Sustainability Assurance for Energy from Forestry

Final Report

prepared for WWF International

by

Uwe R. Fritsche & Leire Iriarte (IINAS), Joanne Fitzgerald (EFI), Neil Bird (JR)

IINAS - International Institute for Sustainability Analysis and Strategy

EFI - European Forest Institute

JR - Joanneum Research

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Acronyms

AEBIOM	European Biomass Association
CAP	(EU) Common Agriculture Policy
CBD	Convention on Biological Diversity
CDM	Clean Development Mechanism
CEN	European Committee for Standardization
CENBIO	Centro Nacional de Referencia em Biomassa (Brazil)
CFS	Committee on World Food Security
C&I	Criteria and Indicators
DG	Directorate General
EC	European Commission
ECREEE	ECOWAS Regional Centre for Renewable Energy and Energy Efficiency
EEA	European Environment Agency
EP	European Parliament
EIA	Energy Information Administration (US)
EPA	Environmental Protection Agency (US)
ETS	Emissions Trading System
EU	European Union
EU MS	European Union Member State
FAO	Food and Agriculture Organization of the United Nations
FCCC	Framework Convention on Climate Change
FLEGT	Forest Law Enforcement, Governance and Trade
FSC	Forest Stewardship Council
GBEP	Global Bioenergy Partnership
GEF	Global Environment Facility
GGL	Green Gold Label
GRI	Global Reporting Initiative
IEA	International Energy Agency
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ISCC	International Sustainability Carbon Certification
ISO	International Standardization Organization
IWPB	Initiative Wood Pellet Buyers (now SBP)
JRC	European Commission DG Joint Research Centre
M	Million
MCPFE	Ministerial Conference on the Protection of Forests in Europe
MS	Member States
Mt	million tons
Modt	million oven-dry tons
NLBI	Non-legally Binding Instrument
NRC	Natural Resources Canada
OMA	Office for Metropolitan Architecture
PFEC	Programme for the Endorsement of Forest Certification Schemes
RED	EU Renewable Energy Directive (EU 28/2009)

REDD+	UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation
REN21	Renewable Energy Network for the 21st Century
RFS	Renewable Fuel Standard
RPS	Renewable Portfolio Standards
RSB	Roundtable on Sustainable Biomaterials
SBP	Sustainable Biomass Partnership (formerly IWPB)
SFM	Sustainable Forest Management
t	ton
TR	EU Timber Regulation (EU 995/2010)
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
VGGT	Voluntary Guidelines on the Responsible Governance Tenure of Land, Fisheries and Forests in the Context of National Food Security
VITO	Flemish Institute for Technological Research
WB	World Bank
WTO	World Trade Organization

Acknowledgments

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All views expressed here and any omission or errors are the sole responsibility of the authors.

1 Introduction and Overview

This report is based on the proposal presented by IINAS, EFI and JR to the call for tenders from WWF International on "Sustainability assurance for energy from forestry".

This report aims to provide a general overview on "**windows of opportunity**" to improve the sustainability of woody bioenergy use. To do so, earlier WWF studies, expertise of the consortium team, an extensive literature review and results of interviews with selected stakeholders provided the basis to derive recommendations in **Section 7**.

The format and content of this report aims to enable readers to easily identify key points of the topic from several angles and be aware of suggestions to move the discussion ahead.

Given the broad scope of the topic, the consortium has focused on the main issues that could help WWF international to enrich the discussion and adopt practical solutions. The "position" of other stakeholders can be deducted to some extent from the interview reports (see Annex).

This background information has been structured in the following sections:

- **Section 2**, "Long-term Bioenergy Vision in the Global Context" underlines the results of various WWF reports (Living Forest Report, Renewable Energy Report) and IEA and IPCC reports to properly contextualize the topic.
- **Section 3**, "Woody biomass for Energy", describes the main sources of woody biomass, provide an overview of forest potentials for forest biomass in key regions and quantify Biomass Production, Use and Trade for Heat and Power Use – Now and 2020 and 2030.
- **Section 4** deals with the "Sustainability issues". Here the main aspects of sustainability that could be affected by woody bioenergy are discussed with particular focus on issues still under discussion.
- **Section 5** presents the "most promising sustainability initiatives", and gives an overview of the policy landscape and regulations at the international, regional or selected country level for relevant sectors (e.g. energy sector, forestry sector) with the aim of better placing the discussion on woody bioenergy sustainability. The section also identifies most promising sustainability initiatives at various levels.
- **Section 6** discusses the interaction between bioenergy and other forestry products. Several issues such as interactions of bioenergy with forestry management and operations, potential resource competition, role of the bioeconomy (biomaterials, biorefineries…) as well as potential impacts on developing countries are considered.
- The final **Section 7** summarizes key points for WWF International to consider in the development of its woody bioenergy strategy, and derives recommendations for a respective comprehensive sustainability framework.

For an easy understanding of the key points, each Section provides a summary with the most relevant points (see **boxes**).

The **Annex** gives a summary of results from interviews with resource persons.

2 Long-term Bioenergy Vision in the Global Context

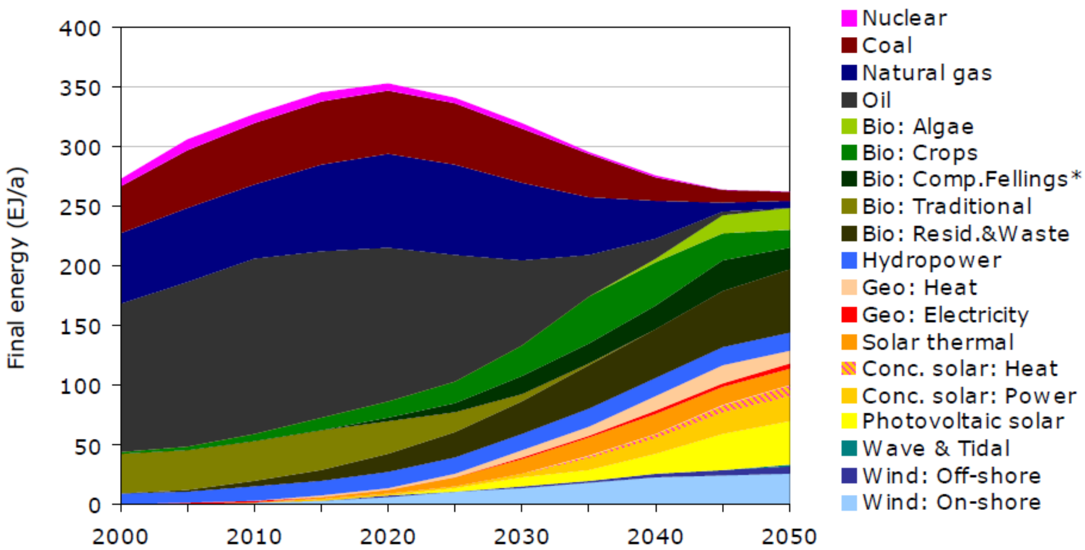
In order to substantiate effort to mitigate climate change and contain anthropogenic global temperature increase within the 2ºC limit until the end of this century, many scenarios and projections give particular attention to substituting fossil fuels trough efficiency and renewable energies.

2.1 WWF Global Scenarios

In this, WWF developed its "100 % renewable energy by 2050" report (see figure below) which advocates for minimizing bioenergy consumption, *using it as a last resort where other renewable energy sources are not viable* (WWF, Ecofys, OMA 2011). Still, in this scenario global bioenergy supply has to double up to 2050, totaling about 100 EJ of primary energy equivalent.

The trends for bioenergy applications are significantly different: whilst WWF projects industrial heat and biofuels for transport to increase substantially, electricity from bioenergy will grow only slowly and WWF advocates for reducing biomass use for heat despite that its Living Forest Report (WWF 2011) assumes household fuelwood consumption remaining constant up to 2050.

Figure 1 Global Energy Supply by Source in the WWF Energy Report



*Source: WWF, Ecofys, OMA (2011); *= Complementary fellings include the sustainable share of traditional biomass use*

Additional modelling efforts have been done under the WWF Living Forest Report (WWF 2011). The forest biomass to meet the above mentioned demand consists of (WWF, Ecofys, OMA 2011):

- Complementary fellings: Additional forest growth potential, estimated in about (~27 EJ) and sustainable use of traditional biomass (~11 EJ: 30 % of the current use). The Living Forest report (WWF 2011) states that by 2050, the expansion of forest managed would be 304 Mha in addition to the 1200 Mha already managed.

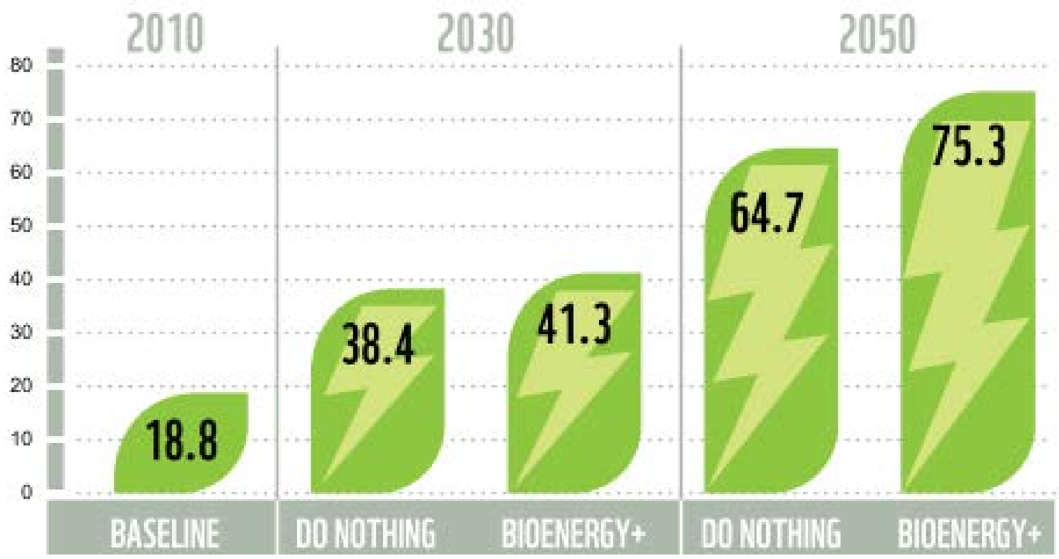
- Forestry residues and wood waste (25 EJ): Logging residues (~ 5 EJ), wood processing residues (~ 10 EJ), wood waste (~ 10 EJ)

This represents some 4.5 billion cubic meter (Bm^3) of wood products, and 250 Mha for energy crops, respectively.

WWF has made additional modelling efforts through the Living Forest Report (WWF 2011) considering various scenarios, as can be shown in Figure 2. As it can be observed, a significant increase on the final energy supply based on bioenergy from land-based feedstocks results for both the "Do Nothing" scenario and the "Bioenergy Plus" scenario by 2050.

Moreover, the demand projection of forest products as given under the Bioenergy Plus scenario is 7.5 Bm^3 by 2030 and 13 Bm^3 by 2050 of which 5 and 10 Bm^3 would be for energy purposes by 2030 and 2050, respectively (WWF 2011) – see Figure 3.

Figure 2 Final Energy Supply based on Bioenergy from Land-based Feedstocks until 2050 under the "Do Nothing" and the "Bioenergy Plus" Scenarios



Source: WWF (2011); data given in EJ end energy

Figure 3 Projected annual Rate of Wood Removals in 2030 and 2050 under various Scenarios of the WWF Living Forest Report compared to FAO Statistics on Reported Wood Removals in 2010

	FAO	LIVING FORESTS MODEL			
	2010	2030		2050	
		Do Nothing	Bioenergy Plus	Do Nothing	Bioenergy Plus
Saw logs & veneer logs	853	1,444	1,444	1,763	1,773
Pulpwood*	527	754	754	905	893
Other industrial roundwood[19]	153	153	153	153	153
Energy wood	1,868	2,753	3,138	6,317	8,209
Household fuelwood		2,064	2,064	2,218	2,054
Total wood supply	**3,401**	**7,168**	**7,553**	**11,356**	**13,082**

Units: millions of cubic metres (roundwood equivalent)

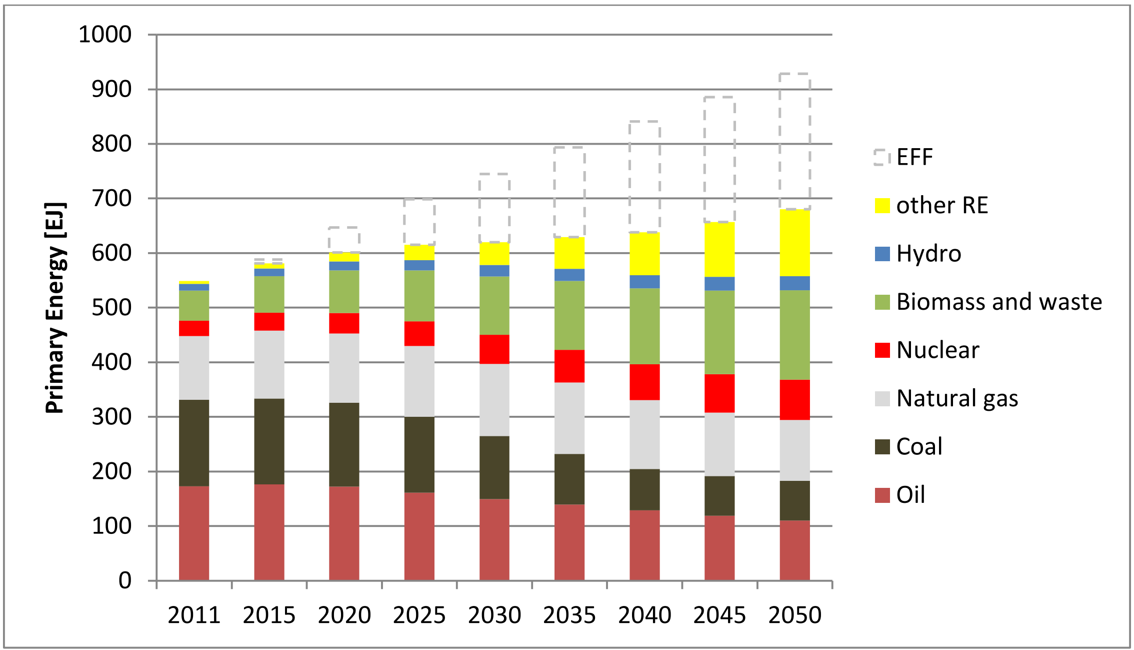
Source: WWF (2011); Note that pulpwood does not include offcuts and sawdust from saw logs that are used in significant amounts in pulp production.

2.2 IEA and IPCC Scenarios

Similarly the latest IEA (2014) and IPCC (2014) scenarios project that the overall role of bioenergy in the global energy system will **increase** up to 2050, but it should be noticed that its **composition** will change drastically: away from (unsustainable) fuelwood and annual crops towards sustainable lignocellulose products from residues and biogenic wastes, perennials, and forest products.

Previous estimations of the IEA (2012) determined that around 100 EJ (5 to 7 billion t) of wood for bioenergy and up to 60 EJ (3 to 4 billion t) for production of biofuels will be required by 2050.

Figure 4 Role of Bioenergy in the IEA 2050 Global Energy Outlook (2DS Scenario)

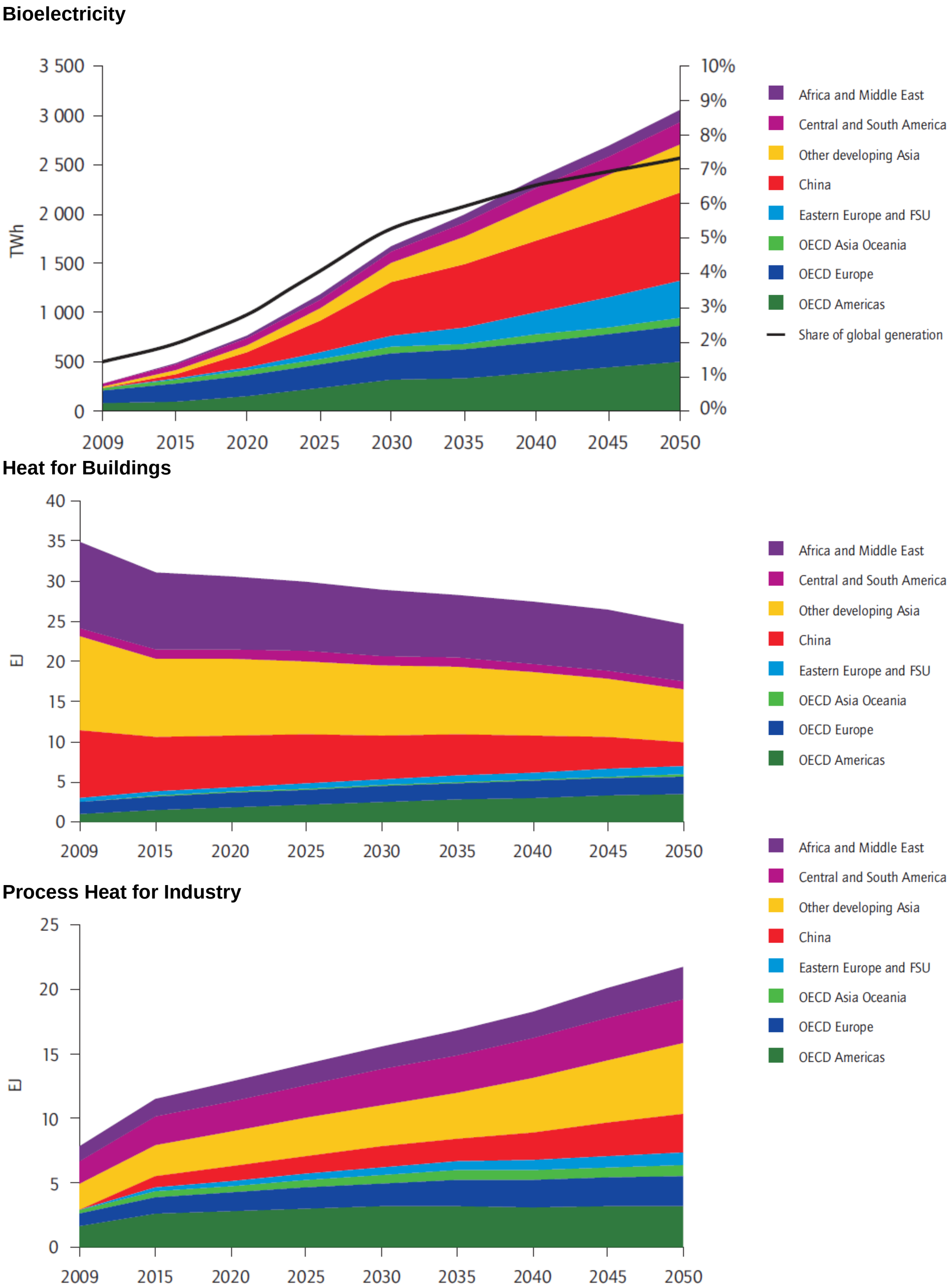


Source: IEA (2014); EFF = increased energy efficiency, compared to BAU scenario

Moreover, the bioenergy 2050 roadmap elaborated by IEA (Figure 5) foresees an increase of bioelectricity generation and process heat for industry but a decrease in bioheat for buildings.

Despite IEA expects biomass consumed in the building sector for cooking and heating purposes to diminish, the total amount of biomass consumed would increase up to 160 EJ by 2050, with 100 EJ of this for generation of heat and power (IEA 2012).

Figure 5 IEA 2050 Roadmap for Global Bioenergy by Regions



Source: IEA (2012); note that data given here represent the "2° C" scenario of the IEA

2.3 Summary: Long-term Bioenergy Vision in the Global Context in a Nutshell

In the IPCC 2 °C scenarios as well as in other recent global analyses (e.g. IEA 2014), bioenergy **is required** in the order of 100-150 EJ per year, with a dominant share of woody biomass.

Today, bioenergy contributes globally about 50 EJ including so-called **traditional** biomass use for cooking and heating.

WWF projections (Renewable Energy Report) result in an increase of biomass up to about 100 EJ of primary energy equivalent for biofuels and woody biomass by 2050 of which about 75 EJ would be provided by land-based feedstocks under the Bioenergy Plus Scenario.

The IEA, IPCC and WWF scenarios expect a much higher demand increase for bioenergy than for biomaterials by 2050.

On the supply side, this would require an expansion of **managed forest** by about 300 Mha (currently about 1200 Mha) and about 250 Mha increase in **forest plantations** (currently about 250 Mha).

All scenarios expect a global **transformation** of woody biomass consumption patterns in the longer-term: Today, heating (and cooking) in buildings is the major use, but up to 2050, bioenergy will predominantly be used for liquid biofuels, some electricity generation, and process heat.

3 Woody Biomass for Energy

3.1 Woody Biomass Sources

In general, woody biomass[1] can come from several sources, as follows:

- **Primary forest biomass** sources from conventional forest management, from forest plantations, from conservation cuttings or from natural disturbances. This can consist of stemwood, harvest residues (i.e. stem tops, branches, and foliage) and/or stumps and coarse roots
- **Secondary woody biomass** sources include solid forest and wood industry by-products (sawmill residues, bark, wood industry wastes) and liquid wood industry by-products (black liquor)
- **Tertiary woody biomass** sources are wood products after the end of their useful life as materials, i.e. post-consumer wood (i.e. packaging materials, demolition wood, timber from building sites, etc.)

It is worth noting that not all stakeholders have the same understanding on what the various feedstocks encompass, they define e.g., primary forest residues differently.

3.2 Forest Bioenergy Availability

Despite the many efforts to assess biomass potentials in general and forest potentials in particular which occurred during last years, it is not straightforward to assess the potential availability of biomass from forests, especially under sustainability constraints. While models exist that can estimate annual increment and forest available for wood supply on national and regional level, realistic mobilizations can be a lot lower. Many countries are limited in terms of how much biomass they can extract from forests due to lack of established supply chains, lack of infrastructure such as forest roads, low levels of mechanization and many other factors. Therefore, when evaluating biomass availability, once the theoretical potential is estimated, technical, economic and sustainability constraints must be applied to derive more realistic mobilization estimates.

There are many efforts[2] at different scales in this regard proving a wide variation in results depending on the methodology adopted.

Table 1 provides a summary of these potentials for selected relevant countries. Global forest potentials were also assessed in the WWF Energy Report (WWF, Ecofys, OMA 2011) and shown in Figure 6.

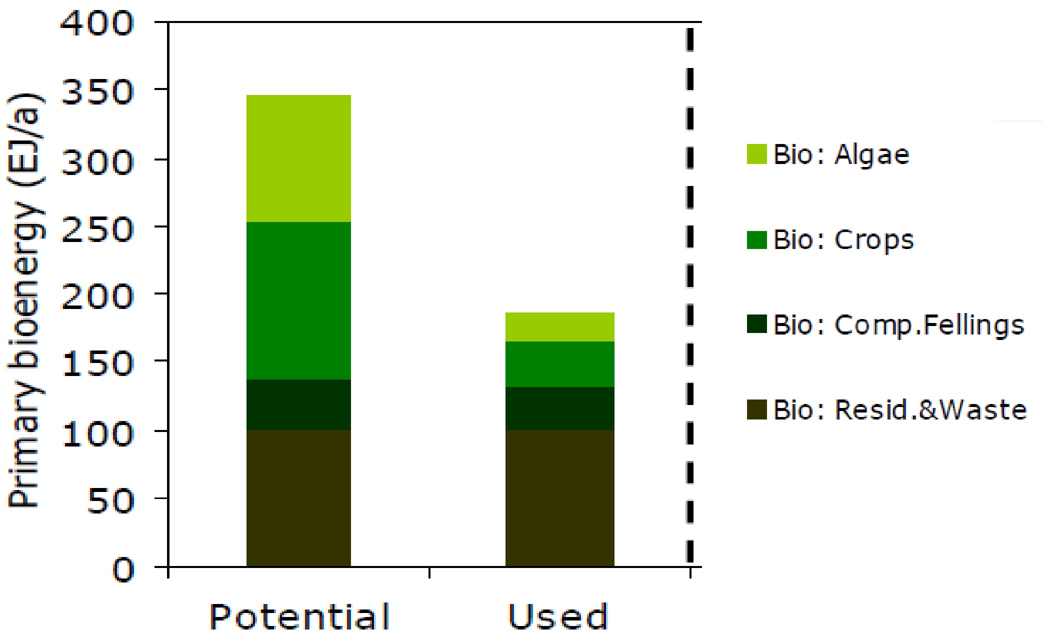
1 Other woody biomass can also come from landscape care, urban park management, gardening, etc. and perennials cultivation (grasses or short rotation coppices) on agricultural land. This short introduction aims not to provide a comprehensive discussion on the various categories but a general overview. A more detailed description about the various woody biomass categories is provided in IINAS, EFI, JR (2014).

2 IPCC (2011); IEA (2012); Batidzirai, Smeets, Faaij (2012); Indufor (2013); Mantau (2010); Fritsche, Iriarte (2014)

They consist of:

- Complementary fellings: Additional forest growth potentials and sustainable use of traditional biomass
- Forestry residues and wood waste.

Figure 6 Sustainable Bioenergy Potential vs. Use in the WWF Energy Scenario 2050



Source: WWF, Ecofys, OMA (2011)

The WWF Energy Report determined an availability of 673 Mha for the cultivation of rain-fed energy crops. Currently, plantations occupy about 250 Mha but most of them are low and medium productivity plantations while high productive plantations only occupy a small share but provide about 50 % of the wood supply. Some of this **land** might be used for forest plantations under short rotation plantations (e.g. eucalyptus and pine). There is a relevant experience in the management of plantations and there have been significant efforts with regard to their sustainability (see section 4). The concept of production intensification is in line with the proposal under planetary boundaries (Rockström et al. 2009).

The potential of short rotation coppice (SCR) should not be ignored. In this respect, the WWF Energy Report aims to minimize land use for bioenergy and determined a maximum area of 250 Mha for bioenergy cropland (this is a low estimate in comparison with the values found in the literature), as shown in Figure 7.

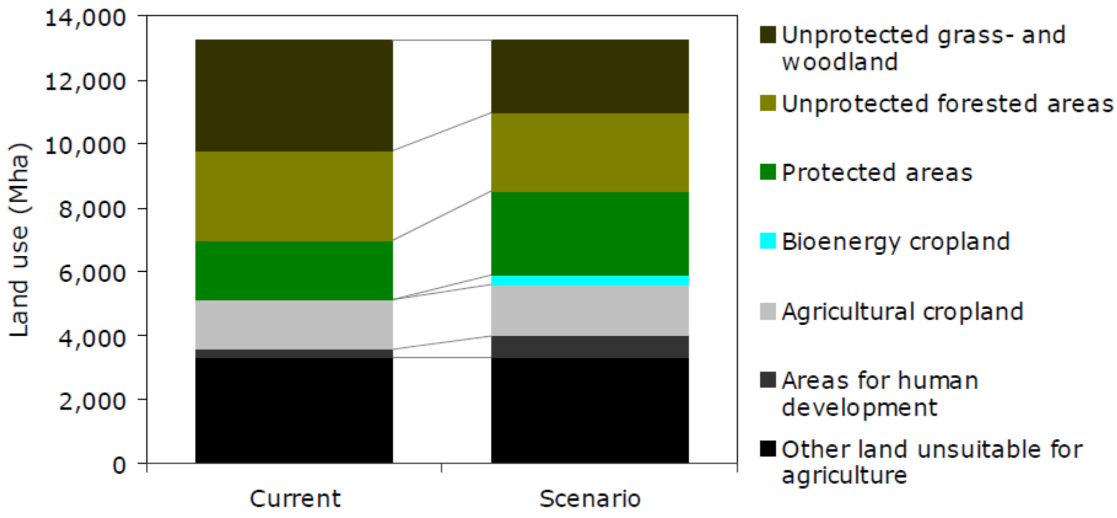
In addition to current forest resources, there are about several million ha (M ha) available for plantations, depending on the assumptions. It has to be kept in mind that land intensity (m^2/GJ_{el}) of most bioenergy options is much higher than other renewable of fossil fuel options.

Table 1 Forest and Woody Bioenergy Potentials in Selected Countries

Region/ country	Forest and Woody Bioenergy Potential
Canada	Estimates by Dymond et al. (2010) determined a total annual production of 51±17 Mt/a from natural disturbances and 20±0.6 Mt/a from clearcut harvesting residues. The potentially available biomass for bioenergy from dead wood stocks totaled 331 million tons (Mt, oven-dry) in 2020. Natural disturbances in Canada (both fires and Mountain Pine Beetle outbreak in Western Canada) might be relevant sources of supplying material. Moreover, natural disturbances are expected to increase due to climate change. The assessment by Dymond et al. (2010) already included a 50% discount factor to reduce theoretically available quantities to a more realistic estimate of potential ecologically sustainable bioenergy feedstock. Further work on potentials based on field data is carried out by Natural Resources Canada (NRC).
USA	Many efforts to assess woody potentials have undertaken. The "one billion ton" study (Perlack et al. 2005) concluded that potential available forest resources for bioenergy was 366 Mt/a. Further refinements have concluded in a significant downward potential (The Heinz Center, Pinchot Institute for Conservation 2010). When focusing in the US Southeast, recent estimates from Pöyry (2013) determined that sustainable wood supply potential as 156 Mt, with 35 Mt unmobilized fiber (current consumption of the pulp and paper sector is 68 Mt). Alavalapati et al. (2013) project woody biomass for bioenergy as 170 to 336 Mt (green) by 2050, an increase of 54 to 113 percent over current levels. This might not necessarily impact negatively on forest because of increased plantations of fast growing species, afforestation of agricultural or pasturelands, and intensive management of forest land.
Russia	High potential availability of un- and underused forest resources, especially residues (> 50 Mt in Northwest Russia alone, see Thiffault et al. 2014). The pellet production capacity could increase significantly in the coming years but this will depend on the investment climate.
EU28	In the EU27, 133 Mha of land is estimated to be available for wood supply. A study carried out by IINAS, EFI and JR (2014) determined a potential up to about 900 Mm^3 (wood for materials and energy from pre-commercial thinnings, thinnings and stemwood, including residues and stumps) by 2030 that would be reduced by 33 % if ambitious environmental criteria were applied.
Brazil	Brazil is the largest producer of wood from planted forests. Eucalyptus is main species, with 5 Mha planted in 2011. Relevant amounts of the roundwood production is used domestically for energy purposes either as firewood or charcoal (In 2011, 62 Mm^3 out of 118 Mm^3 consumed in total). In addition to potentials from already established plantations, CENBIO (2013) estimates that under current conditions, the area of planted forests in the country could increase from 7 to over 12 Mha by 2020 mainly from degraded lands from pasture. Moreover, the total area of degraded land is 105 Mha.

Source: compilation by IINAS based on recent studies

Figure 7 Current Land Use and in the WWF Energy Scenario in 2050



Source: WWF, Ecofys, OMA (2011)

Apart from potentials, a key point is to consider aspects regarding **mobilization**. Outputs of mobilization will largely determine competition among sectors. The EU has potential to mobilize more resources but efforts on the organizational side and investment are needed. At EU level, the forestry regulation depends on the Member States (MS) so despite the fact that the EC has been active in this (e.g. EU Forest Strategy, where mobilization is encouraged), national policies are very diverse. The EU Common Agriculture Policy proposes some measures for biomass mobilization (Fleureck 2014). Other organizations such as MCPFE, UNECE and FAO as well as other national initiatives in some European countries, Canada and the US made efforts in this regard (see e.g. Fritsche et al. 2014).

A key point in the discussion of forest potentials for bioenergy is the **dual character** of biomass for bioenergy and biomaterials: The "structural" value of woody biomass (as a material) is economically higher than the "heating" value (for bioenergy), but once the structural value is "used", the heating value remains. Thus, the preferred use of biomass would be that providing the highest value first while the bioenergy use would be the lowest preferred use, as the "structural" value is lost once woody biomass is burnt (or processed to energy carriers such as pellets).

This dual character is the base for the "cascading use" of biomass (see Section 3). The more use of biomass for biomaterials (e.g. building sector etc.), the more subsequent by-products, residues and wastes for bioenergy will be available.

3.3 Summary: Forest Bioenergy Availability in a Nutshell

Forest potentials might result in very **different figures** depending on the parameters considered in the assessment.

Apart from the various theoretical potentials (e.g. technical potential, sustainable potential), the **real potential** (e.g. mobilization and processing capacity) has to be considered.

The forest potentials for bioenergy will depend as well on how the material **markets** are shaped and on **policies on land**, among others.

There are **countries** such as US and Canada with high forest potentials that could be mobilized in the short term. Other countries such as Brazil and Russia show high theoretical potentials but face other challenges (e.g. investment climate).

Land for forest plantations (e.g. short rotation eucalyptus or pine plantations) is an additional source to be considered. The intensification of production is in line with the concept of "**planetary boundaries**".

A key point is the mobilization of biomass not just for bioenergy but for **biomaterials**. This would allow using by-products, residues and wastes from biomaterials for bioenergy, reducing the demand for dedicated biomass for bioenergy.

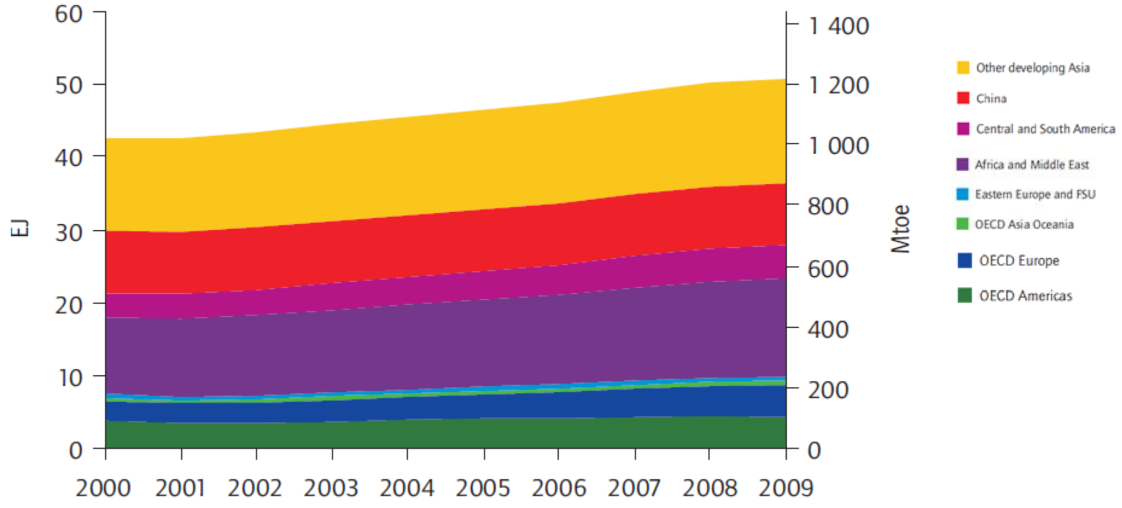
3.4 Quantification of Current Woody Biomass Production, Use and Trade

Apart from traditional fuelwood and charcoal used all around the world mainly for domestic applications (cooking, heating) new types of woody bioenergy carriers are being increasingly internationally traded: wood chips and especially pellets.

Still, according to FAOSTAT (2013), **fuelwood production in 2011 had a share of 54.5 % of the total global industrial roundwood production** (approx. 3500 million cubic meters = Mm^3), but its significance varies regionally. In fact, fuelwood is dominating biomass consumed globally (IPCC 2011) mainly to satisfy basic needs in developing countries, and often faces unsustainable supply and use.

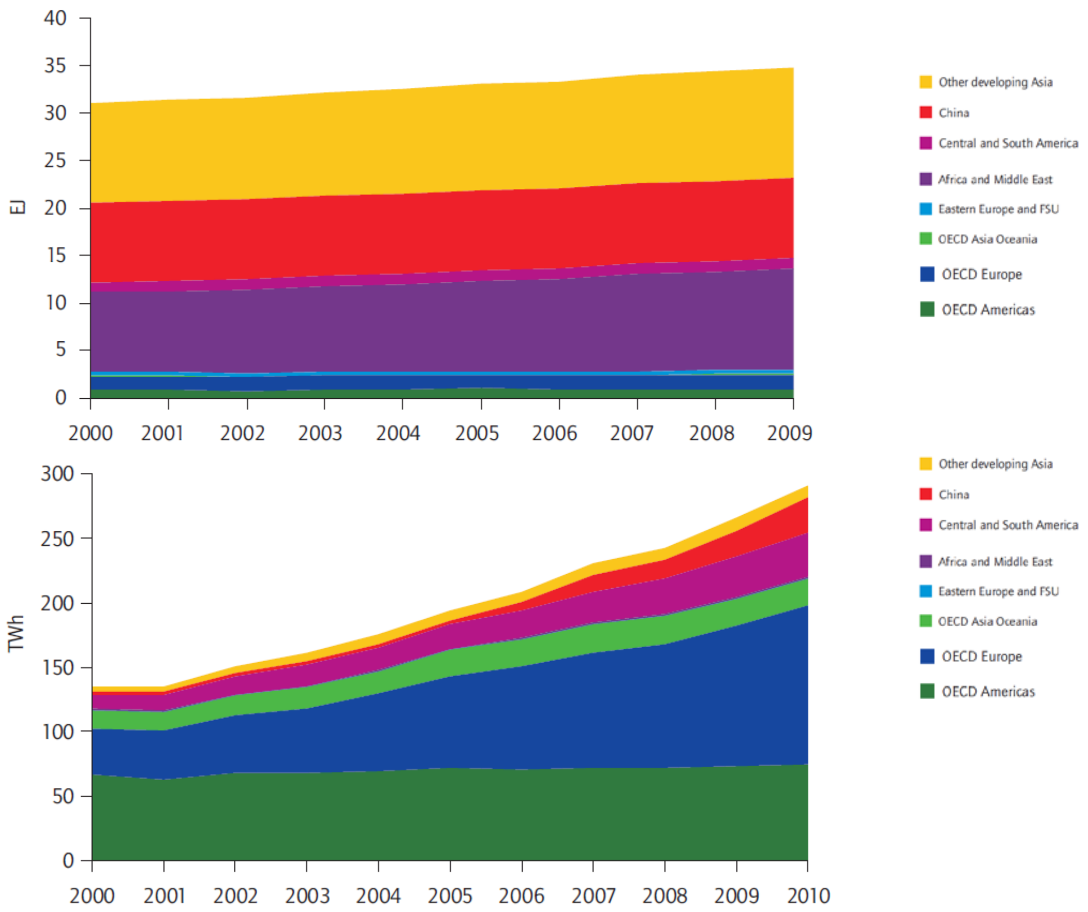
Figure 8 and Figure 9 illustrate global bioenergy supply and consumption of bioenergy for bioheat and bioelectricity, respectively, from 2000-2010 at the global level.

Figure 8 Global Bioenergy Supply by Regions 2000-2010



Source: IEA (2012)

Figure 9 Global Bioheat (upper part) and Bioelectricity (lower part) by Regions 2000-2010

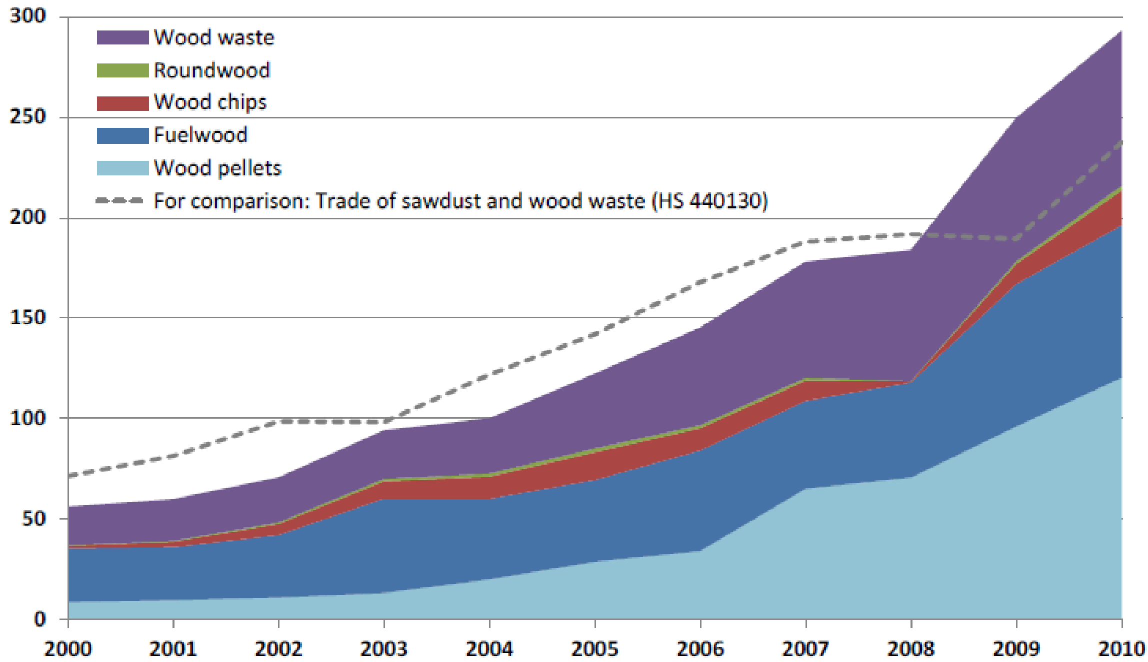


Source: IEA (2012)

3.4.1 Global Dynamics and the EU Woody Biomass Market

The dynamics of global woody bioenergy trade in the decade from 2000 to 2010 is shown in the following figure.

Figure 10 Global Woody Biomass Trade for Energy



Source: Junginger (2013); trade flows are given in PJ

Figure 11 and Figure 12 present the wood pellet global production during the period 2000-2012 and the world wood pellets consumption share in 2012, respectively. It is worth highlighting that although the international pellet trade mainly serves large-scale users, the main European pellet consumers have adopted different strategies for the final uses of pellets as reported in Figure 13.

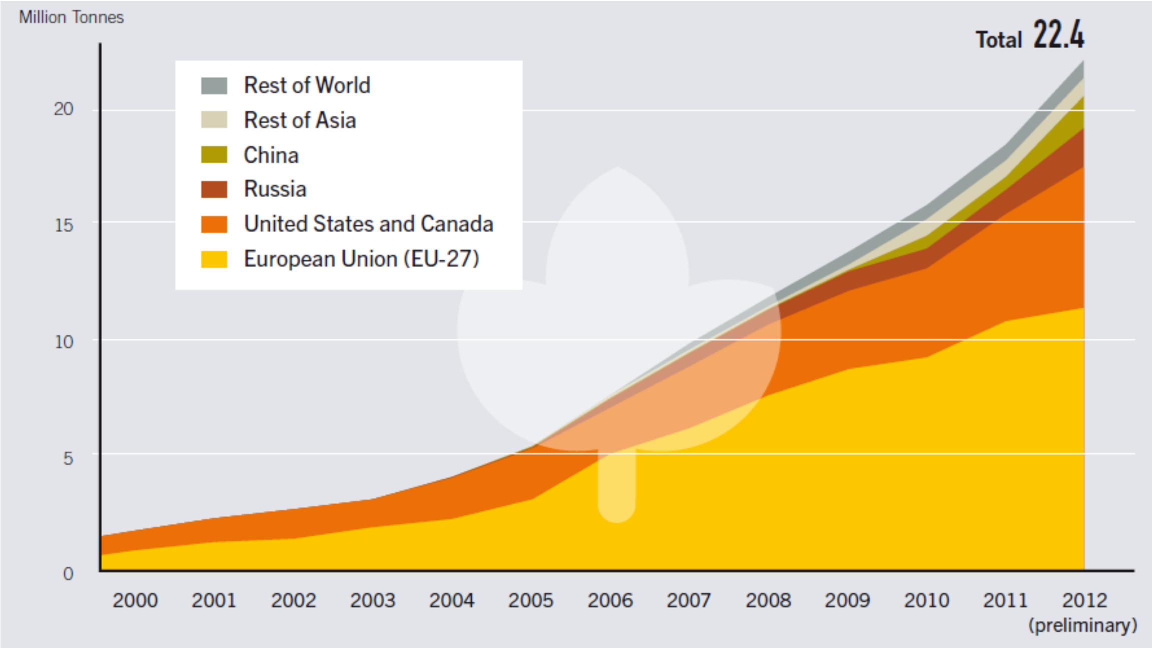
Pellet exporters are US, CA and RU and their dominance is expected to continue given their competitive position in comparison with other potential exporters (e.g. Brazil, Ukraine, Belarus or other countries in Africa)[3]

In 2014, the North American Wood Fiber Review[4] reported a doubling of wood pellet exports to the EU in two years. This increase in EU demand can probably be attributed to RED. However ambitious targets in US could impact on the availability of this resource.

3 See extensive discussion of this aspect is given in IINAS, CENBIO (2014)

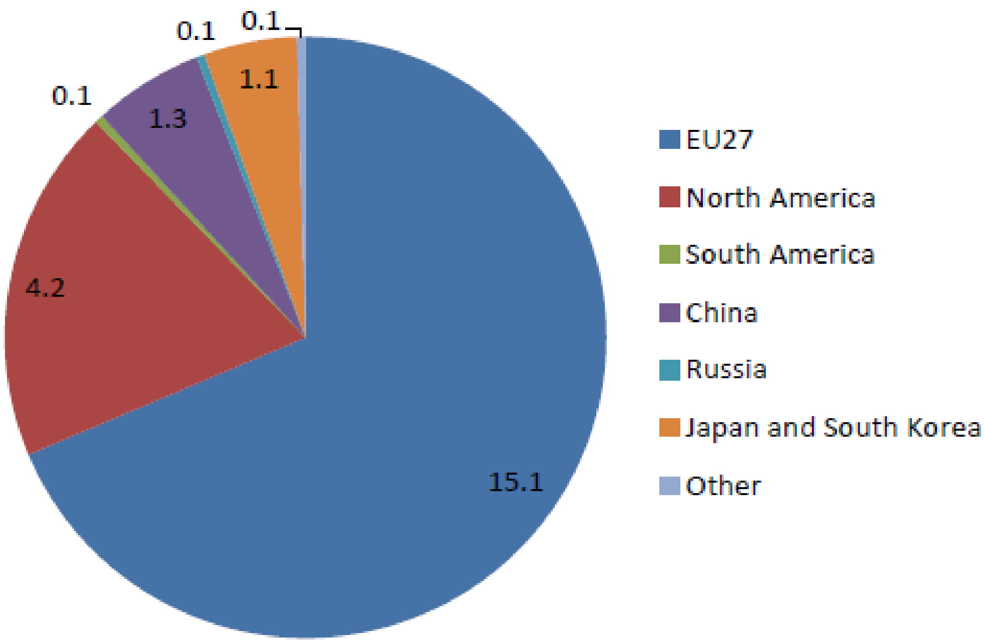
4 http://woodbioenergymagazine.com/blog/2014/wood-pellet-exports-from-north-america-to-europe-have-doubled-in-two-years/

Figure 11 Global Wood Pellet Production by Region/Countries 2000-2012



Source: REN21 (2013)

Figure 12 Global Wood Pellets Consumption by Region/Countries in 2012

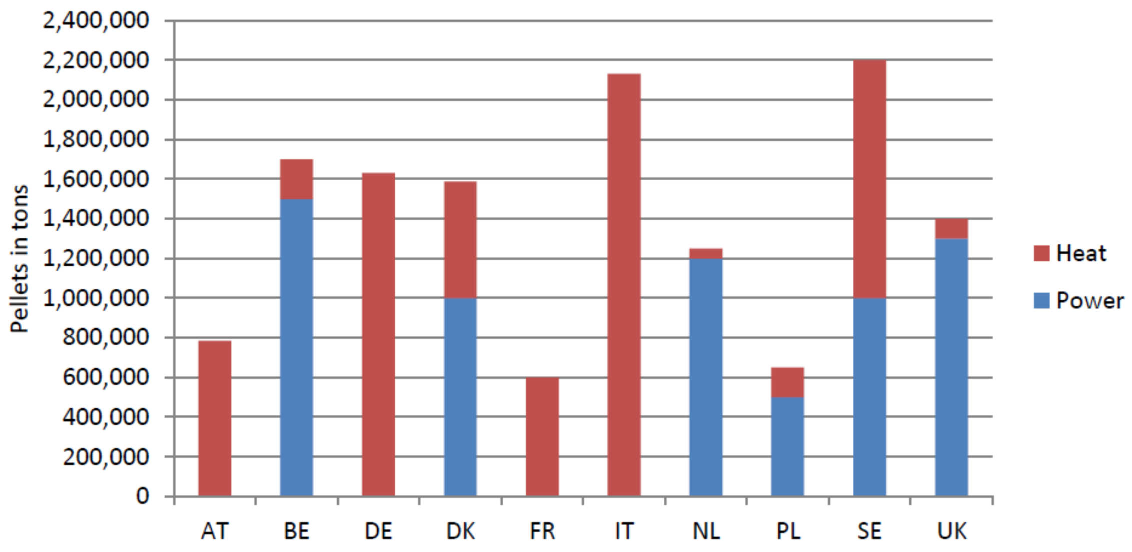


Source: AEBIOM (2013); data given in Mt

When focusing on new technological forms of bioenergy, pellets are key and the EU market has been and it is still being the most relevant international importer of woody pellets for heat (and cooling) and co-firing in large coal-fired powerplants plus industrial pellets for combined heat and power generation (CHP) and district heating and small-scale residential heating[5].

Despite that the domestic European pellet production capacity has dramatically increased during the last decade and it achieved a rate of about 80 % of self-supply in 2010, the market is being served from increasing amounts of imports.

Figure 13 Pellet Consumption for Heat and Electricity in Selected EU Countries 2012



Source: AEBIOM (2013)

There are various **types of feedstocks** used for bioenergy generation and pellet production but there is a lack of sound data regarding these figures. In general terms, industrial residues e.g. sawdust is greatly utilized where industrial integration for the production of pellets is in place, i.e. US or EU. Primary forest residues are only used in relevant amounts in some countries i.e. Finland or Sweden. Meanwhile, Brazil relies on dedicated eucalyptus plantations for charcoal production.

The decision on which feedstock is used depends mainly on economic aspects: wood energy is much cheaper than feedstocks for other purposes. Thus, the paying capacity of wood energy processing industries is lower than that for material uses.

For illustration purposes, Table 2 and

Table 3 show the share of different assortments used for bioenergy purposes in the EU and US, respectively. A recently published study (Matthews et al. 2014) deepens knowledge on this for the EU. Still, there is uncertainty on the amounts of biomass supply, particularly for those feedstocks (such as logs for heating) that do not enter into formal economic value chains.

5 In most EU countries, the majority of pellets for residential heating come from “local” sources, but there is a growing share of imported pellets being traded also within the EU, and ending up in residential pellet heating systems.

Table 2 Use of Woody Biomass for Energy in the EU (2006)

Assortment	Share (%)	Energy total (PJ)
Forest residues (mainly slash, some thinnings)	11	350
Firewood	30	953
Solid industrial wood residues	20	636
Use of refined biomass (e.g. pellets)	5	159
Spent liquors (mainly black liquor)	15	477
Used wood	6	191
Herb. & fruit biomass	7	222
Other solid biomass	6	191
Total	**100**	**3178**

Source: Junginger et al. (2010); for comparison: the total extra-EU imports were 75 PJ in 2012 (Junginger 2013)

Table 3 Share of Wood Sources for Bioenergy Plants, Fiber- and Sawmills in the US South

Wood source (%)	Energy Plants	Fibermills	Sawmills
Roundwood	1	63	88
Clean Chips	6	17	<1
Whole tree chips	33	5	0
Harvesting residues	6	2	0
Urban Wood Waste	4	<1	0
Mill Residues	38	13	2
Other	12	0	9

Source: Conrad et al. (2011)

3.5 Summary: Current Bioenergy Production and Use in a Nutshell

The demand for new uses of forest bioenergy is mainly driven by **policies** but at present, most biomass for bioenergy is consumed in traditional heating applications.

The **EU** is leading this market particularly when referring to imports. Different Member States have different strategies for woody bioenergy promotion (based on domestic feedstocks or imported biomass from nearby countries vs. co-firing based on overseas imports).

Other countries such as Brazil or the US have promoted bioenergy in general and biofuels in particular with different strategies and, to various extents, also woody bioenergy from forests.

The **US Southeast** is leading woody pellet exports to European markets. Western Canada and Russia also trade relevant amount of this feedstock.

Different **types of feedstocks** are being used for bioenergy depending on the location.

There are relevant **uncertainties on data** (feedstocks consumed, trade, etc.).

3.6 Bioenergy Production, Use and Trade in 2020 and 2030

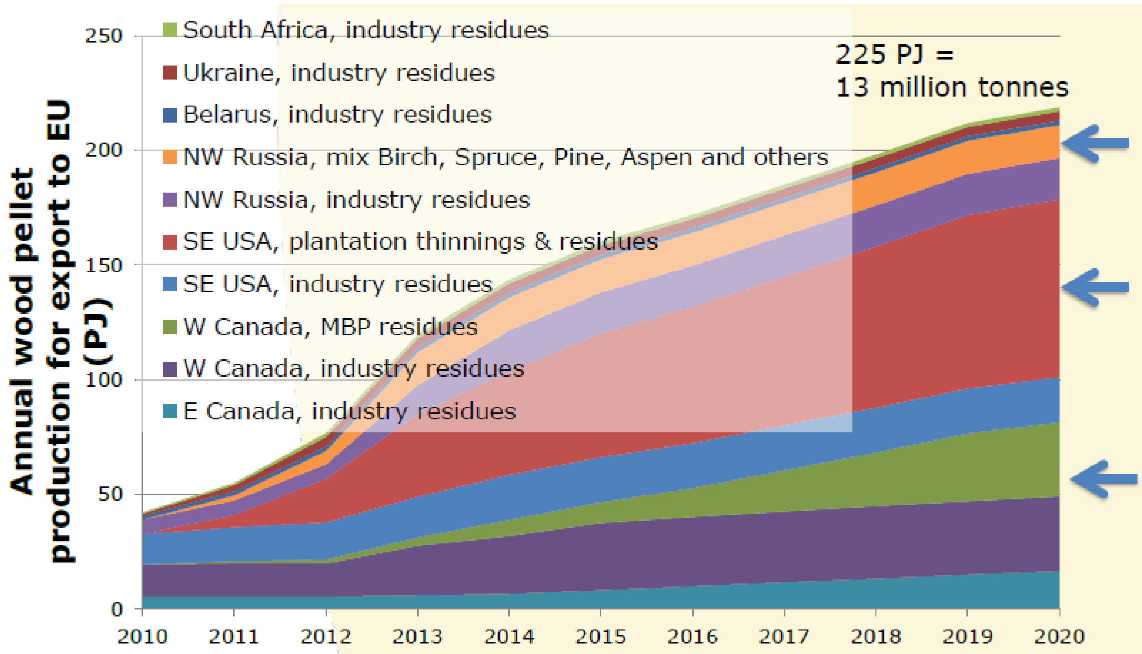
To meet these relevant increase on biomass consumption the supply based on domestic demand or on imports will vary depending on several issues such as: policies (mainly targeting climate change goals) and regulations, domestic demand (and respective availability for exporting), feedstock costs and infrastructure and logistics. How these policies evolve will determine the final biomass amount required. The evolution of the US policy in this respect will be highly relevant.

In the short term, recent studies expect that non-EU countries will also increase their use of pellets. Besides demand in Western Europe (23 Mt by 2020), Japan and Korea may use 13.5 Mt, China 10 Mt and North America 6 Mt (Goh, Junginger 2014; IINAS, CENBIO 2014).

Given current trends, some EU Member States will continue relying on imports by 2020 (e.g. BE, DK, NL, UK) mainly for large-scale co-firing. For illustration purposes, Figure 14 shows projected wood pellets import to the EU by 2020 even though recent estimates (see interviews in Annex report) indicate imports to the EU in the range of 20-25 Mt of pellets by 2020, being 80 % supplied from the US Southeast.

In contrast to this, Northern European countries use mainly domestic woody products for relatively small-scale applications, especially district heating (e.g. in public buildings) and residential pellet heating systems.

Figure 14 BAU Scenario for Wood Pellet Exports to the EU



Source: Junginger (2013)

Providing figures for 2030 is even more challenging. Nonetheless, efforts by Kranzl et al. (2013) concluded that in ambitious scenarios, woody bioenergy trade would range from 700 Mt to more than 2,500 Mt in 2030 and from 800 Mt to almost 4,200 Mt in 2050 (see Figure 15).

Figure 15 Regional Bioenergy Trade Balances

Source: Kranzl et al. (2013); median of ambitious scenarios for 2030 and 2050; data given in Mt

3.7 Summary: Bioenergy Production and Use 2020-2030 in a Nutshell

Decisions on **climate policies** by major players (e.g. USA and Canada) could affect their domestic demand for woody bioenergy, and the availability of pellets for exports, respectively.

In the short term, pellet production will dominate the trade of new technological forms of bioenergy. The entrance of new technologies in the market (2G biofuels, biorefineries etc.) might drastically shape the context but **technology** developments (including also other energy sectors) are uncertain.

Comparatively speaking, investments in pellet production are much cheaper than for other technologies.

Relevant players such as the EU-28 might rely **on imports** for a significant share of its consumption. The US South would be the major **supplier** to the EU market while West Canada could feed Pacific markets (e.g. Japan and South Korea).

The **feedstocks** used will depend on many factors such as mobilization of woody biomass for biomaterials (construction, etc.) and the respective availability of co-products, residues and waste. Dedicated bioenergy plantations (SRC) are also possible with guarantees on sustainability.

Intensification of forest management is expected if ambitious renewable energy targets are implemented.

4 Sustainability Issues

To assess the role of woody bioenergy, all three "pillars" of the sustainability concept need to be considered (though the economic dimension is less problematic). When sustainability of woody bioenergy is evaluated the focus is used to be put on the negative impacts that its development might cause and respective safeguards to avoid them. It is true that forest bioenergy might entail several negative impacts but its promotion also brings opportunities that have to be properly acknowledged. A review of the risks and opportunities brought by woody bioenergy is provided in IINAS (2014) and also considered in Denruyter et al. (2010). Then, the approach here proposed is **twofold**:

- Identifying "red lines" that need to be preserved when forest bioenergy is promoted (e.g. land use change)
- Assess other parameters for the full value chain in which forest bioenergy can result in positive or negative effects.

The **term sustainability** is widely used to express different, even divergent or contradictory, concepts. There are different approaches to sustainability (see e.g. Kaphengst (2014) in the context of land) and because of that various degrees of ambitiousness are captured within the diverse (voluntary certification) schemes. Generally speaking, loose and strict sustainability criteria can be applied and some stakeholders claim that usually a loose sustainability approach is used in the context of sustainable forest management.

Some of the risks and impacts of woody bioenergy procurement are associated to the **feedstock** (e.g. roundwood, primary forest residues, processing residues and wastes, etc…) to some extent. However, the full impacts of any woody bioenergy value chain will depend on the specific procurement conditions so categorizing the sustainability of woody biomass only based on the feedstock has several limitations. Nonetheless, there are some categories such as processing residues and wastes that are seen as **low risk** feedstocks.

This is also valid when considering the **origins** (e.g. countries or regions). Regulations (and enforcement) and performance of SFM all around the world and the particular performance of any value chain should be assessed independently. Thus, it is challenging to make generalizations about whether a forest bioenergy value chain could be sustainable when procured in a given country.

There are various **methodologies** and respective tools to evaluate the environmental and the – broader - sustainability impacts of bioenergy options, including

- life cycle analysis (LCA) to assess environmental impacts of a product or process along all stages of its life cycle
- strategic environmental assessment (SEA) which aims to ensure that environmental consequences of plans and programs are identified and assessed during their preparation and before their adoption; and
- sustainability impact assessment (SIA) which integrates the likely environmental, social and economic impacts of policies, plans and strategies.

Each of these approaches has benefits and drawbacks, and many tools are available to support the application. Apart from various voluntary certification schemes (see Section 5), several initiatives developed during the last years to assess the sustainability of liquid biofuels (and to some extent applicable to woody biomass) are: the Biofuels Environmental Sustainability Scorecard developed by the World Bank and WWF, the Inter-American Development Bank Biofuels Scorecard, the FAO-UNEP UN Energy Bioenergy Decision Support Tool, and the Global Environment Facility Biofuel Standards (see Section 3).

4.1 Environmental Aspects

The main concerns about woody bioenergy from forests at present are to do **with land use change** (e.g. natural forests to plantations or unforested state), **sustainable forest management** (including biodiversity and the harvesting rates) and impacts on **climate**. A sound understanding of the climate effects of woody bioenergy (mainly from primary forest materials) is needed – the so called "carbon debt".

When considering the sustainability of bioenergy from forests, it is useful to consider the various stages along the production life cycle from feedstock production, feedstock logistics, conversion to bioenergy carriers and respective downstream logistics, and end uses.

The impacts of primary forest biomass procurement might pose different risks when the **stand and landscape level** are assessed so both scales are needed in the analysis. The geographical scale is important, particularly for some aspects such as the carbon accounting issues and biodiversity. The definition of landscape level is still under discussion and needs consensus between stakeholders.

A potential environmental positive effect of harvesting biomass for bioenergy is that there are forest activities that become economically feasible due to the use of the biomass for bioenergy. Depending on the context, this could apply to some pre-commercial thinnings and thinnings.

The potential environmental effects of increased wood and residue removal from forests are leading to questions on sustainable harvesting levels, especially regarding ecosystem services (e.g. biodiversity, C sequestration, nutrient balances, water flow regulation, etc.). A recent review of predominantly European and North American studies (Tuomasjukka et al. 2014) on the environmental sustainability of intensive residue extraction from forests showed varied results which strongly depend on local conditions.

Some **forest bioenergy value chains** (e.g. based on primary forest residue harvesting or stumps) are quite new so long-term effects are not well known. Thus, conclusions on environmental impacts of intensive extraction from forests for bioenergy cannot be drawn from short–term studies only.

Most short term studies report no negative impacts of harvest residue extractions for example but this cannot be interpreted as a safeguard against possible **long term** adverse effects.

The next sections briefly depict main impacts, a discussion on this topic is given in Fritsche et al. (2014) and Tuomasjukka et al. (2014).

4.1.1 Biodiversity

Addressing biodiversity protection needs to consider two risk mitigation strategies:

Definition of "no-go" areas

The conversion of areas of high biodiversity value to areas used for bioenergy feedstock production can have significant negative impacts on biodiversity and ecosystems, for example, through landscape change, fragmentation and loss of ecological corridors.

The RED (EU 2009) clearly defines the statuses of areas that should be avoided from biofuel and bioliquids (e.g. primary forests, protected areas, areas with high carbon stock, etc.) production so a similar approach should be considered for forest biomass. The adaptation of some of the concepts that apply to the biofuels discussion such as that of "primary forest" maybe cannot be extrapolated straight forward and deserves more attention (some stakeholders defend that "old-growth" forests might be a more appropriate approach than "primary forest" for biodiversity consideration).

Proper management of harvestable stands

Some types of forest bioenergy harvesting (e.g. primary residues harvesting) might affect the amount of deadwood, which is an essential structural component for biodiversity. Standing dead trees and down wood and debris, biological legacies and snags as well as the various types of organisms that might be affected have to be considered. A key point after harvesting is the proper regeneration (natural regeneration, artificial regeneration with native or exotic species, etc…) of the stand to avoid land use changes and to assure that forests are maintained as forests.

4.1.2 Soil and Water Impacts

Forest biomass harvesting can affect the chemical, biological and physical properties of soils. Forest residues and whole tree harvesting can remove material with high concentration of nutrients so more intensive removal of wood biomass frequently raises concerns about whether adequate levels of nutrients can be maintained to protect site productivity. This could be compensated by fertilization; however, this does not maintain the level of organic matter in the soil.

Forests have an important role in maintaining and improving water retention capacity, protecting watersheds and maintaining clean water for streams and wetlands. Residues harvesting can affect hydrologic flows and physical, chemical, and biological properties of waterways. It is recognized that road construction is usually the greatest contributor to erosion of the nutrient-rich soil surface layers. Main impacts of residue harvesting on water and hydrology refer to ecosystem hydrologic flux (infiltration, groundwater recharge, interception and transpiration) and physical (turbidity, temperature, light infiltration), chemical (nutrients, toxic compounds, pH) and biological properties.

4.1.3 Greenhouse Gas Emissions

Bioenergy is often considered carbon-neutral, i.e. a value of zero is assigned to direct biogenic CO_2 emissions under the assumption that emissions from wood burning are offset straightaway through carbon fixing via forest growth (i.e. hypothesis of perfect carbon sequestration parity)[6]. Yet, when woody biomass is burnt for energy, the embodied C is released instantaneously as CO_2 — quite different from the time over which wood left in the forest would have slowly decomposed, or from alternative uses for longer-living products.

As forest regrowth is slow especially during the first years after final harvest, there is a **period** over which more C is emitted from forest bioenergy use than C stored in the forest system. In sustainably managed forests, regrowth will diminish this **temporal** C imbalance over time. Still, the dynamics, of higher biogenic C emissions may conflict with GHG reduction targets.

Given current understanding of the global climate system, longer-term global temperature responses to higher emissions coupled with longer-term **net** emission reductions are uncertain, as there may be "tipping points" in the climate system with regard to temperature changes to protect biodiversity or ocean acidification (Steinacher, Joos, Stocker 2013). Thus, the GHG emissions from forest bioenergy need to be considered with regard to short- and longer-term targets, and for this, appropriate climate metrics are needed - which may result in **risk levels** rather than precise quantitative figures.

There are now many peer-reviewed studies on C balances for forest bioenergy, with a good overview in JRC (2013) and Matthews et al. (2014), and discussions are ongoing, seeking broader understanding and agreement on the scientific fundamentals, and respective conclusions (see e.g. IINAS 2014; IINAS, CENBIO 2014).

Furthermore, the scope of the analysis has to address product pools (see e.g. Bird et al. 2013; Carus et al. 2014; Smyth et al. 2014), as potentially wood-based materials can displace GHG-intense materials such as cement, plastics, and steel. Under the heading of "cascading" use, this became an issue in national sustainable regulation for woody bioenergy in Belgium and is under discussion also in Denmark, and the Netherlands.

The study by IINAS, EFI and JR (2014) demonstrated that differences in terms of GHG emissions between the results for the 20 and 100 year time horizons are also quite small, showing that the **discussion of the "carbon debt" associated with forest bioenergy becomes insignificant if sustainable and low-C options** for forest bioenergy are used, and the total energy system is considered.

6 There is a common misconception that GHG emissions from bioenergy are zero because biomass will regrow or decay "anyway". This misconception is strengthened further by the UNFCCC accounting practice which allocates no direct emissions to bioenergy *in the energy sector*. However, they are accounted for under the UNFCCC *in the agriculture, forestry and other land use sector (AFOLU).*

Table 4 GHG emission reductions of various woody biomass feedstocks.

Woody biomass source for energy use	Time horizon for CO_2 emission reduction					
	short (10 years)		medium (50 years)		long (centuries)	
	Coal	gas	coal	gas	coal	gas
Boreal, stems final harvest	---	---	-	- -	+	+
Temperate, stems final harvest	---	---	+/-	-	++	+
Harvest + thinning residues, landscape care & salvage wood*	+/-	+/-	+	+	++	++
SRC on marginal agricultural land	+++	+++	+++	+++	+++	+++
SRC replacing forest	-	-	++	+	+++	+++
industrial residues, wastes	+++	+++	+++	+++	+++	+++

*-; --; ---: **bioenergy system emits more** CO_2eq than reference fossil system **in given time frame***

*+/-: GHG emissions of **bioenergy and fossil are comparable** **in given time frame***

*+; ++; +++: **bioenergy system emits less** CO_2eq than reference fossil system **in given time frame***

**For harvest/thinning residues & salvage wood, balance depends on alternative use (burning) and decay rates*

Source: own compilation by IINAS based on JRC (2013)

4.1.4 Air Emissions

Apart from GHG emissions, airborne life-cycle emissions of **non-GHG pollutants** from bioenergy related to air quality need to be considered. In this, emissions of SO_2 equivalents, emissions of PM_{10} (which also includes black carbon) and air toxics (e.g. heavy metals, volatile organic compounds) have to be taken into account along the full value chain.

In addition to emissions from transport, small scale combustion of fuelwood (logs or other small dimension pieces of wood) can result in severe air quality impact (particulate emissions) and respective impacts on health mainly when considering inefficient combustion at the household level in developing countries (see section 6.4.).

4.2 Social Aspects

Social aspects of forests are of utmost relevance when addressing sustainability. Those social aspects range from the tenure and ownership side to the cultural values of forests, including the role of forest to provide non-timber forest products. The social aspects to be brought to the discussion might be different in developing and developed countries since challenges are different:

Displacement effects: Given the reliance of 2.6 billion people in developing countries on traditional biomass, assurance that new technological development of woody bioenergy will not significantly impact fuelwood security is key. This displacement could pose as well risks to markets which are already developed such as that of the pulp and paper industry or offer opportunities in places where traditional forest industries are declining.

Forest tenure and ownership regimes are particularly challenging in developing countries. The Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security (VGGT; CFS 2012) is a worth noting effort in this respect. With the general goal of contributing to food security, the VGGT particularly seeks to improve tenure governance, support the improvement and development of the policy, legal and organizational frameworks, enhance the transparency and improve the functioning of tenure system and strengthen the capacities and operations of stakeholders. Within the framework of the REDD+ initiative (Reducing Emissions from Deforestation and Forest Degradation) mechanisms to address tenure and ownership are also considered.

Employment and Rural development: Establishment of bioenergy supply chains to replace energy from fossil fuel can create local industry and employment and add value to local economies. It may prevent depopulation in certain areas.

Food security. The food versus fuel argument has gained much attention in recent years but not necessarily in the context of biomass from forests. However if strong energy security concerns drive very ambitious bioenergy targets, a situation may arise where there is competition for land between short rotation forest plantations and food crops. When procuring biomass forests, the role of forests on food security has to be kept in mind.

4.3 Economic Aspects

In recent years, more attention has focused on the overall economic sustainability of forest biomass production. Biomass from forests should be economically viable for the different actors in the value chain or it will not be extracted. **Competition** with other energy sources such as fossil fuels like coal, and other end users of woody biomass e.g. the pulp and paper industry, are important considerations. Energy from woody biomass often requires incentives and subsidies in order to compete with cheap coal and gas, however the consequent increase in value of woody biomass puts the energy industry in direct competition with end users such as pulp, paper and chemical processors who would argue that such incentives compromise the viability of their respective industries. On the other hand, increasing the price of the biomass can provide higher revenues to the forest owners.

The **competitiveness** of biomass-based energy generation strongly depends on the cost but this varies between the new technological applications (electricity and transport fuels) and heating and cooling applications.

Mitigating climate change is one of the main reasons why renewable energies receive policy support. Thus, the potential of GHG emission reductions from woody bioenergy systems is a key factor of its attractiveness, but - as there are alternative options to reduce CO_2 such as wind and solar energy or efficiency measures - also respective costs have to be considered. The cost of bioenergy from woody biomass depends on the wood source and the conversion technology. Typically, within the EU there are three types for this:
- biomass power plants using local forest residues,

- biomass co-generation unit using local wood chips, and
- large-scale co-firing in coal powerplant with imported pellets.

The **cost-effectiveness** of GHG emission reductions by woody bioenergy depends on the source of the woody biomass, the reference system it is compared with, and the time horizon for the comparison (short- versus long-term). Currently**, co-firing** woody bioenergy in coal power plants is among the most cost-effective near-term options in terms of GHG reduction. Co-firing is **still more expensive** than electricity from coal and it is not economic under current EU conditions. Main options to change this situation are either supplying cheaper feedstock or increase the prices for CO2 certificates under the European Trading System (ETS) or promoting alternative support and financial aid. As shown in Figure 13, various EU countries have developed different strategies for woody bioenergy use and particularly promote co-firing[7].For heating and cooling, fossil taxes are already high (in industrialized countries) or wood prices low/non-existent (in developing countries) so that fuelwood is already "competitive" in many cases.

[7] i.e. IINAS (2014) further discusses this issue with concrete examples for Germany and UK.

4.4 Summary: Sustainable Woody Bioenergy in a Nutshell

The **definition** of sustainability should embrace the ‘triple bottom line’ approach: i) people, ii) planet and iii) profit.

The definition of sustainability is often **not properly** agreed between stakeholders and usually a “**loose**” approach is applied (i.e. low ambition).

Assessment of forest biomass sustainability should consider especially the **landscape level.** A better understanding of the landscape level definition is needed, though.

Different feedstocks pose different degrees of **risks** on different sustainability issues (e.g. biodiversity, soils, climate change, etc…) and their performance in terms of sustainability will depend on how they are supplied. A list with positive and negative feedstocks is too simple – but in general, **low risk** feedstocks are forest residues (from thinnings and final harvest), wood industry wastes and postconsumer wood.

A rigid categorization of **origins** is not possible, as forest regulation and implementation in major producing countries is quite different so that risks of forest bioenergy promotion are also different. There are examples of good and bad performance all around the world.

Main concerns related to woody bioenergy are land use change (e.g. natural forests to plantations or deforestation), sustainable forest management (including biodiversity and harvesting ratios) and impacts on climate. Social aspects and indirect effects and the overall limits of forest resource base (land restrictions) have to be considered.

A sound understanding of the **climate effects of woody bioenergy** mainly for primary forest materials is needed to address the so called “carbon debt”. When sustainable and low-C options for forest bioenergy are used, the “carbon debt” discussion is less relevant, though.

The precautionary approach should be the guiding principle where potential impacts are not well known.

Cascading use of biomass is a relevant principle to be acknowledged. However, there is a lack of common understanding of what it means, how it might be applied at different locations and how it might be implemented. Some traditional forest sectors (e.g. pulp and paper industry) already apply this principle.

5 Promising Sustainability Initiatives

There are many initiatives from various sectors (at various levels in the forestry sector, biofuels, and specific initiatives for woody bioenergy) that have to be identified and mapped to have a good understanding of the sustainability landscape, identify potential synergies between activities and see where the gaps in terms of sustainability requirements at various levels are. These activities are greatly diverse, attending to different features:

- Type of scheme or regulation: mandatory or voluntary
- Type of bioenergy: biofuels vs. solid vs. all types (incl. gaseous)
- Application level: international, regional or national
- Sector of origin: energy vs. sectoral (forestry, agriculture)
- Scope in sustainability: environmental vs. holistic approach.

5.1 Overview of Sustainability Initiatives

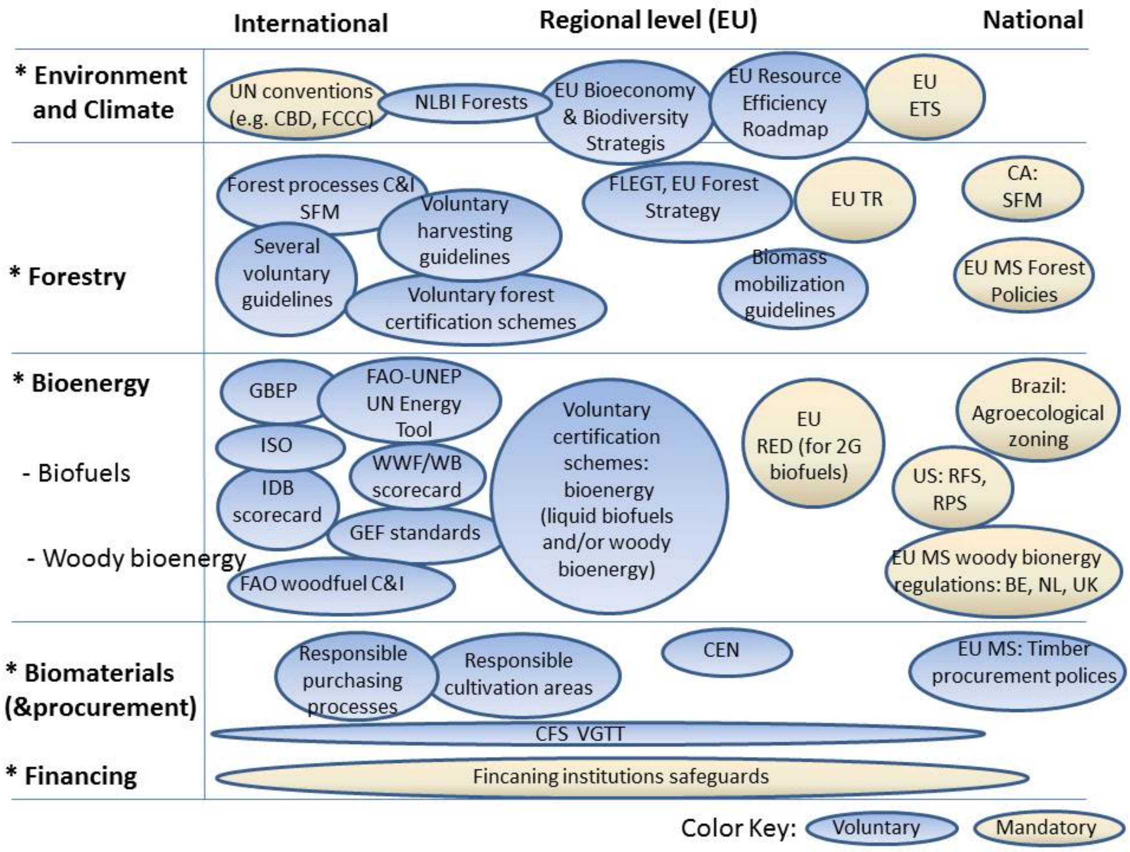
Figure 16 illustrates selected activities relevant for shaping the sustainability of woody bioenergy with regard to the targeted sectors and level of governance[8]. This report will not depict all these initiatives in detail since extensive literature can be found elsewhere. Nonetheless, a list of full references is provided at the end of the report.

At the mandatory level and based on the EU RED (EU 2009) logic, major European (pellet) importing countries such as BE, DK, NL and UK are developing specific frameworks to consider woody bioenergy sustainability. There are also initiatives that interact with the voluntary side such as the Sustainable Biomass Partnership (SBP) of major EU electric utilities or the voluntary forest certification schemes.

As stated in the WWF Living Forest Report (WWF 2011), very few countries have introduced new forestry regulations to address issues specific to the harvesting and use of forest biomass for bioenergy.

[8] The sub-section "Additional references - Initiatives related to forest bioenergy sustainability" briefly provides a full list of references of the various initiatives from various sectors related to sustainable forest bioenergy that have not been explicitly mentioned in the text (see Figure 16).

Figure 16 Map of selected initiatives related to sustainability of forest bioenergy



Source: own compilation by IINAS

5.2 Governance of Sustainability

The **governance** architecture of woody bioenergy sustainability is diverse and requires coordination and harmonization. Figure 17 synthetizes the various alternatives to assure sustainability of forest bioenergy taking into account the most directly related initiatives and putting the focus on the EU angle (as importer from somewhere else):

On the **international level**[9] various initiatives exist with different objectives and applicability.

- The **GBEP** aims to guide the bioenergy analysis undertaken at domestic level in order to inform decision making and for that it has developed a set of comprehensive sustainability indicators in the environmental, social and economic domain (see: GBEP 2011).

- The **International Standardization Organization** works on a standard addressing sustainability issues related to bioenergy production (ISO 13065)

[9] The various international conventions are translated into national regulations. For bi-and multilateral trade, World Trade Organization (WTO) principles need consideration particularly when mandatory systems are developed.

- **Financing institutions and donors safeguards**. Financing institutions (e.g. World Bank, regional development banks) - and donors (e.g. GEF, bilateral agencies) need to require specific sustainability safeguards, including woody bioenergy projects.

- The **voluntary guidelines** comprise a list of several global or regional initiatives related e.g. to the forestry sector (for example for plantations such as the New Generation Plantations[10] initiative of the FAO (2006) voluntary guidelines for responsible management of planted forests) or to land (Voluntary Guidelines on the Responsible Governance Tenure of Land, Fisheries and Forests in the Context of National Food Security; CFS 2012)

From the EU point of view (which is expected to be a major importer), the main pathways to sustainability are described in Figure 17. Basically, there could be three ways:

- Passing **binding** specific sustainability criteria for solid biomass: this could be at the EU level, which is not expected in the short term (Volpi 2014) or by means of specific national legislation by major importers (e.g. UK, NL, BE).
- The **voluntary systems** might be based on various approaches:
    - Forest certification schemes (e.g. FSC[11] and PEFC[12]), biomass (for all type uses)
    - Certification schemes such as the Roundtable on Sustainable Biomaterials (RSB)[13]
    - Initiatives promoted by the industry[14] (e.g. the Sustainable Biomass Partnership – SBP).
- The third pathway implies to assume that **other** policies and regulations (at various levels and from various sectors) would be enough to meet sustainability targets.

Nowadays there is not yet a comprehensive scheme that considers all fundamental aspects of woody bioenergy sustainability. Voluntary forest certification schemes do not have specific modules for GHG accounting (taking into account iLUC and forest C stock changes) but some efforts are being made in this direction.

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[10] http://newgenerationplantations.org/

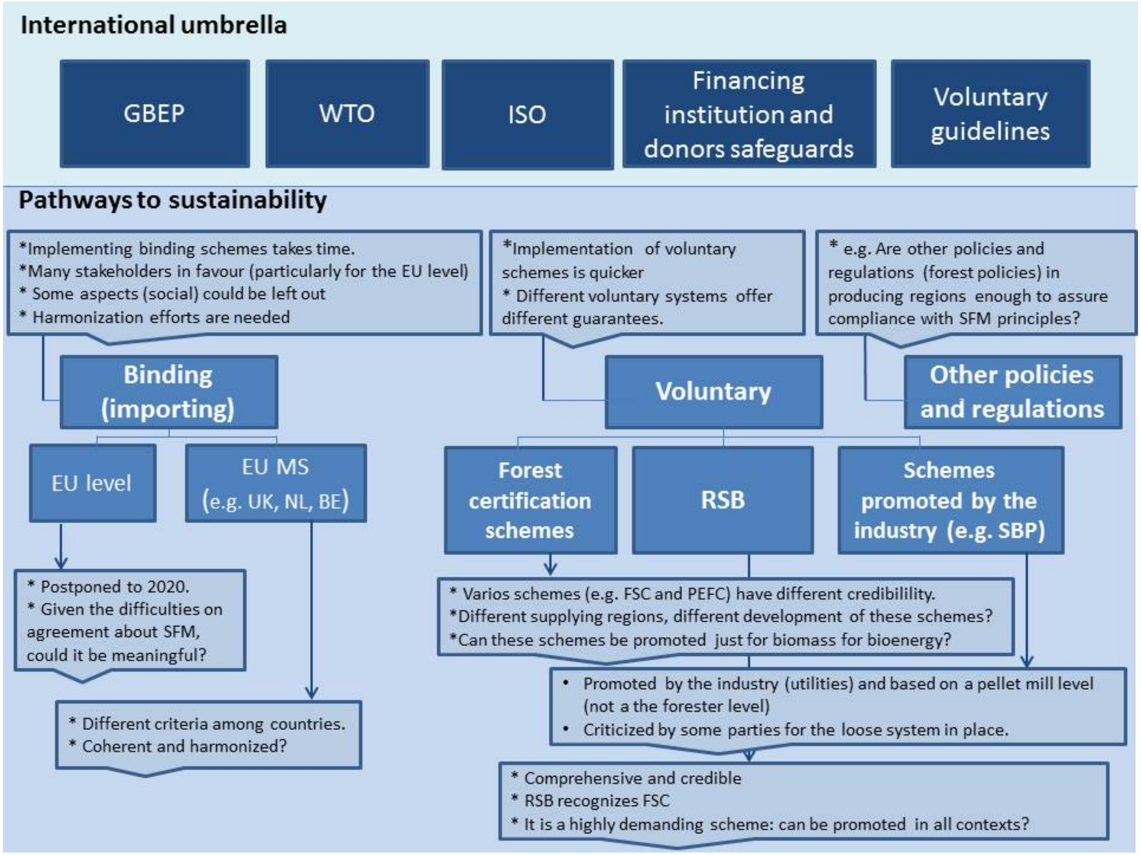
[11] https://ic.fsc.org/

[12] http://www.pefc.org/

[13] http://rsb.org/

[14] SBP: http://www.sustainablebiomasspartnership.org/ Also, there are other initiatives that might apply such as International Sustainability Carbon Certification –ISCC- (http://www.iscc-system.org/es/) or Green Gold Label – GGL- (http://www.greengoldcertified.org/site/pagina.php?)

Figure 17 Overview of the Landscape of various Alternatives to Assure Sustainability of Bioenergy from Forests



Source: own compilation by IINAS

In general, stakeholders prefer a **binding** sustainability system. The best solution might be to develop an international mandatory scheme but this seems quite unlikely at the time being. Second, national binding systems as those in progress within some EU countries could be effective but this might carry some difficulties in trade if these schemes are not properly coordinated. In parallel, **voluntary** certification schemes provide some advantages such as a faster implementation and should be promoted while national legislation is developed. In that regard it is important to keep in mind that recently the EC (Volpi 2014) announced **not** to propose binding sustainability requirements for solid and gaseous bioenergy before 2020.

It is not only important to have voluntary schemes but also to ensure their quality to avoid that voluntary verification or certification becomes a *race to the bottom.* In this, efforts should be made in order that certification schemes meet **ISEAL credibility principles** (sustainability, transparency, relevance, accessibility, efficiency, engagement, impartiality, Improvement, rigor, truthfulness).

The recently WWF published report of on the comparison of the certification schemes for biofuel production approved to comply with the EU RED requirements (WWF 2013). The study measured performance of the standards against WWF sustainability criteria, identified strengths and weaknesses of each scheme and provided some policy recommendations.

Among those, the report concludes that many standards poorly performed against the WWF criteria and that *many standards do not adequately address transparency in public reporting, internal system governance, and audit scope and intensity.*

Considering the difficulty of enforcing comprehensive mandatory systems at a relevant scale and the limited impact of the voluntary certification schemes in some contexts (i.e. SFM certification schemes have little coverage in some regions such as US Southeast or the tropics), an effective solution might be that **financing institutions** require the compliance with sustainability standards at project level. Since many bioenergy investments need financing, this approach overcomes the barriers that the mandatory systems may face under the WTO context and offer the opportunity to bring not only environmental criteria but also social requirements.

The development of sustainability criteria for biomass solely when it is for bioenergy is bringing some other concerns: should these sustainability requirements be extended to **all biomasses** regardless of their end use? In order to avoid “sustainability leakage” and create the same playing level field, many stakeholders defend this position. This also raises the question for the energy sector: should all types of energy (fossil fuels or other renewable energies) be subject to the same sustainability approach?

For the **safeguarding**, agreement on sustainable forestry **management requirements** is fundamental. This should acknowledge and embrace the different challenges in the forest biomes (boreal, temperate, tropics) posed by increasing demands for lignocellulosic feedstocks (whatever the use of those), and should build on the voluntary “precursors” such as FSC and RSB, but needs to reach out to the broader political landscape:

The REDD+ process, timber trade regulations and (forestry and infrastructure) project finance (e.g., World Bank/IFC, private sector banks) are windows which need to be used in parallel to the (mainly EU-driven) policies to “risk-hedge” woody bioenergy trade - and in perspective also lignocellulosic supply of forest products for biomaterials, biorefineries and the bioeconomy in general, including advanced biofuels (see Section 6.3).

5.3 Summary: Sustainability Governance in a Nutshell

There are **many initiatives** from the forestry and the bioenergy sector related to woody bioenergy. It is important to apply **experience** already gained in other sectors to woody bioenergy.

These initiatives are very **diverse**, apply to various geographical levels and differ in scope and vision. At present, there is **no comprehensive scheme**.

Simplification, coordination, alignment and harmonization of these initiatives are needed. As stated in the *Forest Living Report* (WWF 2011) a single coherent framework is needed.

Binding sustainability requirements are preferable but the advantages of **voluntary** schemes need to be recognized (e.g. rapidness in implementation). Both could be developed in parallel. When focusing on some developing countries, restricting trade of wood certified material is required. The potential **binding** criteria should be aligned with proposals from the forestry sector and be required to **all** feedstocks regardless where they are produced, and for which market segments.

Currently there is a proliferation of initiatives with different requirements which creates confusion, and possibly market distortions.

Sustainability criteria at (large) **project levels** should be required through **financing institutions** since many initiatives need relevant investments.

Ambitious sustainability schemes (e.g. RSB) are very credible but show low market shares. Most promising initiatives might be:

- Voluntary forest certification schemes: FSC has a higher credibility than PEFC, but the latter shows higher market acceptance. Both lack of some sustainability criteria to embrace the full value-chain (e.g. GHG reduction requirements taking into account iLUC and forest C stock changes). However, due to the low price of the feedstocks for bioenergy it seems unlikely that these schemes are implemented for the only purpose of bioenergy.
- The Sustainable Bioenergy Partnership and other industry standards such as Green Gold Label promise acceptance from electric utilities, but lack ambition especially on GHG emission reduction. They consider social issues, though.
- The Roundtable on Sustainable Biomaterials (RSB) which already collaborates with FSC seems the most promising voluntary approach.

Other relevant initiatives to be considered are the “Dutch Energy Agreement” which builds on NTA8080 and FSC and involves industry and NGOs as stakeholders (to be published in summer 2014), a similar Danish governmental activity and the Forest Europe process.

6 Bigger Picture: Interaction between Biomass for Energy, Forestry, and the Bioeconomy

This section briefly presents broader implications of developing bioenergy – and more general: the bioeconomy – for the traditional forestry products such as timber, pulp and paper, etc. The sketching of respective global and regional dynamics prepares the base for the recommendations in Section 7.

6.1 Interactions within Forestry Management and Operations

As discussed in Section 3, a key challenge is to "align" current forestry practices (and respective management) with the bioenergy and bioeconomy dynamics, which imply growing demand for lignocellulosic feedstocks. As stated by Matthews et al. (2014) for the EU context, forest management will need to change to meet demands for forest bioenergy, and with that, certain wood feedstocks will be more likely harvested and certain forest management practices more likely occur than others. In addition, the interlinked global food system (agroforestry, water management) and sustainable land use (stopping degradation, erosion, landscape diversity…) requirements need reflection.

Given the "nexus" character of these dynamics (biodiversity, carbon, energy, food/feed, land, soil, water)[15], it is most important to **identify and implement** both key **safeguards** (see Section 5) and **synergies** between the traditional forestry sector (with its own diversity and regional variations) and its management, and future bioenergy and bioeconomy requirements.

For **synergies,** it is crucial to further implement and mainstream sustainable **forestry practices** from respective showcase examples, which go beyond the traditional forest management by establishing **cross-sectoral** links: examples here are agroforestry, "green walls", and water-smart wood plantations (SRC) which deliver on **multiple** benefits. In that regard, also **non-timber** forest products such as e.g. phytomedical substances and fruits as well as **landscape functions** such as erosion and water control, ecological stepping-stones and corridors need to be considered, depending on scale and socioeconomic settings. Given the potential challenges on the social side (see Section 4.2), the cross-sectoral synergies should also consider sustainable fuelwood supply, and respective transition pathways.

A recent international workshop on GHG balances of woody bioenergy pointed out that forest management is responsive to markets and often has a long-term focus – yet, there is currently no revenue from C storage in forests (EEA, IEA Bio, IINAS, JRC 2014). Policies frame markets for bioenergy, and forest product markets and forest management react to that. As forests are multiple output systems and forest product markets are interlinked, there is no easy approach to "steer" forest management from a single viewpoint such as bioenergy.

[15] For the broader "nexus" debate on energy, food and water see http://www.water-energy-food.org/. There are also links to biodiversity, climate, land and soil degradation, and the respective socio-economic conditions and dynamics – especially the livelihoods of people. So far, some case studies illustrated the nexus approach (http://nexus-assessment.info/), but is seems more a conceptual issue than one allowing policy implementation.

6.2 Resources Competition: It's the Economy, Stupid!

To illustrate the relative role of the different global biomass uses and the respective role of forest products in that, the following figure provides key benchmark data.

Table 5 Global Biomass Use for All Human Activities

Biomass Use	Energy Equivalent [EJ]	Shares of Use
Fibers (e.g. textiles)	**1**	**1%**
food & feed	**128**	**72%**
- of that: cereals & rice	64	36%
- of that: vegetable oils	13	8%
- of that: feed from grasslands	50	28%
wood	**50**	**27%**
- of that: for materials	26	14%
- of that: for energy*	24	13%
total	**179**	

*Source: IINAS calculations based on various sources; *= Wood for energy use is in the low range of estimates provided in the literature – note that there is significant uncertainty about the consumption of wood for energy*

As this table indicates, current global biomass use is dominated by the food and feed system, while demand for wood represents less than 1/3 of all biomass uses.

Given that the global energy system needs decarbonization in the decades ahead (2° C target) in parallel to shifting away from fossil feedstocks, demands for lignocellulose from both **existing** forests and **new plantations** (including SRC) will increase significantly.

This is **independent** from strategies to increase resource efficiency such as cascading that surely can increase overall output per material input: Even the best multi-stage cascades need input feedstocks, and the amount of biogenic residues and wastes will necessarily be smaller than the input of "virgin" material.

The magnitude of the potential future bioenergy and biomaterials demand for lignocellulose up to 2050 is in the order of 150 EJ (range: 100-200 EJ) on the energy side (mainly for aviation fuels, some process heat, and advanced small-scale cooking/heating). Further 50-100 EJ (energy equivalent) will be needed for biomaterials (including construction materials) which would supply approximately the same amount in terms of energy value after the useful "material" product life. This is in line with the estimates in the WWF Energy Report (WWF, Ecofys, OMA 2011) where 66 EJ of demand for material feedstocks is assumed by 2050, in addition to the bioenergy uses.

Today's segmentation and separation of wood markets for "energy" and "materials" will become less prominent (see Section 6.3), and allocation of respective raw material to specific end-uses will be driven by the overall economics: it is less competition in terms of mass (or energy) but in **terms of revenue**, i.e. prices being paid, and **marginal** volumes being traded.

As policies shaping the energy markets (e.g. feed-in tariffs, quota systems, carbon payments) favor revenues from this sector, low-quality wood products with small **revenues per unit** will face more and more price competition from the bioenergy sector, including (advanced) biofuels and biorefineries (see Section 4.3). Depending on infrastructures, also "free" uses of forest products such as fuelwood may well come under pressure (see Section 4.4).

On the other hand, improvements of resource efficiency will favor higher-value wood products (timber, biomaterials…), and some of the traditional low-quality wood markets (pulp & paper) may actually shrink, at least in some regions (Infodur 2013). Thus, even comparatively low revenues from energy markets may attract low-quality feedstocks without displacing previous uses in other sectors (e.g. US Southeast market developments favoring pellet exports to EU). Bioenergy could particularly compete with panel and pulp and paper sectors for the same type of low-quality woody feedstocks but respective market developments are uncertain.

Given these expected dynamics, careful cross-sectoral market policies (incentives…) and regulation (safeguards) which consider global system feedbacks need to be developed.

6.3 Biorefineries and Advanced Biofuels as "Backbones" of a future Bioeconomy

Much buzz is in the media about the "bioeconomy", and fuzz generated regarding the role of synthetic biology, gene-"tailored" plants and multipurpose algae as **the** new and green resource base. Surely, technical developments in these fields can be expected in the coming decades, and might actually enter and shape markets to some extent. Still, the mass markets for future lignocellulose demand – and thus the ones influencing forestry, wood product use and respective land use - will be less in high-value specialty chemicals, cosmetics, food additives or pharmaceuticals but in the "smart" constructive industry (e.g. wood fiber composites), some bioplastics (e.g. for packaging), and platform chemicals such as ethanol, syngas, and possibly substitutes based on lignin.

Given that decarbonizing transport is especially challenging for aviation fuels, one can expect respective advanced technologies to convert lignocellulose into liquid fuels as medium-term game changers. Hybrids such as biorefineries aiming at liquid and/or gaseous bioenergy carriers in combination with platform chemicals, food/feed/fertilizer components (e.g. proteins) and fibers are starting with low-cost feedstocks such as straw, but will need to access the broader forest resource base due to the limitations of sustainable straw extraction with regard to soil quality, and carbon emissions.

6.4 Potential Impacts on Developing Countries

Although this study excludes the particular situation of fuelwood consumption in developing countries, there are some general points to bear in mind:

About **2.6 billion** people in developing countries rely on inefficient and unhealthy consumption of woody biomass to cover their basic energy needs such as cooking and heating, and often, respective wood comes from unsustainable supply. Future woody bioenergy exports from such countries might actually displace respective local fuelwood use, but no major role of developing countries as woody bioenergy exporters to international markets is expected in the short term (IINAS, CENBIO 2014).

Traditional fuelwood use is a key underlying cause of diverse problems such as mortality due to indoor air pollution from stoves, and deforestation and forest degradation from fuelwood supply. Despite international initiatives to shift to clean energy in developing countries (i.e. the Global Alliance of Clean Cookstoves, UN Sustainable Energy for All Initiative), traditional bioenergy use is expected to remain high (IEA 2012). WWF has a more ambitious vision in this respect as shown in the WWF Energy Report (see section 4.2), and to fulfill this vision, more activities and strong policies are needed beyond the current levels.

The development of international woody bioenergy markets and the related international trade **could** become a window of opportunity to **improve** sustainable woody supply to meet fuelwood demand **if** export-oriented investments were coupled to investments in sustainable forest management, as e.g., South Africa did with regard to investments in biofuels and respective coupling to agricultural improvements.

6.5 Summary: The Broader Context in a Nutshell

Woody bioenergy has a "**nexus**" to many other issues such as traditional forest management, climate, food, land, water etc.

Both identification and promotion of key **safeguards and synergies** between sectors is needed.

Sustainable forest practices delivering on **multiple benefits** (e.g. agroforestry, green walls, etc.) and reflect social needs require mainstreaming.

As biomass demand will **increase** in the next decades, there will be a need for both new forest plantations and intensification of managed forests.

Both IEA and WWF project around 100 (50-150) EJ for **bioenergy** by 2050, and about 50-100 EJ (energy equivalent) might be used for **biomaterials**, including construction materials which would supply about the same amount in terms of energy value after the useful "material" product life.

Competition will not be in terms of amount of material but on terms of **revenue** (prices). Currently, the paying capacity for bioenergy (mainly pellets) is often lower than for material uses, but prices of forest products are subject to change.

There might be opportunities for bioenergy to develop without major displacement of some material uses, and the **forest industries** have a window of opportunity to shift to bioenergy.

Advantages and synergies from the promotion of woody bioenergy markets based on new technological uses should be particularly considered in **developing countries.**

7 Recommended Next Steps

The following section derives key points for further discussion, and suggests items for WWF International to consider in the development of a forest bioenergy strategy. The listed items are based on findings of this study, own understanding of the study team and inputs received from stakeholders interviewed. The section does not assume that all items and suggestion have the same relevance or that all stakeholders would agree. As much of the discussion on forest bioenergy is passionate and has been polarized, the section offers views and thoughts to focus on a more "productive" approach.

7.1 Resources for Bioenergy: Which, How Much, from Where?

Which Woody Biomass?

There is a need for clearer **definitions** of woody feedstock categories to foster understanding between stakeholders from the "realms" of biodiversity, climate change mitigation, energy, forestry, and land use that all relate to woody bioenergy from forests.

Avoid **"**one-size fits all" generalizations about sustainability. Nonetheless, an agreement should be possible on what low-risk feedstocks are. Based on that, further discussion might address the performance of other feedstocks. In this regard, efforts should be made to clarify the definition of "critical" stemwood use, defining what "high" and "low" quality stemwood is. On the other hand, there is a dominant negative perception on forest plantations although the experience gained during the last decades indicate that there are now much more sustainable options available (e.g. Bahia initiative in Brazil)[16]. There **are** opportunities to mainstream sustainable forest practices that deliver on **multiple benefits** (e.g. agroforestry[17], green walls, etc.)

How Much?

Beyond the conceptual agreement that biodiversity conservation, climate change mitigation and resource efficiency improvements[18] are crucial for any form of sustainable development, the understanding of possibilities and impacts

- of promoting **biomaterials**, e.g. as lignin-based bioplastics for packaging and wood composites as construction materials with subsequent cascading use and
- of advancing the **bioeconomy** in general, based on sustainable biomass supply

needs **balancing** with opportunities and risks of woody bioenergy use, as those are crucial as near-term non-fossil options.

At least for a **transition period** from 2020 to 2050, lignocellulose from forests as well as from perennial crops are needed in parallel to sustainable residue extraction from agriculture (e.g.

16 See also examples given at WWF's New Generation Plantations platform http://wwf.panda.org/what_we_do/footprint/forestry/sustainablepulppaper/ngp_platform/

17 See e.g. the CIFOR activities http://foreststreesagroforestry.org/

18 Under this term, also land and water use efficiency as well as maintaining ecosystem services are considered, i.e. it follows a **nature capital** logic.

corn stover, straw, rice husks) and use of manure, and grass cuttings[19] in order to replace fossil fuels **both** in the energy and the material sectors. Still, GHG mitigation through more intense use of biomaterials **alone** will not deliver on required reductions, and though some of the lower-value wood uses in the construction and furniture sector allow temporal carbon storage, these uses may also delay near-term fossil fuel displacement and respective GHG reductions[20].

Furthermore, the availability of low risk woody biomass (by-products, residues and waste) for bioenergy under the cascading approach requires "virgin" inputs of woody biomass, i.e. focusing on residues and wastes just shifts the "burden" of sustainable supply from bioenergy to other biomass uses. The (sustainability) governance of these other sectors might prove to be less effective (or ambitious) as in the bioenergy sector which still receives significant governmental and market support.

Beyond Efficiency: Sustainable Consumption Levels

The expression and severity of sustainability impacts of woody biomass supply mainly depends on the **amount** of biogenic resources mobilized. Surely, the management of its cultivation and harvest are also relevant, but even the most ambitious sustainability certification scheme still is necessarily ignorant about the total level of supply (and demand), as it only can address a certain area or specific production volumes.

Hence, the issue of sustainable **consumption levels** must be brought into the discussion, at least in the longer-term: Given the limited land (and forest) area and growing numbers of consumers with growing economic "wealth", a sustainable bioeconomy concept for woody biomass needs to reflect on resource efficiency (cascading use etc.), but also to address which uses of woody material are fundamental (and for whom) and which types **and levels** of woody biomass consumption are not "sufficient", as competition for resources such as land and water and ecosystem functions prevent to supply "enough".

It must be underlined that **distributional** effects (who gets what) are the core of this discussion and that such effects need to be consideration in the realm of policy, not science.

In preparing and supporting such considerations, science as well as civil society stakeholders have a role to play, though: Elaborating the (positive and negative) tradeoffs of woody biomass development options, demystifying claims of "(bio-)technology will give the answer", identifying sustainable practices and transparently argue for synergies as well as perceived limits and social implications will allow dialogue.

From Where?

Not all countries (and regionals within) have same forest contexts, the same governance of forests (regulations and respective enforcement) nor the same economic and social settings (and dynamics) so that generalizations about sustainability performance at the country level might not result in the right answer –the scale of what "landscape" means is still disputed.

19 Woody material from landscape care and nature protection area maintenance should be seen also as potentials, though their overall potential is quite low and costs are comparatively high.

20 This is valid for woody bioenergy feedstocks with a short C "payback time", i.e. low-GHG risk feedstocks.

Depending on the strategy adopted by countries (consumption of biomass based on its own resources vs. imports, or exports of "excess") different trade patterns might origin. Long-distance transport has costs and GHG emissions implications, but once technological developments and policy support allow torrefied wood products and advanced lignocellulosic biofuels to enter markets, concerns regarding transport will become less relevant.

7.2 Sustainability Governance: Do We Live in the Same World?

Actors in the bioenergy sector currently discuss and reflect work on sustainable forestry from the last decades, especially both voluntary and mandatory initiatives at international, regional and country levels. In addition to benchmark sustainability criteria and operability of the schemes targeting woody bioenergy, there is room to improve the **governance** of the sector in general.
As stakeholders have different **understandings** on what sustainability is, promotion of dialogue aimed at improved understanding and on practical issues such as promotion of voluntary certification schemes will be useful.

A minimum set of sustainability **requirements** independent of where forest products are from and for what they will be used (energy, materials, domestically or exported) should be considered the **overarching goal** of this discussion.

In that regard**,** requirements for woody bioenergy need complementing by extending equivalent sustainability requirements to **all biomass** types regardless of end-use (e.g. food, feed and fiber)[21].

When assessing sustainability often **red lines** are established. Communication on woody biomass should recognize these "no-go" thresholds (i.e. in terms of land use restrictions or minimum GHG emissions savings) but should also aim at positive implications (e.g. improved biodiversity, higher water use efficiency, rural income, social inclusion etc.).

Shaping markets

Forest regulations in main exporting countries (CA, RU, US) are very **diverse** in addressing sustainable forest management and apply quite different approaches. In parallel, exporting countries in the developing world need to improve their domestic forest and **land tenure** policies, building on existing voluntary guidelines (CFS 2012).

With the recent decision of the (current) European Commission to abandon plans of mandatory sustainability requirements for woody bioenergy at least until 2020, the role of "regionalized" approaches such as the Forest Europe process, multilateral agreements between governments (e.g. the GBEP) and voluntary schemes of key private sector actors (e.g. SBP) become of high importance. Still, the new European Commission and the new European Parliament should be called upon to reconsider a coherent regulation of the bioenergy market.

Whatever the outcome, comprehensive sustainability requirements for woody bioenergy need to address not only biodiversity and GHG emissions, but also crucial social issues such as food

[21] One can go even further by asking for equivalent requirements for non-biomass resources, i.e. both fossil fuel value chains and other renewable energies. It is beyond the scope of this study to reflect on this, though.

fuelwood and land tenure security. Respective mandatory requirements may face challenges under the WTO rules so that alternatives need to be considered.

For this, **international finance institutions** - especially the World Bank and the regional development banks - and **donors** (e.g. GEF, bilateral agencies) need to require specific **sustainability safeguards** for (larger-scale) woody bioenergy projects, as this will not be subject to WTO challenges and could fully endorse comprehensive sustainability criteria. The current review of the World Bank Safeguards is a key opportunity for this and must be seen as a window of opportunity.

Last but not least: If the pace of growth of markets is too fast, this might create distortions and lack of capacity to adapt to new contexts that both impede sustainability. Thus, the dynamics of implementing sustainable woody value chains requires careful analysis.

7.3 The Broader Picture

No Simple Messages

Bioenergy is closely interlinked with the energy, forestry and agriculture sectors – and in the end, with land use. Assessing bioenergy without considering these closely related sectors will result in biased answers – a vision of the "whole system" is needed, even if it is complex.

The view of the WWF Energy Report with respect to feed and food is highly valuable but not too many references are made to woody biomass for material uses. In that it is necessary to take into account counterfactual scenarios (i.e. the "no biomass" cases for the energy, material and land sectors).

The discussion on which type of bioenergy end-uses is "preferable" (e.g. co-firing vs. CHP; district vs. residential heat) has to reflect the ambitious objectives of the WWF Energy Report, and the implications on e.g. trade, and rural development needs.

An integrated vision of land use is needed - as stated in the WWF Energy Report: *better land use planning, from the local to the global level, will be vital in securing a sustainable energy supply.*

What About Water?

Water use of bioenergy systems – also perennial crops such as SRC – and the role of water retention and regulation through forests is increasing its relevance in the discussion. Woody bioenergy can contribute both positively and negatively, but most importantly, synergies exists which should be promoted.

Avoiding Noise: Where are the Major Risks?

A prioritization of major risks not only from woody biomass for energy but for any energy carrier and raw material could be used as a "map" to guide public and political discussions. Currently, woody bioenergy risks are discussed without reference being made to alternatives.

Not to be forgotten: Fuelwood

Last but not least, the **unsustainable reliance on fuelwood** of 2.6 billion people in developing countries requires more emphasis on transformative policies not only on the demand side, but also synergies to improve sustainable wood supply.

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Annex to the main report. Summary of the Stakeholder opinion mapping

A.1. Note of the authors

This Annex gives a **summary** of informal notes from interviews with selected stakeholders between 19 May 2014 and 6 June 2014. The interviews followed a list of questions prepared by IINAS. Additional questions were asked depending on the profile of the interviewees. Given the different expertise and backgrounds of the interviewees, the particular issues addressed under each general question were different. Because of that this summary reflects the points most commonly addressed or those issues that the interviewer deemed most relevant. This implies that not all participants might agree on the issues discussed here.

A list of representatives from all sectors taking part in the bioenergy debate was jointly selected between the consortium and WWF. The opinions of the stakeholders do not necessarily reflect the position of their respective organizations.

A.2. Interview participants

Regional Bodies:

Bah F. M Saho, ECREEE
Florian Steierer, UN-ECE

Regional or National Representatives:

Suani Coelho, CENBIO – BR
Nicklas Forsell, IIASA
Emily Fripp, Efeca – UK
Maria Gafo Gomez-Zamalloa, EC DG AGRI
Brian Kittler, Pinchot Institute - US
Laszlo Mathe, Independent Consultant
Kees W. Kwant and Jan Iespsma, Netherlands Enterprise Agency, Ministry of Economic Affairs
Luc Pelkmans, VITO (Belgium)
Evelyne Thiffault, Natural Resources Canada
Jinke van Dam, Jinke van Dam Consultancy – NL

Civil Society/Private Actors:

Sini Erajaa, Birdlife
Sébastien Haye, Roundtable on Sustainable Biomaterials
John Hontelez, Forest Stewardship Council
Meghan Sapp, Kerry O'Donoghue and Lieve Borremans, Pangea
Luis Neves Silva, WWF
Martha Stevenson, WWF

Selected Utilities & other organizations:

Bart Dehue, Nuon
Timo Lehesvirta, UPM
Fanny-Pomme Langue, AEBIOM
Peter Paul Schouwenberg, essent, SBP (IWPB) & IEA Bioenergy Task 40

A.3. Overview of the responses

1. Do you foresee relevant competition for various biomass uses between traditional forestry uses, bioenergy and uses for the overall bioeconomy in 2020 and 2030 at global level? And at a more local level?

Generally speaking, there already is - and will continue to be in the near future - competition in terms of volume for the various forest biomass end uses particularly between biomass for bioenergy and biomass needed by the pulp and paper sector. Several interviews highlighted the difference between global and local levels. Thus, whilst at global level competition could not be that problematic, there could be competition at local level in some areas. The competition will also depend on how demand from other sectors evolves, the pace of growth, and feedstocks used.

Not all interviewees addressed the paying capacity of industries: the energy sector can only afford purchasing relatively cheap biomass (depending on coal, gas and CO_2 certificate prices and political incentive schemes for bioenergy) while other sectors can buy more expensive material.

Many of the effects attributed to competition depend on the capacity to mobilize biomass not only for bioenergy but for other uses (e.g. in housing): *The bigger the wood market in housing, the more woody residues are available for energy.* Thus, there can be opportunities for synergies. Also, competition for land use was mentioned.

Under this question, potential regions of supply (e.g. US, CA) and global trade patterns were mentioned, and opinions of stakeholders from developing countries were also captured who emphasized the role of traditional biomass.

2. In your opinion, which forest bioenergy routes (taking into account feedstocks and origins) could be classified as problematic and deserve more attention and which seem to be low-risk routes?

A general agreement existed on the difficulty of elaborating a risk matrix according to the feedstock and the country (or region) of origin. Most of the effects will depend on specific issues, that is, on the performance of the whole value chain. Despite this, feedstocks with high “carbon debt”, high land footprint, relevant impacts on soils or those causing land use change might be more problematic. Nevertheless, there might be tenuous agreement on lowest-risk feedstocks e.g. wastes and residues could be included in this category. Generalizations are also tricky when discussing origins; bad and good practices can be found around the world regardless of forest regulations and respective enforcement.

The size of the market determines the scale of the effects: *The larger the market, the bigger the problem*.

Bioenergy uses low quality biomass (what low quality is has to be defined) and in some cases forest operations for bioenergy that otherwise would be unprofitable (e.g. some pre-commercial thinnings and thinnings), can contribute to sound forest management.

3. To assure a sustainable development of forest biomass, where should be the major efforts be made? E.g. on the mobilization side? On the promotion of the most resource-efficient uses of biomass? On the assurance of sustainability (e.g. on binding legislation or on a voluntary basis)? Etc.

Effective dialogue between parties involved was pointed out several times.

Many stakeholders referred to both the demand and supply side and some of them remarked the need of balance between both sides. In short, there was general agreement on:

- The need to comply with Sustainable Forest Management principles (and address other strategic issues such as planning). The necessity of a clear market signal and generation of demand for sustainably produced materials was mentioned.
- Resource efficiency of the end use. When specifically referred to bioenergy several reflections about the pros and cons of co-firing and Combined Heat and Power options came up. The use of biomass for heat was addressed by some of the stakeholders.

The cascading principle is deemed important by most participants but questions on what it really means and how it can apply are raised in many interviews. One interviewee cautioned against fundamentalist application of cascading principles, as alternative end uses to energy for wood simply do not exist in some markets. Other participants raised the question: how to promote more mobilization for higher value added products (e.g. timber)?- It was also stated that *it seems very likely that in a 2 degrees world large amounts of biomass will need to go directly to energy.*

In this, it is important to *start to think as a system not as a single aspect.*

“Local needs first” principle is seemed as important by stakeholders from the South.

The increasing demand “for new biomass use” is based on climate policies.

Mobilization was identified as a key factor.

The role of forest plantations as source of sustainable feedstocks was underlined several times.

Most stakeholders defend binding sustainability criteria but others opine that the assurance of sustainability should be on a voluntary basis. Moreover some participants were into the detail: *The EU sustainability requirements (if any) are not going to make* *big differences* (meaningful criteria not expected). Some interviewees highlighted the potential risks that the proliferation of initiatives may pose (this refers to both the various proposals from major EU Member States importers - e.g. NL, BE, UK - and the voluntary initiatives). Given the differences between the binding legislation and the voluntary standards, a combination of both approaches was an option remarked on by some interviewees. *Harmonization in requirements not only in biomass importing countries but also in producing countries* was emphasized. A good way (towards sustainability) *would be to introduce best practices in a step-wise approach.* It is important *not reinvent everything, the forestry sector has done a lot.*

The relevance of subsidies and their applicability not only to bioenergy but to other (renewable) energies was discussed with some participants.

4. Which steps should be taken to develop a practical solution to assure sustainability of forest-based bioenergy?

There were many suggestions in this respect:

First you need to have clear understanding of what sustainability means and what would be the minimum set of sustainability criteria. *Instead of aiming for a global definition of sustainability, the application of voluntary certification might be useful.* Also:

- Investment in sustainable forest management, in the supply area.
- Building on existing SFM systems and try to avoid proliferation of schemes.
- Explore systems such as the Best Management Practices in the US.
- Practical solutions for smallholders.
- In addition to the sustainability criteria per se, the certification bodies and the controls of any scheme should be considered. Simplify everything from legislation to certification. Make things more understandable

In general, it was agreed that sustainability principles should be applied to any type of feedstock, independently of the final use of biomass.

What is generally missed in the debate on bioenergy is the bigger picture and an integrated vision about land use

Joining of expertise from all sides is needed.

Organise a worldwide awareness/necessity on the importance of sustainable forest management

Analyse and replicate "lessons learnt" (From the biofuel sector, from the forest certification sector, etc.).

Besides adequate legislation strong enforcement is also required

Develop capacity building in local populations.

Not dwelling too long on the theoretical discussion but start acting

5. Which sustainability initiatives are most promising?

Voluntary forest certification (e.g. FSC and PEFC) were highlighted by the vast majority of interviewees. Details about applicability (limitations such as lack of specific GHG saving accounting or resource efficiency, applicability depending e.g. on type of ownership, costs, range of credibility, articulation with voluntary guidelines, etc…) were discussed with some of the interviewees. *We need to promote FSC and also identify other processes and see where you can make the big impacts. Also, certification alone will not automatically help companies compete in global markets in a sustainable way.*

The initiatives promoted by the industry such as the Sustainable Bioenergy Partnership were underlined by some of them but others criticized it as too superficial.

The sustainability scheme under the “Energy Agreement in the Netherlands” (expected by summer 2014) seems to be promising because it had a participatory approach, among other reasons

The Global Bioenergy Partnership, EU Timber Regulation, and Roundtable on Sustainable Biomaterials and the Massachusetts Sustainable Standard need to be considered.

Regulations in exporting countries (i.e. US) might play some role but not as huge as in importing countries (EU).

Need a good balance between ambition and “practicality”.