b>Ireland</b>	Yes	<ul style="list-style-type: none"> <li>• A standardized sustainability criterion enables comparisons across countries, sectors, and fields of the bioeconomy</li> <li>• A standardized approach may provide a mechanism for regulating behavior and effectively managing social impact, including the transition to a more sustainable, low-environmental-impact cycle of production and consumption</li> <li>• However, a uniform sustainability criterion may face challenges regarding diversity inherent within the bioeconomies, e.g. different trade-offs and aspects of sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Suggestion of making a comparable Sustainability Rating method using qualitative and quantitative factors that allow adjustment to changing market conditions</li> <li>• The Sustainability Rating method is useful in a clear, transparent, and manageable context</li> </ul>

<b>Italy</b>	No	<ul style="list-style-type: none"> <li>• Bioeconomy is divided into two streams (Production of raw material and transformation)</li> <li>• There are no uniform criteria for the fields of bioeconomy</li> </ul>	
<b>Netherlands</b>	Yes	<ul style="list-style-type: none"> <li>• Every field of bioeconomy possess sustainability criteria, or is in preparation to possess</li> <li>• Adding up the criteria for every field would not be workable for especially SME's</li> </ul>	<ul style="list-style-type: none"> <li>• To focus on the connection between the fields of the bioeconomy</li> </ul>
<b>Spain</b>	Yes	<ul style="list-style-type: none"> <li>• Only considering sustainability in an environmental perspective</li> </ul>	<ul style="list-style-type: none"> <li>• To establish the definition of sustainability considering the social and economic approaches</li> <li>• To measure sustainability, a definition of indicators adopted by consensus between the different agricultural systems is an important task</li> </ul>
<b>Sweden</b>	No	<ul style="list-style-type: none"> <li>• A universal approach should not be standardized due to different conditions and variables</li> <li>• A standardized approach includes many negative side effects</li> <li>• Sweden has implemented general policy instruments creating cost-efficiency and low market distortion</li> <li>• To provide consistency in the formulation of the end-goals, common principles, comparability in reporting and benchmarking on chains-of custody are more important elements than a standardized approach</li> </ul>	
<b>United Kingdom</b>	Yes	<ul style="list-style-type: none"> <li>• Recognize the importance of a sustainable approach to all sectors of the bioeconomy</li> <li>• Working on a new bioeconomy policy</li> </ul>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>

		which includes three leadership forums to coordinate activities <ul style="list-style-type: none"> <li>• Moving to a more tunable and coordinate cross-government approach</li> </ul>	
<b>France</b>	Yes	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Due to a high diversity of local contexts – a results-based principle is better than a means-based principle</li> <li>• We need general criteria, based on expected results in order to define specific criteria adapted to the local context.</li> <li>• When results are difficult or too long to be measured (e.g. groundwater quality), action criteria have to be defined.</li> <li>• France takes part in the European Standardisation Committee work on sustainability criteria for biobased products.</li> </ul>

When assessing areas where sustainability criteria are not compatible between different end uses of the same biomass, Table 3 gives an overview of responses from different countries. Table 3 also provides a greater overview in terms of “Yes” or “No” statements to the asked question.

<b>Table 3. Areas where sustainability criteria are not compatible</b>		
<b>Country</b>	Do you find areas where the sustainability criteria are not compatible between different end uses of the same biomass (maybe even impacting cascading uses of the biomass)? If so please describe below.	
<b>Denmark</b>	Yes	<ul style="list-style-type: none"> <li>• Lack of binding sustainability criteria for solid and gaseous biomass for electricity, heating and cooling at EU level</li> </ul>
<b>Finland</b>	Yes	<ul style="list-style-type: none"> <li>• The sustainability criteria are different for usage of biomass for transport biofuels than for other forms of end use</li> </ul>
<b>Flanders</b>	Yes	<ul style="list-style-type: none"> <li>• Binding sustainability criteria for biofuels and bioliquids, but not for solid and gaseous biomass used for electricity, heating, and cooling</li> <li>• A minimum set of sustainability criteria should apply to biomass regardless the end use</li> <li>• Energy policy, when not developed in a broader coherent perspective on sustainable bioeconomy can impact cascading uses of biomass</li> </ul>
<b>Germany</b>	Yes	<ul style="list-style-type: none"> <li>• Challenges within the RED (e.g. different sources of bio-resources for the production of biofuels)</li> </ul>

		<ul style="list-style-type: none"> <li>• Cascading use can be impacted by the regulation on fertilizers and the waste regulations</li> </ul>
<b>Ireland</b>	Yes	<ul style="list-style-type: none"> <li>• 1<sup>st</sup> generation biomass for biofuels vs. bio chemicals</li> <li>• Demand for a flexible mechanism to assist the management of the allocation of 1<sup>st</sup> generation biomass between food and other uses</li> <li>• Minimum energy efficiency criteria for CHP, but no efficiency measures applied for other bio-products</li> </ul>
<b>Italy</b>	Yes	<ul style="list-style-type: none"> <li>• Methane production or heat production from the same vegetal matrix cannot be evaluated with the same criteria</li> </ul>
<b>Netherlands</b>	Yes	<ul style="list-style-type: none"> <li>• Concerning animal welfare the cows should be outside, but concerning GHG emission the cows should be inside</li> </ul>
<b>Spain</b>	Yes	<ul style="list-style-type: none"> <li>• The use of foreign species to produce biomass if their environmental impact have not been analysed</li> </ul>
<b>Sweden</b>	-	<ul style="list-style-type: none"> <li>• Not applicable</li> </ul>
<b>United Kingdom</b>	Yes	<ul style="list-style-type: none"> <li>• Energy from waste is ‘counted’ as recycling, this amalgamation is not useful because it implies to the public higher recycling rates than are actually occurring</li> </ul>
<b>France</b>	Yes	<ul style="list-style-type: none"> <li>• Toxicological criteria are not the same for food and biomaterials uses.</li> <li>• For all criteria, we stress the importance of stating the assumptions so a knowledge-based assessment could be facilitated.</li> <li>• There is a dilemma when two criteria cannot be satisfied by a given action (e.g. climate effects and animal welfare for cattle). Could it be possible to have a weighting of criteria?</li> </ul>

Table 4 summarizes the responses with regard to identification of linkages and interrelations between voluntary and mandatory sustainability criteria by an overview of their responses as a “Yes” or “No” with supplementary comments.

<b>Table 4. Linkages or interrelations between voluntary and mandatory sustainability criteria</b>		
<b>Country</b>	Do you see any linkages or interrelations between voluntary and mandatory sustainability criteria – any lessons learnt?	
<b>Denmark</b>	Yes	<ul style="list-style-type: none"> <li>• Voluntary criteria can inspire or even become mandatory criteria</li> <li>• As voluntary sustainability criteria become more solid they get support from the governments</li> <li>• Voluntary schemes can strengthen the understanding and recognition of the importance of applying responsible management practices, which can lead to a positive approach to comply with legislation</li> </ul>
<b>Finland</b>	Yes	<ul style="list-style-type: none"> <li>• National and EU legislation create a framework for mandatory actions, while various kinds of market-driven sustainability and traceability systems create voluntary actions</li> </ul>
<b>Flanders</b>	Yes	<ul style="list-style-type: none"> <li>• Voluntary sustainability criteria with enough public attention could lead to higher standards of mandatory sustainability criteria</li> </ul>

<b>Germany</b>	-	<ul style="list-style-type: none"> <li>No answer</li> </ul>
<b>Ireland</b>	Yes	<ul style="list-style-type: none"> <li>Mandatory and voluntary quality assurance schemes widespread in the food industry can be informative</li> <li>Voluntary schemes tend to be market oriented and by time become a part of the mandatory schemes</li> </ul>
<b>Italy</b>	Yes	<ul style="list-style-type: none"> <li>Carbon credits</li> </ul>
<b>Netherlands</b>	Yes/No	<ul style="list-style-type: none"> <li>Ecological agriculture that is voluntary but with a government controlled set of criteria</li> </ul>
<b>Spain</b>	No	<ul style="list-style-type: none"> <li>Mandatory criteria should not be applied in the broad European agricultural systems</li> <li>Voluntary criteria is implemented now</li> </ul>
<b>Sweden</b>	No	<ul style="list-style-type: none"> <li>Mandatory is through laws and regulations and shall only be used when the market fails in addressing certain issues</li> </ul>
<b>United Kingdom</b>	-	<ul style="list-style-type: none"> <li>Hard to comment on the whole of the bioeconomy</li> </ul>
<b>France</b>	Yes	<ul style="list-style-type: none"> <li>A political consensus in EU is needed on minimum requirements for safety, for the environment protection, and for the economical and societal aspects (the “good”). This minimum should be mandatory so that the general purpose is collectively shared.</li> <li>Moreover, firms/territories may have differentiation criteria (the “better”), but there is a need for a control of conditions and justification of these claims (possibility of environmental or social claims, similar to nutrition claims on food).</li> <li>Voluntary and mandatory criteria are both needed, but with a clear distinction between the two, and in a framework allowing articulations and evolutions.</li> <li>Voluntary sustainability criteria like standards allow firms to promote positive externalities, which increases competitiveness of sustainable industrial activities and products.</li> </ul>

Whether the countries are using sustainability criteria as qualitative and/or quantitative are assessed in table 5, which includes a summary of the general views and additional comments on the quality and availability of the data for the criteria.

<b>Table 5. Qualitative or quantitative sustainability criteria</b>		
<b>Country</b>	Are the sustainability criteria being used mainly qualitative and/or quantitative?	Do you have comments on the quality and availability of data for these criteria?
<b>Denmark</b>	<ul style="list-style-type: none"> <li>Criteria mainly quantitative, but it can be mixed</li> <li>Criteria for sustainable timber is mainly quantitative</li> </ul>	<ul style="list-style-type: none"> <li>Demand for more transparency</li> </ul>
<b>Finland</b>	<ul style="list-style-type: none"> <li>Usage of both qualitative and quantitative criteria for assessing the sustainability of forest biomass production</li> <li>Qualitative criteria can be converted into quantitative ones and</li> </ul>	<ul style="list-style-type: none"> <li>Information is available on a general level for all raw materials</li> </ul>



	vice versa	
<b>Flanders</b>	<ul style="list-style-type: none"> <li>• Usage of both qualitative and quantitative sustainability criteria in the green certificate system for renewable power</li> </ul>	<ul style="list-style-type: none"> <li>• Quantitative criteria are important to stimulate continuously to approve processes</li> </ul>
<b>Germany</b>	<ul style="list-style-type: none"> <li>• Sustainability criteria are mainly used as quantitative</li> <li>• Qualitative criteria are important for the food production</li> </ul>	<ul style="list-style-type: none"> <li>• Qualitative criteria should be integrated in future food production</li> </ul>
<b>Ireland</b>	<ul style="list-style-type: none"> <li>• Quantitative criteria are mainly used in the marine sector</li> </ul>	<ul style="list-style-type: none"> <li>• Little data available regarding seaweeds</li> <li>• Availability of data is a challenge, but research is underway</li> </ul>
<b>Italy</b>	<ul style="list-style-type: none"> <li>• Qualitative criteria cannot be general</li> <li>• A focus on specific criterion is better</li> </ul>	<ul style="list-style-type: none"> <li>• Assessment of CO2 is impossible in practice, but its estimation is easier</li> </ul>
<b>Netherlands</b>	<ul style="list-style-type: none"> <li>• Usage of qualitative and quantitative criteria is determined by the type of field</li> </ul>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
<b>Spain</b>	<ul style="list-style-type: none"> <li>• Awareness of qualitative and quantitative criteria</li> <li>• First approach has been qualitative</li> <li>• Searching for quantitative indicators</li> </ul>	<ul style="list-style-type: none"> <li>• No general knowledge on the qualitative and quantitative approach so far</li> </ul>
<b>Sweden</b>	<ul style="list-style-type: none"> <li>• Usage of both qualitative and quantitative criteria within the sustainable forest management</li> <li>• The environmental quality objectives to solve major environmental problems are qualitative by nature</li> </ul>	<ul style="list-style-type: none"> <li>• The FOREST EUROPE criteria and indicators were used as a basis for development of the certification platform</li> </ul>
<b>United Kingdom</b>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>	<ul style="list-style-type: none"> <li>• Life Cycle Analysis is a common tool for assessing the sustainability of a process, but no standard model is available across all the bioeconomy sector</li> </ul>
<b>France</b>	<ul style="list-style-type: none"> <li>• Quantitative criteria seem comfortable, but fixing some cut-off levels do not allow to conform regulations to the diversity of situations in the field of life and local ecosystems (agronomy, terroirs, social facts, etc.).</li> <li>• That's why we would prefer qualitative criteria at a EU level, which determine how to fix quantitative criteria at a local level (subsidiarity principle).</li> <li>• Nevertheless, for some main subjects (e.g. greenhouse gases) quantitative minimal criteria should be shared, and they should have a holistic approach of the whole life-cycle of a given process.</li> </ul>	<ul style="list-style-type: none"> <li>•</li> </ul>

Table 6 and 7 provide an overview of the responses regarding creative ideas and additional approaches in relation to sustainability criteria.

<b>Table 6. How to deal with sustainability</b>	
<b>Country</b>	Do you have any creative ideas on how to deal with sustainability along parts of the bioeconomy?
<b>Denmark</b>	<ul style="list-style-type: none"> <li>• Easy available universally recognized LCA methods which potentially could include ILUC at some stages</li> <li>• The UN Global Compact Integrated Sustainable Agriculture Programme (ISAP) has an interesting way of creating a platform for easy comparison of standards, including sustainability criteria</li> </ul>
<b>Finland</b>	<ul style="list-style-type: none"> <li>• Demand for policy coherence in a holistic view</li> <li>• Creation of an assessment framework showing the significance of the bioeconomy sector relative to other raw materials (fossil economy)</li> </ul>
<b>Flanders</b>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
<b>Germany</b>	<ul style="list-style-type: none"> <li>• Different use chains would need to be certified starting with some more generic soft criteria</li> </ul>
<b>Ireland</b>	<ul style="list-style-type: none"> <li>• A measurement approach of waste within the bioeconomy to assess possible positive or negative contributions in an economic/social/environmental perspective, including stakeholder involvement</li> </ul>
<b>Italy</b>	<ul style="list-style-type: none"> <li>• Programs to calculate LCA provide a graphic that indicate the weight of each stage of bioeconomy</li> </ul>
<b>Netherlands</b>	<ul style="list-style-type: none"> <li>• Suggestions on looking at fundamental values all fields need to apply to, e.g. a “license to produce”</li> <li>• Producers need to prove what they claim, e.g. if the product is claimed to be good for climate, the producer has to prove it</li> </ul>
<b>Spain</b>	<ul style="list-style-type: none"> <li>• The same sustainability criteria in agrifood systems must be used for general bioeconomy</li> <li>• Consideration of a European agreement of the areas to define environmental sustainability based on scientific consensus</li> </ul>
<b>Sweden</b>	<ul style="list-style-type: none"> <li>• Multilateral solutions within and outreach between sectors</li> <li>• The sustainable development goals and targets from the UN regarding the post-2015 agenda should form a baseline for further work on the bioeconomy</li> </ul>
<b>United Kingdom</b>	<ul style="list-style-type: none"> <li>• Development of a sustainability tool “Horizons” which highlights the sustainability factors and help companies assessing how to become more sustainable</li> </ul>
<b>France</b>	<ul style="list-style-type: none"> <li>• The bioeconomy viability depends firstly on the viability of living systems that it uses, and secondly on the capacity of industrial systems to adapt themselves to cycles and viability requirements of living systems. This is not the case when raw materials or processors are issued from industrial processes. So, the sustainability criteria of the bioeconomy have to take into account this main difference between the two sides of the bioeconomy.</li> <li>• Each activity which uses biological resources consists in a derivation of organic matter normally involved in ecosystem cycles. The bioeconomy has to pay a special attention to the closing the loop of this biological cycles, instead of creating</li> </ul>

linear chains producing waste.

**Table 7. Additional or new approaches to sustainability criteria**

Country	Do you have additional approaches to sustainability criteria or do you foresee new approaches to guarantee the sustainability of biomass (e.g. changes in legislation etc)?
<b>Denmark</b>	<ul style="list-style-type: none"> <li>• Broader group certification or documentation of compliance at landscape level could be an option in the future</li> <li>• The ICT Standards Map could become a useful tool</li> <li>• Approaches and tools to provide sustainability assurance to forests and their products</li> </ul>
<b>Finland</b>	<ul style="list-style-type: none"> <li>• National legislation supports new bioeconomy innovations by updates from new research information, development of society, and other changes that ensure sustainability</li> </ul>
<b>Flanders</b>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
<b>Germany</b>	<ul style="list-style-type: none"> <li>• Take into account the quality of the food and/or the item of traditional food</li> <li>• Using food from a local region could be more sustainable (transport reduction)</li> </ul>
<b>Ireland</b>	<ul style="list-style-type: none"> <li>• New approaches will evolve as more knowledge becomes available</li> <li>• Suggestion of investments in smart technologies</li> </ul>
<b>Italy</b>	<ul style="list-style-type: none"> <li>• The distance from biomass production site and the transformation plant should be 0 km to reduce environmental impacts</li> </ul>
<b>Netherlands</b>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
<b>Spain</b>	<ul style="list-style-type: none"> <li>• Won't accept an introduction of "this subject" into legislation without scientific or technical consensus</li> </ul>
<b>Sweden</b>	<ul style="list-style-type: none"> <li>• Suggesting plurality in the approaches to sustainability, both political and economic</li> </ul>
<b>United Kingdom</b>	<ul style="list-style-type: none"> <li>• The three leadership Forums are newly formed and is expected to drive the bioeconomy innovation</li> </ul>
<b>France</b>	<ul style="list-style-type: none"> <li>• The bioeconomy needs efforts in the general and local consistency (e.g. short time to market or territorialized approaches applied to processing and marketing).</li> <li>• High diversity of plants production contexts induces difficulties for having LCA criteria making sense for the biological part of bio-products production. For this reason, a specific approach of the assessment of the raw materials production has to be preferred to classical LCA approaches and must be elaborated.</li> <li>• A need for allowing and facilitating technical adaptations (cut-off levels, parameters...), and a need for allowing adaptation of the whole regulatory framework</li> </ul>

## 4.2 Overview of sustainability criteria and initiatives

### 4.2.1 Bioenergy

Table 8 summarises the responses with regard to voluntary or mandatory sustainability criteria and initiatives used in their country concerning bioenergy. The type of bioenergy and biomass related to the criteria and initiatives is also stated.

<b>Table 8. Bioenergy - Overview of sustainability criteria and initiatives</b>			
<b>Country</b>	<b>Sustainability criteria and initiatives</b>	<b>Types of bioenergy</b>	<b>Types of biomass</b>
Denmark Flanders Germany Ireland Netherlands Sweden France	<ul style="list-style-type: none"> <li>Renewable Energy Directive (RED) 2009/28/EG</li> </ul>	<ul style="list-style-type: none"> <li>Biofuel</li> <li>Biodiesel</li> <li>Bioethanol</li> <li>Liquid biomass</li> <li>Liquid biofuel to electricity</li> <li>Transport biofuel</li> <li>Solid biomass for heat</li> </ul>	<ul style="list-style-type: none"> <li>Cereal</li> <li>Sugar beet</li> <li>Oil seeds</li> <li>Corn</li> <li>Tallow</li> <li>Rapeseed</li> <li>Recovered cooking oil</li> <li>Imported biomass</li> <li>Wood</li> <li>Palm oil</li> <li>Animal residues</li> </ul>
Denmark	<ul style="list-style-type: none"> <li>Voluntary industry agreement on sustainable biomass (wood chips and pellets)</li> </ul>	<ul style="list-style-type: none"> <li>Heating</li> <li>Electricity</li> <li>Biogas</li> <li>Biofuels</li> </ul>	<ul style="list-style-type: none"> <li>Wood chips and pellets</li> <li>Firewood</li> <li>Straw</li> <li>Manure</li> <li>Energy crops</li> <li>Biodegradable waste</li> </ul>
Denmark Finland	<ul style="list-style-type: none"> <li>FSC (Forest Stewardship Council)</li> </ul>	<ul style="list-style-type: none"> <li>Heat, power, biofuels and bioliquids</li> </ul>	<ul style="list-style-type: none"> <li>Forest industry side-streams</li> <li>Forest chips</li> </ul>

	<ul style="list-style-type: none"> <li>• PEFC (The Programme for the Endorsement of Forest Certification)</li> </ul>	<ul style="list-style-type: none"> <li>• Forest industry side-streams</li> <li>• Firewood</li> <li>• Arable energy</li> <li>• Animal manure</li> <li>• Biogas</li> <li>• Food industry side-streams</li> <li>• Transport biofuels</li> <li>• Paper</li> <li>• Furniture</li> <li>• Construction works</li> </ul>	<ul style="list-style-type: none"> <li>• Household small scale use of wood</li> <li>• Recycled timber</li> </ul>
Finland Ireland	<ul style="list-style-type: none"> <li>• RES (Renewable Energy Strategies)</li> </ul>	<ul style="list-style-type: none"> <li>• Transport biofuel</li> </ul>	
Flanders	<ul style="list-style-type: none"> <li>• Sustainability declaration for agricultural products</li> </ul>	<ul style="list-style-type: none"> <li>• Biofuel</li> </ul>	<ul style="list-style-type: none"> <li>• Classical large scale crops as sugar beet, oil seeds, and corn</li> </ul>
Flanders	<ul style="list-style-type: none"> <li>• National decision tools</li> </ul>	<ul style="list-style-type: none"> <li>• Bio transport fuel</li> <li>• Bioliquids</li> <li>• Solid biomass</li> </ul>	<ul style="list-style-type: none"> <li>• Wood</li> </ul>
Germany	<ul style="list-style-type: none"> <li>• ISCC (International Sustainability &amp; Carbon Certification)</li> </ul>	<ul style="list-style-type: none"> <li>• Electricity</li> <li>• Heat</li> <li>• Biofuels</li> <li>• Biogas</li> <li>• Biomethane</li> <li>• Biomass heat plants</li> </ul>	<ul style="list-style-type: none"> <li>• Starch crops</li> <li>• Sugar crops</li> <li>• Rapeseed oil</li> <li>• Sunflower oil</li> <li>• Linseed oil</li> <li>• Fibre plants</li> <li>• Medical plants</li> </ul>

Ireland	<ul style="list-style-type: none"> <li>• WFQA (Wood Fuel Quality Assurance Scheme)</li> </ul>	<ul style="list-style-type: none"> <li>• Heat</li> <li>• CHP</li> <li>• Power</li> <li>• Waste to energy – CHP</li> <li>• Waste to energy – Power</li> <li>• Electricity co-firing</li> <li>• AD</li> <li>• Landfill gas</li> <li>• Biofuels</li> </ul>	<ul style="list-style-type: none"> <li>• Wood chip firewood pellets and briquettes</li> </ul>
Ireland	<ul style="list-style-type: none"> <li>• Development of certification of gaseous fuels (proposed)</li> </ul>	<ul style="list-style-type: none"> <li>• Gaseous biofuel</li> </ul>	<ul style="list-style-type: none"> <li>• Animal manure</li> <li>• Food waste</li> <li>• Municipal waste</li> <li>• Agri-food residues</li> </ul>
Italy	<ul style="list-style-type: none"> <li>• Bioenergy Sector Plan</li> </ul>	<ul style="list-style-type: none"> <li>• Biofuel</li> <li>• Bioliquids</li> <li>• Biogas</li> <li>• Biomethane</li> </ul>	<ul style="list-style-type: none"> <li>• Residual biomass from the agro-forestry sector</li> </ul>
Netherlands	<ul style="list-style-type: none"> <li>• Standards NTA 8080 and 8081 for sustainable biomass for energy purposes (green deal)</li> </ul>	<ul style="list-style-type: none"> <li>• Biofuels</li> <li>• Bioliquids</li> <li>• Ethanol biodiesel</li> </ul>	<ul style="list-style-type: none"> <li>• Imported biomass</li> <li>• Wood</li> <li>• Palm oil</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>• The Industrial Biotechnology Leadership Forum</li> </ul>	<ul style="list-style-type: none"> <li>• Biomass CHP</li> <li>• Energy from waste</li> <li>• AD</li> <li>• Small scale pyrolysis</li> </ul>	<ul style="list-style-type: none"> <li>• Wood pellets</li> <li>• Green waste briquettes and food waste</li> </ul>
France	<ul style="list-style-type: none"> <li>• 2bsvs certification (voluntary scheme mandatory to obtain the French tax benefit measures on biofuels)</li> </ul>	<ul style="list-style-type: none"> <li>• Biofuel</li> </ul>	<ul style="list-style-type: none"> <li>• Rape, beetroot</li> </ul>

Additionally concerning bioenergy, an overview of the public authorities' role is provided in table 9. The public authorities' role can be described through information about legislations, Green Public Procurement subsidies, and taxes.

<b>Table 9. Bioenergy – Overview of the public authorities' role and further observations or suggestions</b>		
<b>Country</b>	What has been the role of public authorities in your MS with regards to sustainability criteria (legislation, Green Public Procurement subsidies, taxes, other)?	Do you have observations or suggestions with regards to the use of the above mentioned sustainability criteria?
Denmark	<ul style="list-style-type: none"> <li>• The voluntary agreement on woody biomass is an industry led initiative and has support from the government</li> <li>• The public authorities are not directly involved</li> <li>• Guidelines and rules for public procurement of timber has been used to promote sustainable forest management</li> <li>• The Danish Ministry of Environment, Nature Agency supports the development of green management plans in private forestry</li> </ul>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
Finland	<ul style="list-style-type: none"> <li>• The bioenergy production has been steered through legislation and supervision of the law, guidelines, education and training, advice, dissemination of good practices, support systems and as a part of the policy to promote renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>• The key issue is to ensure that an increase in renewable energy takes place in an economically, socially and environmentally sustainable matter</li> <li>• Criteria for biomass production must be the same as those for the other forms of end use of biomass</li> <li>• Important that bioenergy do not produce higher GHG emissions it its lifecycle than fossil fuels</li> <li>• Rely on current systems and criteria, to be developed if necessary</li> <li>• No obstacles to bioenergy production and market development should be created through EU legislation</li> <li>• Avoid unnecessary administration and monitoring in all actions to verify the sustainability of bioenergy</li> <li>• The sustainability of biomass should be tackled in a holistic and systemic way without introducing separate sustainability schemes for one particular end use of</li> </ul>

		biomass
Flanders	<ul style="list-style-type: none"> <li>• Sustainability criteria for electricity with a goal of 100 % green energy conform to the RED</li> </ul>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
Germany	<ul style="list-style-type: none"> <li>• No answer</li> </ul>	<ul style="list-style-type: none"> <li>• GBEP (Global Bioenergy Partnership) is an interesting initiative</li> <li>• IEA Bioenergy task 40 (Sustainable International Bioenergy Trade: Securing Supply and Demand) and task 43 (Biomass Feedstocks for Energy Markets)</li> </ul>
Ireland	<ul style="list-style-type: none"> <li>• Regulation of biofuels blending obligation</li> <li>• Removal of excise tax regime in the production of biofuels</li> <li>• Recent approval of preferential excise tax regime in the use of gaseous fuels</li> <li>• NREAP (National Renewable Action Plan)</li> <li>• A new green public procedure launched by the Green Technologies Department of Enterprise Ireland</li> <li>• Renewable Heat policies</li> <li>• National Renewable Energy Action Plan submitted under RED</li> <li>• Local Authority Renewable Energy Strategies is implemented and developed by the local authorities</li> <li>• SEAI (The Sustainable Energy Ireland)</li> <li>• The Biogas Industry</li> <li>• SFI (Science Foundation Ireland) and MaREI (Marine Renewable Energy Ireland) are public funded research</li> <li>• ATBEST (Advanced technologies for biogas efficiency sustainability and transport)</li> <li>• The Animal &amp; Grassland Research and Innovation Centre Teagasc</li> <li>• ERI (The Environmental Research Institute)</li> <li>• UCC (University College Cork)</li> <li>• The Irish Gas Grid</li> </ul>	<ul style="list-style-type: none"> <li>• Highly biodiverse grassland, as stated in the RED, has not yet been fully defined by the European Commission</li> <li>• Biomass shall be produced in an environmentally responsible way, including protection of soil, water and air and the application of G.A.P.</li> <li>• A policy that promotes indigenous production, with introduction of mechanisms to protect the supplies of feedstock available for use as a food source, makes more sense</li> <li>• The lack of heat demand and communal heat distribution infrastructure has been a big barrier to compliance with the High Efficiency CHP criteria. Adapting the high efficiency criteria to reflect market circumstances would spur development of a very big industry</li> </ul>
Italy	<ul style="list-style-type: none"> <li>• To meet the sustainability criteria the public authorities have defined measurements as Legislation, Green Public, Procurement subsidies and taxes</li> </ul>	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
Netherlands	<ul style="list-style-type: none"> <li>• Mandatory blend, subsidies for co-firing</li> </ul>	<ul style="list-style-type: none"> <li>• The Cramer Commission published a list of sustainable</li> </ul>



		principles for the use of biomass for energy which is partially covered by the RED
Spain	<ul style="list-style-type: none"> <li>The general legislation applied in Spain is the general EU legislation translated into national and regional legislation</li> </ul>	<ul style="list-style-type: none"> <li>No answer</li> </ul>
Sweden	<ul style="list-style-type: none"> <li>No answer</li> </ul>	<ul style="list-style-type: none"> <li>No answer</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>There exists a number of financial incentives to encourage organisations to move towards more sustainable, low carbon energy sources including Contracts for Difference and the RHI (Renewable Heat Incentives)</li> </ul>	<ul style="list-style-type: none"> <li>RHI sustainability requirements:</li> <li>60 % GHG saving when comparing GHG emission for cultivation, processing and transport to EU average fossil fuel heating emissions</li> <li>Equates to life cycle GHG emission &lt; 34.8 g CO<sub>2</sub>/MJ</li> <li>Sustainability requirements for land-use, including biodiversity and carbon stock criteria</li> </ul>

#### 4.2.2 Food

Table 10 summarises the responses with regard to voluntary or mandatory sustainability criteria and initiatives used in their country concerning food. Table 10 also includes the type of food and biomass related to the criteria and initiatives.

<b>Table 10. Food - Overview of sustainability criteria and initiatives</b>			
<b>Country</b>	<b>Sustainability criteria and initiatives</b>	<b>Types of food</b>	<b>Types of biomass</b>
Denmark Germany France	<ul style="list-style-type: none"> <li>Organic</li> </ul>	<ul style="list-style-type: none"> <li>All food</li> </ul>	
Denmark	<ul style="list-style-type: none"> <li>MSC (Marine Stewardship Council)</li> </ul>	<ul style="list-style-type: none"> <li>Wild caught seafood</li> </ul>	<ul style="list-style-type: none"> <li>Wild Seafood</li> </ul>
Denmark	<ul style="list-style-type: none"> <li>RSPO (Roundtable on Sustainable Palm Oil)</li> </ul>	<ul style="list-style-type: none"> <li>All food containing palm oil</li> </ul>	<ul style="list-style-type: none"> <li>Palm oil</li> </ul>

Finland	<ul style="list-style-type: none"> <li>• Rural Development programme relating to sustainability of food</li> <li>• National programme to promote Sustainable Consumption and Production</li> </ul>	<ul style="list-style-type: none"> <li>• All food</li> </ul>	<ul style="list-style-type: none"> <li>• Cereals</li> <li>• Grass biomass</li> <li>• Potato</li> </ul>
Flanders	<ul style="list-style-type: none"> <li>• Transformation project: sustainable food chain</li> <li>• Vegaplan</li> <li>• Food chain consultation platform</li> </ul>	<ul style="list-style-type: none"> <li>• Dairy</li> <li>• Products derived from cocoa</li> <li>• Potato preparations</li> <li>• Pork</li> <li>• Beer</li> <li>• Frozen vegetables</li> <li>• Oil products</li> <li>• Fresh vegetables</li> <li>• Cereals in grain</li> <li>• Oilseeds</li> <li>• Apples and pears</li> <li>• Fish</li> <li>• Beet and cane sugar</li> </ul>	<ul style="list-style-type: none"> <li>• Potatoes</li> <li>• Cereals</li> <li>• Sugar beets</li> <li>• Vegetables</li> <li>• Fruit</li> <li>• Pig</li> <li>• Cattle</li> </ul>
Flanders Ireland Italy Sweden	<ul style="list-style-type: none"> <li>• GPP (Green Public Procurement) criteria</li> </ul>		
Germany	<ul style="list-style-type: none"> <li>• Demeter</li> <li>• Bioland</li> <li>• Naturland</li> <li>• Ecoland</li> <li>• Ecovin</li> <li>• Gäa</li> <li>• ISCC</li> </ul>		

Ireland	<ul style="list-style-type: none"> <li>• Origin Green</li> </ul>	<ul style="list-style-type: none"> <li>• Beef</li> <li>• Dairy</li> <li>• Lamb</li> <li>• Pig meat</li> <li>• Poultry</li> <li>• Grain</li> </ul>	<ul style="list-style-type: none"> <li>• Grass</li> </ul>
Ireland	<ul style="list-style-type: none"> <li>• Teagasc Strategic Alliance in Food Research</li> <li>• Moorepark Technology Ltd and Dairy Industry</li> <li>• DAWN MEATS &amp; Teagasc</li> </ul>	<ul style="list-style-type: none"> <li>• Milk</li> <li>• Cheese</li> <li>• Butter</li> <li>• Infant formula</li> </ul>	
Ireland	<ul style="list-style-type: none"> <li>• CFP (Common Fisheries Policy)</li> </ul>	<ul style="list-style-type: none"> <li>• Functional foods from algae</li> <li>• Fish and protein extracts</li> </ul>	<ul style="list-style-type: none"> <li>• Brown macroalgae</li> <li>• Crab and prawn shell materials</li> </ul>
Ireland	<ul style="list-style-type: none"> <li>• MFSD (Marine Strategy Framework Directive)</li> </ul>	<ul style="list-style-type: none"> <li>• Marine</li> <li>• Whitefish</li> <li>• Prawn</li> </ul>	
Ireland	<ul style="list-style-type: none"> <li>• GES (Good Environmental Status)</li> </ul>		
Italy Flanders	<ul style="list-style-type: none"> <li>• Renewable Energy Directive (RED) 2009/28/EG</li> </ul>	<ul style="list-style-type: none"> <li>• All food</li> </ul>	
Italy	<ul style="list-style-type: none"> <li>• Preservation and promotion of biodiversity and ecosystems</li> <li>• Promotion of an efficient energy system</li> <li>• Adoption of sustainable production methods</li> <li>• Establishment of short supply chains</li> <li>• Reduction of waste in all steps of the food supply chain</li> </ul>	<ul style="list-style-type: none"> <li>• All food</li> </ul>	
Netherlands	<ul style="list-style-type: none"> <li>• Ik kies bewust</li> <li>• Gezonde Keuze</li> <li>• Keurmark for vegetarian products</li> </ul>	<ul style="list-style-type: none"> <li>• All food</li> </ul>	<ul style="list-style-type: none"> <li>• Milk</li> <li>• Meat</li> <li>• Horticulture</li> </ul>

	<ul style="list-style-type: none"> <li>• Halal Correct</li> <li>• Glutenvrij</li> </ul>		<ul style="list-style-type: none"> <li>• Sugar</li> <li>• Potatoes</li> </ul>
Sweden	<ul style="list-style-type: none"> <li>• National food industry organization</li> </ul>	<ul style="list-style-type: none"> <li>• All food</li> </ul>	<ul style="list-style-type: none"> <li>• Not known</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>• Agriculture Leadership Forum</li> </ul>	<ul style="list-style-type: none"> <li>• Various types of food</li> </ul>	
France	<ul style="list-style-type: none"> <li>• High Environmental Quality Certification for farms</li> </ul>		<ul style="list-style-type: none"> <li>• All crops</li> </ul>

Furthermore, an overview of the public authorities' role regarding food is provided in table 11. The public authorities' role can be described through information about legislations, Green Public Procurement subsidies, and taxes.

<b>Table 11. Food – Overview of the public authorities' role</b>	
<b>Country</b>	<b>What has been the role of public authorities in your MS with regards to sustainability criteria (legislation, Green Public Procurement subsidies, taxes, other)?</b>
Denmark	<ul style="list-style-type: none"> <li>• Organic Action Plan for Denmark strengthen the collaboration between local and regional authorities through new initiatives</li> <li>• Financial support from the ministry of Food, Agriculture and Fisheries to the development of MSC and national initiatives regarding palm oil</li> </ul>
Finland	<ul style="list-style-type: none"> <li>• Legislation, related control, guidelines, education, training, advice, good practices, and etc.</li> </ul>
Flanders	<ul style="list-style-type: none"> <li>• Sustainable public procurement criteria for food based on EU GPP (Green Public Procurement)</li> <li>• Legislation</li> <li>• Food safety</li> </ul>
Germany	<ul style="list-style-type: none"> <li>• No answer</li> </ul>
Ireland	<ul style="list-style-type: none"> <li>• GPP</li> <li>• The Sustainable Food Production and Processing is a national research priority and is supported by the Department of Agriculture, Food and Marine</li> <li>• The Irish Enterprise Development Agency</li> <li>• The Environmental Protection Agency is the responsible authority for issuing IPPC (Integrated Pollution and Prevention Control)</li> <li>• Maintenance of fish stocks</li> <li>• Regulation of catch</li> </ul>

	<ul style="list-style-type: none"> <li>• Legislation on seaweed harvesting</li> </ul>
Italy	<ul style="list-style-type: none"> <li>• Public authorities defined measures as Legislation, GPP and taxes to meet the sustainability criteria</li> </ul>
Netherlands	<ul style="list-style-type: none"> <li>• Legislation</li> <li>• Some subsidies f.i. ecological agriculture</li> </ul>
Spain	<ul style="list-style-type: none"> <li>• The general legislation is the general EU legislation</li> </ul>
Sweden	<ul style="list-style-type: none"> <li>• No taxes</li> <li>• Ambitions to increase green public procurement</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>• Labeling of food to improve awareness of origin and ‘use by dates’</li> </ul>

### 4.2.3 Feed

Voluntary or mandatory sustainability criteria and initiatives used in the countries concerning the field of feed, is summarized in Table 12, where the type of feed and biomass related to the criteria and initiatives is also stated.

<b>Table 12. Feed - Overview of sustainability criteria and initiatives</b>			
<b>Country</b>	<b>Sustainability criteria and initiatives</b>	<b>Types of Feed</b>	<b>Types of biomass</b>
Denmark Flanders	<ul style="list-style-type: none"> <li>• RTRS</li> </ul>	<ul style="list-style-type: none"> <li>• Imported feed</li> </ul>	<ul style="list-style-type: none"> <li>• Soy</li> </ul>
Denmark	<ul style="list-style-type: none"> <li>• Initiative from Danish Agriculture &amp; Food council</li> </ul>	<ul style="list-style-type: none"> <li>• Imported feed</li> </ul>	<ul style="list-style-type: none"> <li>• Soy</li> </ul>
Flanders	<ul style="list-style-type: none"> <li>• Vegaplan</li> <li>• BEMEFA (Belgian Feed Association)</li> </ul>	<ul style="list-style-type: none"> <li>• Pig feed</li> <li>• Poultry</li> <li>• Cattle</li> </ul>	
Germany	<ul style="list-style-type: none"> <li>• German Federal programme on Organic farming</li> <li>• ISCC Plus</li> </ul>	<ul style="list-style-type: none"> <li>• Legumes</li> </ul>	
Ireland	<ul style="list-style-type: none"> <li>• Consultative forum under the NAP (National Action Plan)</li> </ul>	<ul style="list-style-type: none"> <li>• Grass</li> <li>• Imported feed</li> </ul>	<ul style="list-style-type: none"> <li>• Grass</li> <li>• Forage maize</li> <li>• Field beans</li> </ul>

Ireland	<ul style="list-style-type: none"> <li>• Sustainable Use Directive (2009/128/EC)</li> </ul>		
Italy	<ul style="list-style-type: none"> <li>• Energy and resource consumption</li> <li>• Waste reduction</li> <li>• Emissions in the environment</li> </ul>	<ul style="list-style-type: none"> <li>• All feed</li> </ul>	<ul style="list-style-type: none"> <li>• Cereals</li> <li>• Grass biomass</li> <li>• Minor legumes</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>• The agriculture Leadership Forum</li> <li>• Synthetic Biology Leadership Forum</li> </ul>	<ul style="list-style-type: none"> <li>• Cereal</li> <li>• Wheat</li> <li>• Barley</li> <li>• Oat</li> <li>• Oil seed rape</li> <li>• Imported soya</li> <li>• Whole-crop maize</li> </ul>	
United Kingdom	<ul style="list-style-type: none"> <li>• Food and Feed law</li> </ul>		
France	<ul style="list-style-type: none"> <li>• “Bleu Blanc Coeur” (impact of a legumes-rich feeding on greenhouses gases emissions by the cattle)</li> </ul>	<ul style="list-style-type: none"> <li>• Legumes</li> </ul>	<ul style="list-style-type: none"> <li>• Oilcakes, protein meals, maize, hay/grass, grain</li> </ul>

#### 4.2.4 Bio-materials

Concerning the field of bio-materials, the respondents have outlined voluntary or mandatory sustainability criteria and initiatives used in their country. This is summarized in table 13, where the type of bio-materials and biomass related to the criteria and initiatives is also specified.

<b>Table 13. Bio-materials - Overview of sustainability criteria and initiatives</b>			
<b>Country</b>	<b>Sustainability criteria and initiatives</b>	<b>Types of bio-materials</b>	<b>Types of biomass</b>
Denmark	<ul style="list-style-type: none"> <li>• EU-Ecolabel</li> </ul>	<ul style="list-style-type: none"> <li>• Almost all (not food, beverages and</li> </ul>	

Flanders Germany		medicine)	
Denmark Germany	<ul style="list-style-type: none"> <li>• FSC</li> <li>• PEFC</li> </ul>	<ul style="list-style-type: none"> <li>• Wood</li> <li>• Forest products</li> </ul>	
Denmark	<ul style="list-style-type: none"> <li>• EUTR (European Timber Regulation)</li> </ul>	<ul style="list-style-type: none"> <li>• Wood</li> <li>• Forest products</li> </ul>	
Germany	<ul style="list-style-type: none"> <li>• RSPO</li> <li>• ISCC Plus</li> <li>• Rainforest alliance</li> </ul>		
Ireland	<ul style="list-style-type: none"> <li>• CFP (Common Fisheries Policy)</li> </ul>	<ul style="list-style-type: none"> <li>• Chitin, chitosan and glucosamine from shell material</li> </ul>	<ul style="list-style-type: none"> <li>• Fish skins</li> </ul>
Italy	<ul style="list-style-type: none"> <li>• National Recycle Syndicates</li> <li>• UNI EN 13432 standard</li> </ul>	<ul style="list-style-type: none"> <li>• Films for food packaging</li> <li>• Mulching transparent film</li> <li>• Coffee capsules</li> <li>• Biolubricant for agricultural machinery and marine engines</li> <li>• Bags for separate collection of organic fraction</li> </ul>	<ul style="list-style-type: none"> <li>• Brassica</li> <li>• Sunflower</li> <li>• Tobacco</li> <li>• Rape and canola oils</li> <li>• Glycerine</li> <li>• Fatty acid esters</li> <li>• Succinic acid</li> <li>• Sorghum</li> <li>• Thistle</li> <li>• Corn</li> </ul>
Italy	<ul style="list-style-type: none"> <li>• Legislative Decree (152/2006) and (205/2010)</li> </ul>		<ul style="list-style-type: none"> <li>• Byproducts Waste</li> </ul>
Netherlands	<ul style="list-style-type: none"> <li>• Green deal</li> </ul>	<ul style="list-style-type: none"> <li>• Plastics</li> <li>• Composites</li> </ul>	<ul style="list-style-type: none"> <li>• Sugar</li> <li>• Starch</li> </ul>
United Kingdom	<ul style="list-style-type: none"> <li>• The Industrial Biotechnology Leadership Forum</li> </ul>		
France	<ul style="list-style-type: none"> <li>• Ecocert Repository for “Eco-cleaners”</li> </ul>		

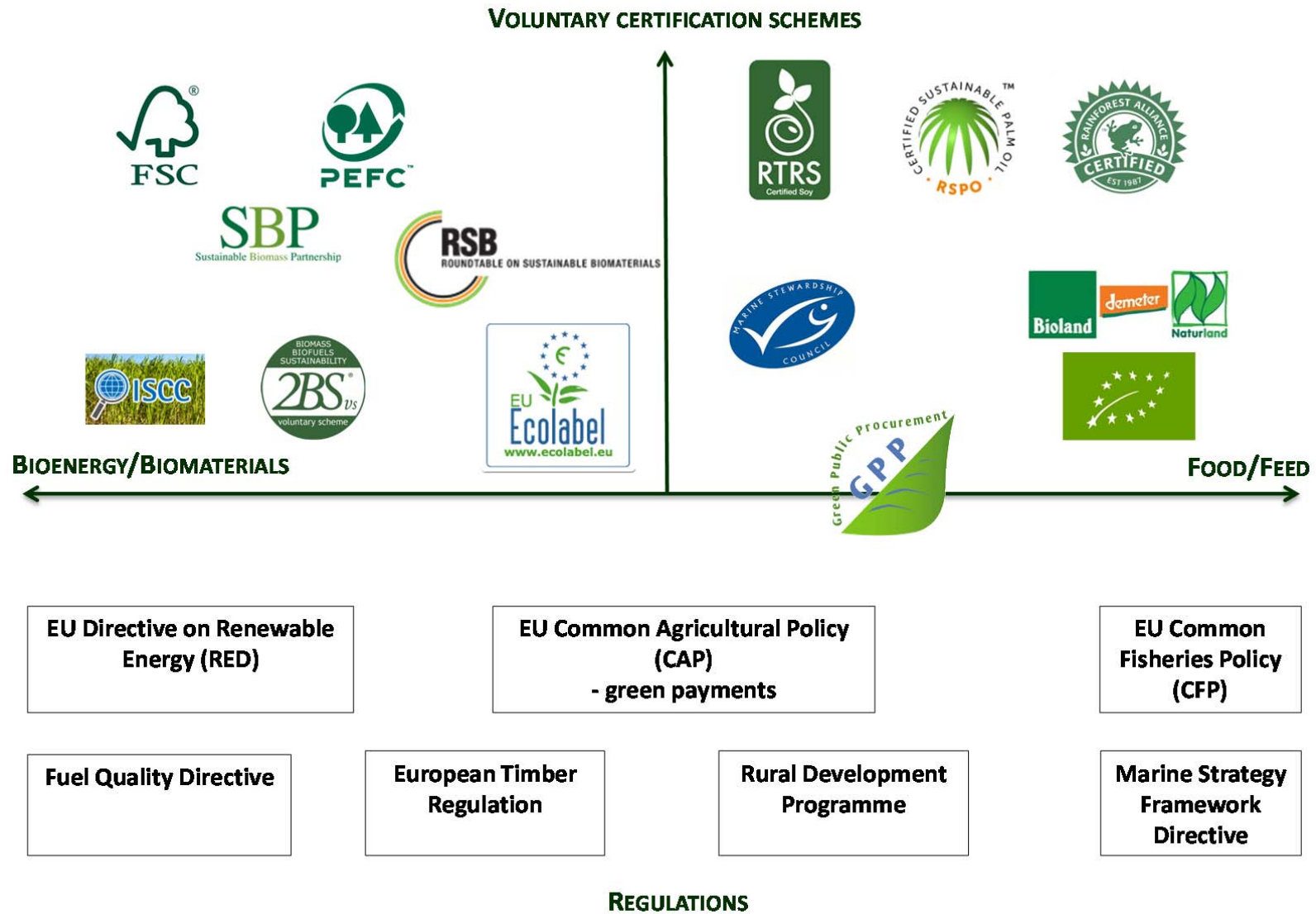


Figure 3. Overview of voluntary certification schemes and regulations for bioenergy, biomaterial, food and feed as identified in the questionnaire.



## 5. DISCUSSION AND CONCLUSION

### *Overview of sustainability criteria and initiatives*

Figure 3 (above) illustrates some of sustainability initiatives relevant for European bioeconomy. Both biomass for energy and material's and for food and feed are supported by common policies, but in addition a variety of voluntary schemes is present. Each regulation and scheme has its own rationale and seeks to address different aspects of sustainability issues. Where the regulations mentioned in relation to sustainability primarily focus on environmental issues, some of the voluntary certification schemes aims to take wider aspects into account. The voluntary schemes are by nature market driven, whereas the regulations at EU or national level set the lower bar. Linkages between voluntary certification schemes and public authorities is also seen especially in the Netherlands, where the authorities is actively supporting certification schemes in the soy and palm oil chain such as RTRS and RSPO.

When choosing an approach with regard to sustainability criteria, two different approaches can be identified when evaluating sustainability (Dale et al., 2015). One approach is more rule based, where a prescriptive set of rules that should be followed in the production and processing, which is documented by control and certification. This approach is the most commonly used in voluntary certification schemes and also the initiatives in the Common Agricultural Policy are rule based. Another approach is based on the effects on the environmental load of the product by a certain practice using e.g. life cycle assessment like in the PEF (Product Environmental Footprint). This approach is both used in e.g. the RED, where the biofuel companies should document 35% lower greenhouse gas emissions compared to the replaced fossil fuel and in e.g. Unilever' SAC (Sustainable Agriculture Code) involving carbon footprint calculations along with a more rule-based approach for other sustainability criteria. Thus, the Unilever SAC uses a mixed approach and so does the RED, where it is stated that, besides the reduction in greenhouse gas emissions, raw material cannot be sourced from land of high biodiversity.

### *A need for a more consistent, standardised approach to sustainability criteria?*

Based on the survey of eleven countries, few countries (three) do not support the idea of having more standardized sustainability criteria across the different fields of the bioeconomy due to different conditions and variables. However, the majority of the countries have a demand for a more consistent and standardized approach to sustainability criteria across the different fields of the bioeconomy. This demand covers widely different criteria and indicators, voluntary schemes as well as EU level approaches. The general arguments for the need of a uniform approach to sustainability criteria are:

- Increase of transparency

- Avoid market distortions
- Enables comparisons across countries

Though, among the answers that agree to more consistent criteria, these countries are also aware of challenges regarding diversity inherent within the bioeconomy. Thus, a more generalized approach to sustainability criteria will only become a reality in the terms of:

- Consideration of the different aspects of the bioeconomy
- Creating a level playing field
- Allowing adjustment to a changing market development
- Special attention to the management regarding a differentiated level of sustainability among fields of the bioeconomy

Some of the suggested ways forward towards a more harmonised, standardised approach is to:

- Define indicators of biomass sustainability in consensus
- Seek inspiration in other schemes
- Align with the PEF (Product Environmental Footprint) on the environmental area
- Include also social and economic aspects
- Allow for a differentiated thresholds in sustainability assessments
- Develop general criteria and specific criteria adapted to local context or field
- Focus on connections between fields in the bioeconomy

With regard to the definition of indicators, Dale et al. (2015) has suggested an approach or a framework for selecting indicators of bioenergy sustainability. The first step according to Dale et al. (2015) would be to define the goals in accordance with e.g. UN's Sustainable Development Goals (SDG) while gaining an understanding of the context and consulting the stakeholders. Based on this, objectives and criteria for indicator selection can be identified. Indicators are then identified and ranked and applied in an assessment to evaluate their effectiveness. A first step in the way forward could be to identify the impacts from different stages of different biobased products and work from there.

With regard to the Product Environmental Footprint (PEF), which is aimed at standardising the environmental life cycle assessment (LCA) of products, a lot of work is at the moment dedicated to deciding the standard LCA procedures with regard to several different food items and other products. This work is mainly focused on the assessment of the environmental aspects.

Among the answers in the questionnaire that would not recommend a more consistent, standardised approach are the main arguments:

- Sustainability can be ensured by the current criteria

- It is impossible due to differences between countries
- Different criteria are needed for different fields of the bioeconomy
- A standardized approach includes many negative side-effects (such as market distortion, strange results and high administrative costs)

Instead it is recommended to:

- focus on developing existing legislation and guidelines
- focus on common principles, comparability in reporting and benchmarking on chains of custody.

**It can be concluded**, that request for biomass globally is increasing and going to increase further in future. It is also recognised at international level that production of biomass can have major negative impacts on environment and that there is a need to address this issue in policy and business. While it is not always the case, different types of biomass can be produced on the same type of land and thus influence the quality of that land, emissions from the growing process, socioeconomic factors related to land use and in fact compete for this scarce resource. Moreover, the bioeconomy has to pay a special attention to closing the loop of the biological cycles, instead of creating linear chains producing waste.

While voluntary certification schemes primarily are market driven and regulations are mandatory, in some cases there is a link and they support each other. The voluntary schemes might serve as inspiration for the development of sustainability criteria since they often cover broad aspects of sustainability.

A majority of the respondents of the questionnaire express the need for a more consistent, standardized approach to sustainability criteria. A number of sustainability criteria already exist or are in progress for the different fields of bioeconomy. But since different fields of bioeconomy in fact are interacting, there is a need to create a common playing field. Much attention is given lately to the bioenergy part of the bioeconomy, risking an unbalanced attention to only one part of the bioeconomy and only one transition.

A way forward in defining sustainability criteria could be to take the point of departure in UN's Sustainable Development Goals and define indicators of biomass sustainability in consensus, while seeking inspiration in other schemes and involving stakeholders.

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