BioTrade2020plus

Supporting a Sustainable European Bioenergy Trade Strategy

Intelligent Energy Europe
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The BioTrade2020plus Project

Objectives

The main aim of BioTrade2020plus is to provide guidelines for the development of a **European Bioenergy Trade Strategy for 2020 and beyond** ensuring that imported biomass feedstock is sustainably sourced and used in an efficient way, while avoiding distortion of other (non-energy) markets. This will be accomplished by analyzing the potentials (technical, economical and sustainable) and assessing key sustainability risks of current and future lignocellulosic biomass and bioenergy carriers. Focus will be placed on wood chips, pellets, torrefied biomass and pyrolysis oil from current and potential future major sourcing regions of the world (US, Ukraine, Latin America, Asia and Sub-Saharan Africa).

BioTrade2020plus will thus provide support to the use of stable, sustainable, competitively priced and resource-efficient flows of imported biomass feedstock to the EU – a necessary pre-requisite for the development of the bio-based economy in Europe.

In order to achieve this objective close cooperation will be ensured with current international initiatives such as IEA Bioenergy Task 40 on "Sustainable International Bioenergy Trade - Securing Supply and Demand" and European projects such as Biomass Policies, S2BIOM, Biomass Trade Centers, DIA-CORE, and PELLCERT.

Activities

The following main activities are implemented in the framework of the BioTrade2020plus project:

1. Assessment of **sustainable potentials of lignocellulosic biomass** in the main sourcing regions outside the EU
2. Definition and application of sustainability criteria and indicators
3. Analysis of the **main economic and market issues of biomass/bioenergy imports** to the EU from the target regions
4. Development of a dedicated and **user friendly web-based GIS-tool** on lignocellulosic biomass resources from target regions
5. **Information to European industries** to identify, quantify and mobilize sustainable lignocellulosic biomass resources from export regions
6. **Policy advice on long-term strategies** to include sustainable biomass imports in European bioenergy markets
7. **Involvement of stakeholders** through consultations and dedicated workshops

More information is available at the BioTrade2020plus website: **www.biotrade2020plus.eu**

About this document

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1. Executive summary

In Europe the demand of biomass for the whole bioeconomy is increasing year by year. In some cases, this biomass comes from non-European countries. The EU is already a net importer of biomass particularly for bioenergy and in general for bio-based industries, and imports could be even more relevant in the near future. Therefore, it is important to guarantee that this biomass supply from outside the EU is being done in a sustainable way and that negative environmental and socio-economic impacts are minimized.

The project BioTrade2020plus, supported by the Intelligent Energy for Europe program of the European Commission (Grant Agreement n °IEE/13/577/SI2.675534) and carried out from March 2014 to August 2016, has provided guidelines for the development of a European Bioenergy Trade Strategy for 2020 and beyond. It has analyzed in depth the role of lignocellulosic biomass (woody resources, agricultural residues and cellulosic crops) imports from six selected sourcing regions: North America (Southeast United States), South America (Brazil, Colombia), East Europe (Ukraine), Southeast Asia (Indonesia) and East Africa (Kenya). It has considered availability and sustainability constrains as well as existing strategies in these sourcing regions. All this info has been integrated in an interactive tool available on the BioTrade2020plus webpage (www.biotrade2020plus.eu).

Additionally various stakeholder consultations (workshops, webinars, surveys) have been performed in relation to sustainability issues in the sourcing regions, import opportunities, risks and barriers related to biomass trade, and seven key principles have been agreed as a prerequisite to have sustainable international biomass trade. Starting from this background, a number of long term strategies and guidelines have been proposed in relation to bioenergy and biomass trade. The conclusions have been summarized in an advisory document (Green Paper) on long-term strategies to include sustainable biomass imports in European bioenergy markets which is also available on the project website together with all other public deliverables.

1. Introduction

European targets set by 2020 in the Climate and Energy package and the Renewable Energy Directive (2009/28/EC) [1] will require a significant increase in biomass use for energy. The analysis of the data reported by the Member States in their National Renewable Energy Action Plans (NREAP) [2] shows that biomass is expected to contribute more than half of the 20% renewable objective of the gross final energy consumption. However, the data provided and trade statistics have revealed that the quantity of woody biomass required to satisfy the 2020 targets, is possibly too large to be met by increased production within the EU. Instead, various Member States will have to rely on imported biomass (especially wood products) from elsewhere; based on analysis of the NREAPs, countries such as Belgium, Denmark, France, Poland and Spain will all face a biomass deficit by 2020 [3]. The overall EU28 sustainable biomass potential is theoretically large enough to supply projected total bioenergy demand by 2020 and 2030 [5], but costs for domestic biomass may be higher than for imported bioenergy, e.g. biodiesel or wood pellets. Yet, importing this biomass from outside the EU may occur at the risk of damaging ecosystems in other parts of the world, while actually increasing the EU's own carbon footprint. As a result of several support measures, the market for bioenergy and biofuels has seen major increases in the last few years. According to Eurostat [4], biomass had a 65% share of all renewable energy consumption in the EU-28 in 2012. This biomass was mostly used in the heating and cooling sector (73%), followed by transport (15%) and electricity (12%).

The demand of biomass not only for bioenergy but also for the whole bioeconomy is expected to significantly increase in the EU in the coming years. Thus, in addition to the biomass demand for bioenergy, feedstock demand for bio-based products (i.e. bioplastics, construction materials, composite materials, etc.) is expected to expand [5].

Moreover, by 2020, most of the increase in imports of woody biomass to the EU-28 is expected for electricity generation, likely in the form of wood pellets supplied to a limited number of large power stations [6]. The most likely sourcing regions are the US Southeast, and Canada. Yet, there are other potential sourcing areas of interest, e.g. several countries in Latin America (such as Brazil and Colombia), Sub-Saharan Africa and Southeast Asia with relevant potentials in non-forest biomass resources (e.g. agricultural residues, and land available for dedicated lignocellulosic crops) that could increase their participation in the international market when technologies are fully accessible. Lignocellulosic feedstocks are likely to become very important, as they are also the basis for advanced biofuels and many bio-based products.

Currently, there is an important international trade of pellets. For instance, pellet exports from the US to the EU have increased 6-fold since 2008 [7]. As illustrated in Figure 1, the US has become the primary source of pellets to the EU, representing more than 60 percent of the total wood pellet imports to the EU in 2014. The UK is the primary import market for pellets from the US Southeast, followed by Belgium and the Netherlands [8].

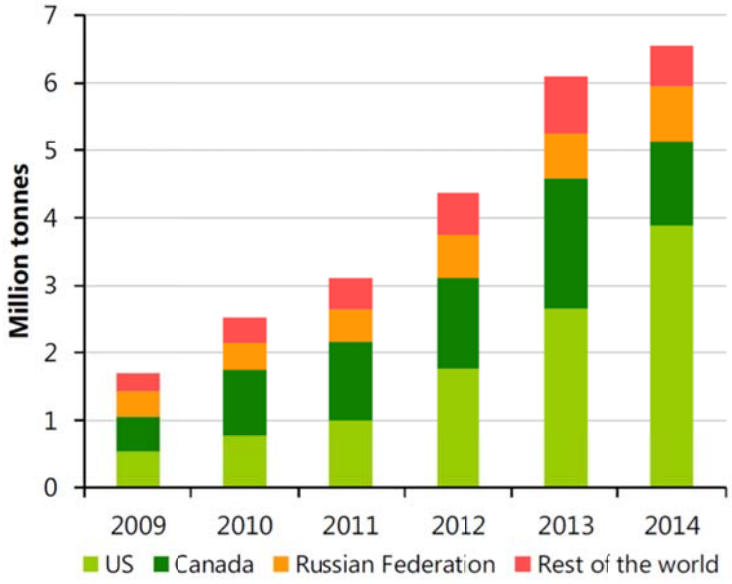

Figure 1: EU 28 imports of wood pellets, 2009-2014.

Source: UNECE-FAO (2015)

The main aim of BioTrade2020plus was to provide guidelines for the development of a European Bioenergy Trade Strategy for 2020 and beyond, ensuring that imported biomass feedstocks are sustainably sourced and used in an efficient way, while avoiding distortion of other (non-energy) markets. This has been accomplished by analyzing the potentials (technical, economical and sustainable) and assessing key sustainability risks of current and future lignocellulosic biomass and bioenergy carriers. Focus was placed on lignocellulosic biomass from current and possible future major sourcing regions of the world (US, Ukraine, Latin America, Asia and Sub-Saharan Africa).

The project had the following specific objectives:

1. Determine **sustainable potentials of lignocellulosic biomass** in the main sourcing regions outside the EU and definition and application of sustainability criteria and indicators.
2. Give insights in possible **availability and indicative costs** of sustainably produced lignocellulosic biomass from the main sourcing regions outside the EU, including interactions with demand from other sectors and other regions.
3. Provide European industry with **transparent information** to identify, quantify and mobilize sustainable and resource efficient lignocellulosic biomass resources from the main export regions to the EU to complete their biomass supply needs by means of a **user friendly interactive tool** based on GIS and an integrated user interface. This includes a **SWOT analysis** of the selected supply chains.
4. Create a **policy strategy** to promote the use of bioenergy, ensuring a sustainable and fair supply market from outside the EU to complement the existing demand without halting domestic production

BioTrade2020plus provided support to the use of stable, sustainable, competitively priced and resource-efficient flows of imported biomass feedstock to the EU – a necessary pre-requisite for the development of the bio-based economy in Europe.

2. Applied approach and methodology

The following main activities have been implemented in the framework of the BioTrade2020plus project:

- Selection of six case study regions from the main sourcing regions outside de EU
- Assessment of sustainable potentials of lignocellulosic biomass in the selected case study regions
- Definition and application of sustainability criteria and indicators
- Analysis of the main economic and market issues of biomass/bioenergy imports to the EU from the target regions
- Development of a dedicated and user friendly web-based GIS-tool on lignocellulosic biomass resources from target regions
- Information to European industries to identify, quantify and mobilize sustainable lignocellulosic biomass resources from export regions
- Give policy guidelines on long-term strategies to include sustainable biomass imports in European bioenergy markets
- Involvement of stakeholders through consultations and dedicated workshops.

In general terms the project has been structured in the following five pillars:

- Sustainability and availability
- Case study regions assessment
- Long term strategies and policy guidelines
- Stakeholder engagement
- On-line tool development

Figure 2 shows a schematic approach of the project:

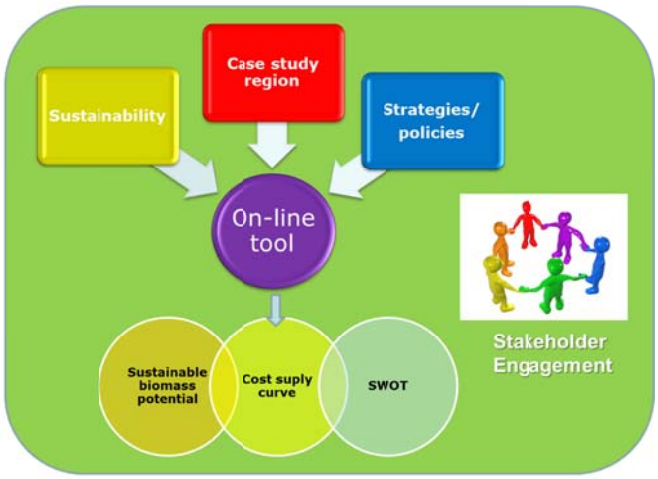

Figure 2: Biotrade2020plus general approach

Source: CENER

3. Sustainability and availability of the biomass

BioTrade2020plus has examined the availability and sustainability of lignocellulosic biomass in the six target regions. Firstly, an assessment of criteria and indicators in existing sustainability schemes for lignocellulosic feedstocks has been carried out. Moreover, updated sustainability criteria have been considered for bioenergy (including social, political and institutional as well as environmental and economic aspects) for 2020 and 2030, also drafting potential criteria for bioeconomy applications. Finally, issues conditioning the operability of sustainability schemes including the impact on costs have been evaluated.

The selected regions represent a great variety of socioeconomic conditions and bio-physical circumstances. This makes necessary to have a broad understanding with respect to sustainability in the different geographical contexts.

3.1. Identification of relevant schemes

The variety of available initiatives responds to different necessities and visions and reflects a broad range of concerns and respective approaches to sustainability. Hence, these activities apply different sustainability criteria and indicators (C&I). As discussed by Fritsche and Iriarte [9], these activities are very diverse and the following characteristics can be distinguished:

- Type of scheme or regulation: mandatory or voluntary;
- Type of bioenergy: biofuels vs. solid vs. all types (including gaseous);
- Application level: international, regional or national;
- Sector of origin: agriculture, forestry, other (e.g. wastes);
- Scope of sustainability: environmental vs. holistic approach (i.e. including social and economic requirements).

This variety lead to a proliferation of sustainability schemes which might cause several inconveniences, as discussed by Pelkmans et al. [10], but at the same time offers various opportunities. A selection of representative schemes and regulations was evaluated. Some of these schemes are: SAFA (Sustainability Assessment of Food and Agriculture systems), SAN (Sustainable Agriculture Network), RSPO (Roundtable on Sustainable Palm Oil), RTRS (Round Table on Responsible Soy), Bonsucro (Better Sugarcane Initiative), FSC (Forest Stewardship Council), PEFC (Program for the Endorsement of Forest Certification), SBP (Sustainable Biomass Partnership), ISCC (International Sustainability and Carbon Certification).

This selection pays particular attention to those initiatives relevant in the EU context, even if some international initiatives are also considered.

Some of these schemes are more relevant for the main product (from cultivation) than for residues that could be used for bioenergy. Nonetheless, all requirements of the schemes have been included in order to provide an extensive compilation of sustainability requirements that could be useful in other parts of the project.

3.2. General Sustainability Criteria and Indicators

The Biotrade2020plus list of indicators provides the umbrella approach to any non-food biomass and it is based on an extensive compilation of indicators and requirements already in place in several schemes. This set is composed by 12 criteria and 27 indicators that consider the environment, social and economic themes [11]:

In the environment theme:

C1 Criterion Resource use:

I1 - Land use efficiency: Biomass (including by- and co-products along life cycles) per hectare of cultivated area.

I2 - Secondary resource efficiency: Heating value of biomass output divided by heating value of secondary resource; applies to conversion of residues and wastes.

I3 - Energy efficiency: Cumulative energy requirements (all inputs based on LHV primary energy) compared to outputs.

I4 - Functionality: Economic value of outputs (€/GJ and €/ton), compared to economic value of heat which could be produced from burning (dried) primary inputs (reference = heat from NG ~ 10€/GJ); economic values excluding taxes, for industrial customers).

C2 Criterion Climate change:

I5 - Life cycle-based CO2eq including direct land use change (GHG emissions during the whole value chain, i.e. crop growth & harvesting, logistics, pretreatment and conversion, distribution and end-use phase) in relation to the final output (combination of electricity, useful heat, biofuels & biomaterials).

I6 - Other GHG emissions (GHG from indirect land use changes - iLUC- and carbon stock changes in forests).

C3 Criterion Biodiversity:

I7 - Protected areas and land with significant biodiversity value (Categories established by the RED).

I8 - Biodiversity conservation and management ("Agrobiodiverse cultivation" through crop rotation; diversity in the landscape; avoidance of alien species), amount of chemicals (pesticides/herbicides), and release/ monitoring of Genetically Modified Organisms).

C4 Criterion Soil:

I9 - Erosion (Probability of erosion where mitigation measures are not feasible).

I10 - Soil Organic Carbon (Probability of soil organic carbon loss where mitigation measures are not feasible (it depends on the type of crops - perennials and annual crops- and respective land management).

I11 - Soil nutrient balance (Probability of nutrient balance loss where mitigation measures are not feasible).

C5 Criterion: Water

I12 - Water availability and regional water stress (Water use in relation to total actual renewable water resources - TARWR), or average replenishment from natural flow in a watershed).

I13 - Water use efficiency (Water use for biomass production, and processing, in kg/kg biomass).

I14 - Water quality (Presence of water pollutants, e.g. nitrate, phosphorous, pesticides, biochemical oxygen demand).

C6 Criterion Air:

I15 - Emissions of SO2eq (Life cycle emissions of SO2, NOx, NH3 and HCl/HF from bioenergy provision, expressed in SO2 equivalents and calculated in accordance to GHG emissions).

I16 - Emissions of PM10 (Life cycle emissions of fine particulates, calculated in accordance to GHG emissions).

In the social dimension:

C7 Criterion Participation and transparency:

I17 - Effective participatory processes (Enable effective participation of all directly affected stakeholders by means of a due diligence consultation process, incl. Free Prior & Informed Consent when relevant).

I18 - Information transparency (Freely availability of documentation necessary to inform stakeholder positions in a timely, open, transparent and accessible manner).

C8 Criterion: Land tenure

I19 - Compliance with the Voluntary Guidelines on the Responsible Governance of Tenure of Land to secure land tenure and ownership (Compliance with the Voluntary Guidelines on the Responsible Governance of Tenure of Land to secure land tenure and ownership).

C9 Criterion Employment and labor rights:

I20 - Full direct jobs equivalents along the full value chain (Number of jobs - gross figure - from biomass along the full value chain).

I21 - Full direct jobs equivalent in the biomass consuming region or country (Number of jobs - gross figure - from biomass in the biomass consuming region or country).

I22 - Human and Labor Rights.

I23- Occupational safety and health for workers: Measures taken to guarantee occupational and health safety for workers.

C10 Criterion Health:

I24 - Risks to public health: Measures taken to safeguard public health, i.e. regulation of noise level and prevention of accidents.

C11 Criterion Food and fuelwood:

I25 - Measures to avoid risks for negative impacts on price and supply of national food basket and fuelwood.

In the economic dimension:

C12 Criterion Production costs:

I26 - Current levelized life-cycle cost (Current levelized life-cycle cost, excluding subsidies (excl. subsidies, incl. CAPEX and OPEX).

I27 - Future levelized life-cycle costs (Future levelized life-cycle cost, excluding subsidies (excl. subsidies, incl. CAPEX and OPEX).

3.3. Operability of sustainability schemes

Since, up to now, there is no EU wide sustainability regulation for solid biomass, major EU Member States importing biomass such as Belgium, Denmark, the Netherlands and the UK are working or have been working on developing their own national schemes to assure sustainability of solid biomass for energy. These national efforts have so far resulted in different approaches to sustainability (including different criteria) that can pose additional burden on market operators and hinder international bioenergy trade.

As shown in previous sections, during the last years a relevant proliferation of schemes has occurred. This proliferation has led to confusion among actors involved, market distortion and trade barriers, an increase of commodity costs, questions on the adequacy of systems in place and how to develop systems that are effective and cost-efficient [12]. The lack of confidence and acceptance among the stakeholders may limit the effectiveness of certification schemes, and lead to loss of belief that participation is meaningful [13].

On the other hand, this proliferation has led to competition among them. A positive impact is that this may lead to improvement in the development of standards and tools for verification and monitoring, and may provide insight into the 'best' or 'most efficient' structure of certification systems (design, implementation constraints, cost-benefits) as well as operational experience and degree of effectiveness of the scheme [13]. These schemes should continue to learn and improve through regular and need-based updates of standards and other scheme elements.

To tackle the proliferation of country/regional specific policies and requirements, it could be preferred to develop an international framework of (minimum) standards creating more coherence between countries/regions [13]. In this, systems should converge up to a level that ensures consistency and transparency, without losing meaning at local levels. Unilateral and mutual recognition are important instruments [13].

4. Case Study Assessment

The main objective of the BioTrade2020plus case studies has been to analyze the technical and sustainable potentials for import of lignocellulosic biomass from selected source industries and regions. These assessments considered the main economic, biophysical, and market drivers affecting biomass availability for the six designated biomass sources described in Table I. The selection of the case study regions and feedstocks for the assessment was based on literature review, partners' previous work in the selected countries and information provided by the Advisory board members[1].

The following table shows a summary of the selected case studies and lignocellulosic feedstocks.

Country	Feedstock				
	Forest residues	Agricultural residues	Forest plantations	Biomass crops	New forest plantations
Brazil		√		√	√
Colombia		√		√	
Kenya		√	√	√	
Indonesia		√			
United States	√		√		√
Ukraine	√	√		√	

Table I: Summary of sourcing regions and feedstock potential

Source: Biotradeplus2020plus project

For each case study, the first objective has been to determine a net sustainable export potential of biomass and then, to elaborate the related cost and GHG supply curves (figure 3). The developments have been summarized in two different scenarios (Business as Usual and High Export). These can give an idea about the potential future suitable biomass export.

- The *Business as Usual Scenario* (BAU) is based on a continuation of current and historic trends
- The *High Export scenario (HE)* envisions more progressive improvements, e.g. higher agricultural yields, lower population growth, lower demand for material application of biomass etc.

Moreover three different timelines have been considered for each one: current, 2020 and 2030. For these scenarios depending the country skill and the type of biomass different assumptions have been adopted.

The following scheme shows the methodology followed in these cases studies:

[1] BioTrade2020plus has an advisory board committee composed by 13 members that represent industry, academy, research, NGOs.

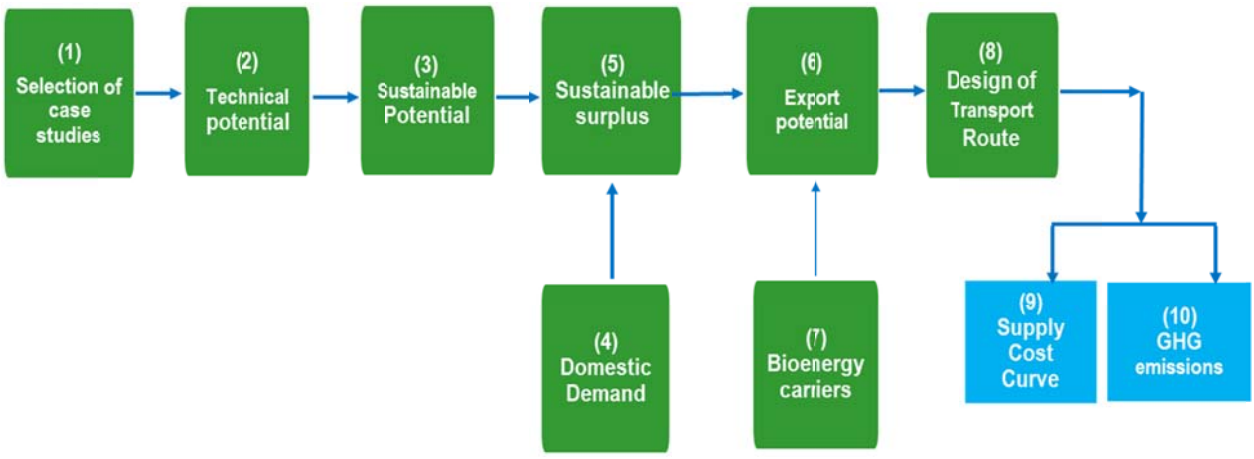

Figure 3: Methodology approach scheme

Source: Biotradeplus2020plus project

As shown in Figure 3, the sustainable potential has been estimated in this methodology in step 3. This is a crucial step in order to accomplish with project.

As it was pointed out in section 3.2, Biotrade2020 plus project has developed a set of 12 criteria and 27 indicators covering environmental, social & economic themes. However, in each case study the methodology was adapted and applied according data availability in each of them. Basic criteria set based on RED criteria: GHG emissions, protection of high biodiverse and high carbon stock lands applied to all case studies. Additional criteria applied where possible, mainly on prevention of soil erosion / depletion according desk based studies or assumptions and some local interviews.

More information available in report *2.4 BioTrade2020plus Approach to Sustainability*.

4.1. United States Southeast

The USA has put relatively high attention to transport biofuels during the last decades, mostly in relation to air quality and energy security concerns. In recent years there is also growing attention to renewable electricity and biorefineries, also in the frame of climate change mitigation.

The BioTrade2020plus case study focuses on biomass from forestry in the Southeastern part of the US. Figure 4 shows the states that have been included in this case study assessment.

The current situation is that most woody biomass is burned for energy, and nearly all of that exported for this purpose is in the form of pellets which are valued for their stability and energy density. By May 2015, installed wood pellet production capacity reached 9.1 Mt (million tonnes) and by the end of the year was on track to top 11 Mt [14]. The vast majority of US wood pellet capacity is found in the Southeast. Several factors have led to the US industrial pellet sector growing mainly in the Southeast, making it the most promising region for production of pellets for the EU market.

Figure 4: States in the US SE study region

Source: Biotradeplus2020plus project

The case study makes it clear that there are significant quantities of biomass that could be mobilized from Southeast US for use in the bioenergy markets of the EU. However, the feedstock quantities indicated for some cases in the results above are significantly higher than the 6.9 Mt of pellets that are estimated to have been produced nationwide in 2014 [8]. This is due to the fact that these are total biomass potentials, unconstrained by pelletization or supply chain capacity.

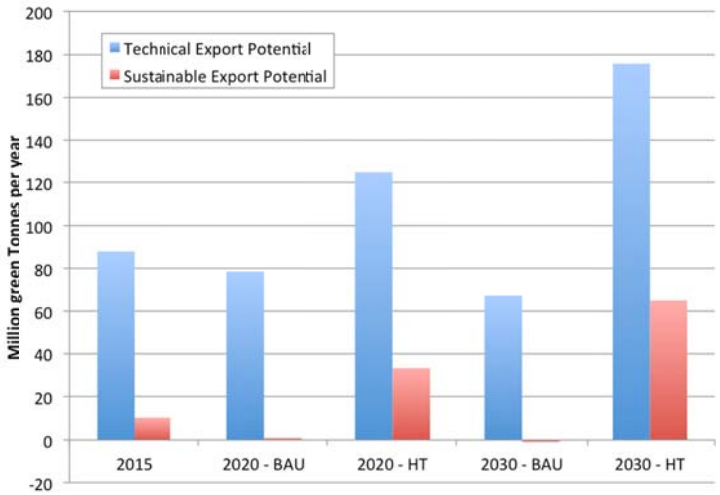

Figure 5: Technical export potential and sustainable export potential when all biomass harvest is confined to sustainable sourcing

Source: Biotradeplus2020plus project

The sustainable potentials presented in figure 5 assume that all biomass harvested in the US Southeast is confined to those areas deemed to meet the sustainability criteria considered in BioTrade2020plus. For this reason, these are conservative estimates of availability, and in some cases the sustainable export values are very small or even negative. Negative export potential implies that domestic demand for biomass from the

region is expected to be greater than total sustainable biomass production. This could therefore require net import of biomass, shifting of production out of the Southeast region, greater harvest level in sustainable regions, or some unsustainable harvest in order to meet domestic demand.

More information is available in report *3.4 Biomass Use and Potential for export to the European Union from 2015 to 2030 United States Southeast – Case Study*. http://www.biotrade2020plus.eu/publications-reports.html

4.2. Brazil

Nowadays Brazil consumes 40% of the energy used in South America [15]. Favorable climatic conditions and the availability of much potentially usable land make the cultivation of energy crops, especially sugar cane, are particularly attractive in Brazil. Biomass can therefore make a significant contribution towards meeting Brazil's increasing energy requirements. There is a high production of ethanol, which can be attributed to the long-term targeted promotion of ethanol production and use by the Brazilian government since 1975.

It was considered unfeasible to include the entire country, considering the size of Brazil and the fact that transporting biomass pellets over such a great distance is unrealistic. Furthermore agricultural production is highly concentrated in Brazil; therefore some states have very little potential to offer. With these considerations in mind, the first step of this research was to make a selection of the different states in Brazil to include in the analysis.

For agriculture biomass, based on the four selection criteria included (production, logistic, sustainability and production cost), seven states were selected and included in the analysis: Espírito Santo, Santa Catarina, Bahia, Rio Grande do Sul, Paraná, Minas Gerais and São Paulo. Forestry production seems to be concentrated in the same states as agricultural production.

Sugarcane residues make up 57% (123 MT) of the total residue production, of which São Paulo has the biggest share with 76% (93 MT). The second largest volume of residues is produced by corn stalks, cobs, and husks (18%), followed by soybean straw (14%). The other feedstock residues only make up 11% of the technical potential (see figure 15). 46% of the residues (99 MT) is not a field residue, but a processing residue: sugarcane bagasse is the product of sugarcane crushing in a sugarcane mill, corn cob and husk are removed at the corn processing plant, and the same applies to rice husk and coffee husk. Regarding forestry, the selected feedstocks (eucalyptus and pine), produced a total technical potential of 16 MT forestry residues (295 PJ) in 2012, with Paraná (4.76 MT), São Paulo (3.47 MT), and Santa Catarina (2.99 MT) as the main contributors.

Figure 6 : Top left to bottom left: Field after wood harvest, piled up forestry residues, residues left in the field, chipping of field residues, Telêmarco Borba, Paraná

Source: Axel Roozen, Biotradeplus2020plus project

Brazil offers a significant potential of agricultural and forestry residues to be used as bioenergy carriers. The large sugarcane industry produces large amounts of bagasse and straw. The use of agricultural and forestry residues for pellet production could offer a potential between 718 PJ in the current situation and 1047 PJ in the most optimistic scenario in 2030.

This study however found that the availability of pellet plants to convert residues into suitable bioenergy carriers for export is greatly limiting the potential. The current potential is reduced to only 8.6 PJ. When using a very optimistic growth rate of 27% per year, this potential might increase to 411 PJ in 2030, a more realistic growth rate of 14% would result in 70.7 PJ in 2030.

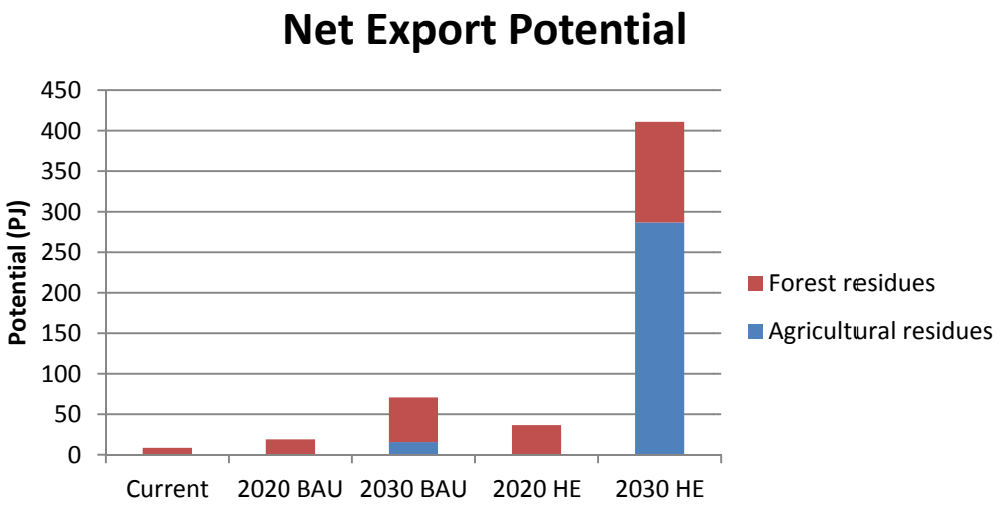

Figure 7: Net Export Potential for 2012/2020/2030 and the BAU and High Export scenarios

Source: Biotradeplus2020plus project

More information available in deliverable 3.2 Assessment of sustainable lignocellulosic biomass export potentials from Brazil to the European Union. http://www.biotrade2020plus.eu/publications-reports.html

4.3. Ukraine

Ukraine has significant natural endowments in the field of renewable energy although substantial potential for producing energy from renewable sources remains largely untapped. In particular, the country's abundant agricultural and forestry waste is a key asset for developing heat and power generation based on biomass. Ukraine is a major producer of grain and oilseeds, located in the top ten of countries of production of wheat, coarse grain, corn, barley and oilseeds. On the other hand, it already produces bioenergy products from wood such as sawdust briquettes, pellets, fuel wood chips, charcoal and firewood. According to Tebodin [16] in 2011 a total of 740 thousand tonnes (kt) of solid fuels were produced, of which 620 kt of pellets and 120 kt of briquettes. An estimated 80-85% of the solid biofuels produced are exported to the EU, to be used for electricity and heat production [16].

All regions in Ukraine will be included in this analysis, in order to calculate the potential for the entire country. In-field data gathering was aimed at the regions with the largest potential, based on agricultural production volumes and the distribution of wood biomass.

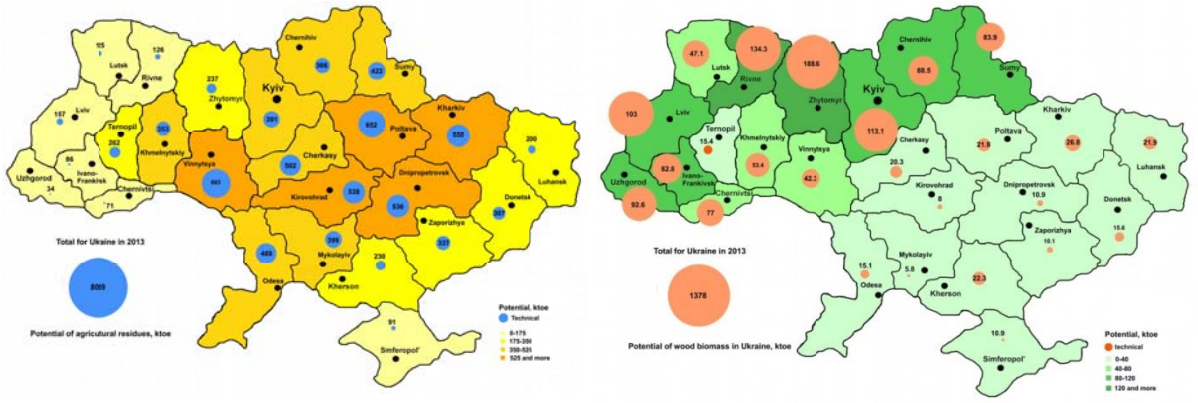

Figure 8: Distribution of the technical potential of primary agricultural residues in Ukraine (left) and wood biomass (right), ktoe (2013)

Source: Oliynyk et al., 2015 [17]

There is a large potential of agricultural and forestry residues in Ukraine available for use as bioenergy carrier. Ukraine is one of the largest producers of grain crops in the world, due to the fertile soils, favorable climate and large availability of agricultural land. At the moment residues are hardly utilized for energy generation, and therefore could be available for export. The use of agricultural and forestry residues for pellet production could offer a sustainable potential of 203 PJ.

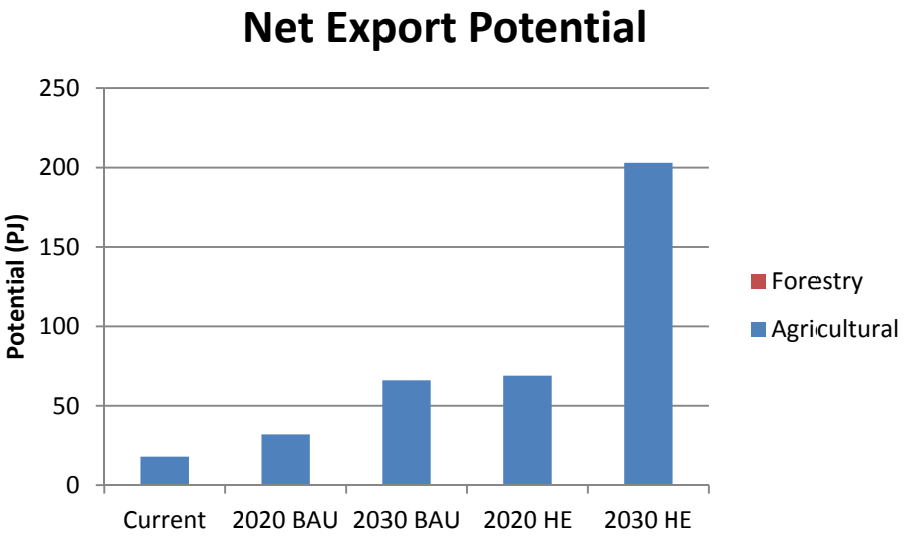

Figure 9: Export potential under Business as Usual and High Export scenario

Source: Biotradeplus2020plus project

More information available in report *3.3 Assessment of sustainable lignocellulosic biomass export potentials from Ukraine to the European Union.* http://www.biotrade2020plus.eu/publications-reports.html

4.4. Indonesia

Indonesia's ambition is to increase renewable energy to 23% of primary energy supply (excluding the traditional use of biomass) by 2025, from a share of 6% early 2014 [17]. This target was anchored in the National Energy Policy in 2014 and is supported by a feed-in tariff

Palm residues are considered the most promising lignocellulosic biomass source for export in Indonesia. Currently, palm residues including frond, trunk, empty fruit bunch (EFB), shell and fiber are locally used. Frond, trunk and EFBs are mostly left or abandoned on field whilst shell, fiber are burnt for electricity and energy generation at oil mills but with low efficiency, and. This indicates a potential for export of residues to the EU.

Figure 10: Palm plantation in Indonesia

Source: Utrecht University

Based on the size of production and productivity, palm oil is largely produced in Sumatera (Sumatra) and Kalimantan regions, however the plantation and production in Sumatera is rather mature and palm biomass is planned to be used mainly for mulching and local electricity production. Kalimantan was therefore chosen as the investigated area due to its expanding plantation and logistic of palm trees. It also has an increasing capacity of biodiesel manufacturing and governmental policies aim to increase the productivity of palm plantation.

Kalimantan was therefore chosen as the investigated area due to its expanding plantation and logistic of palm trees. It also has an increasing capacity of biodiesel manufacturing [21] and governmental policies aim to increase the productivity of palm plantation.

Currently, there are no surpluses of palm residues to be possibly exported outside Indonesia. The priority of the Indonesian energy policy is to reduce oil consumption and to use local renewable energy. For power generation, it is important to increase electricity power in order to meet national demand and to change fossil fuel consumption by utilization of biomass wastes. The development of renewable energy is one of the priority targets in Indonesia. However, the situation may change in the future and there are a number of aspects to be taken into account:

- Palm trunks, shells and fibers used as fuel to generate heat in palm oil mills will be exploited more efficiently
- Whilst fewer quantity of fronds and EFBs is used to maintain soil quality and organics carbon at the palm field due to supplementary fertilizers are provided to boost the palm yield

The total amount of palm residues is therefore additionally collected and increased over time.

Figure 11 summaries the total technical, sustainable and exportable potentials of palm residues over time for both BAU and High Export scenarios. As shown, there are no palm residues to be considered for export at the current situation (data collected in 2011) because 100% of palm residues are locally used.

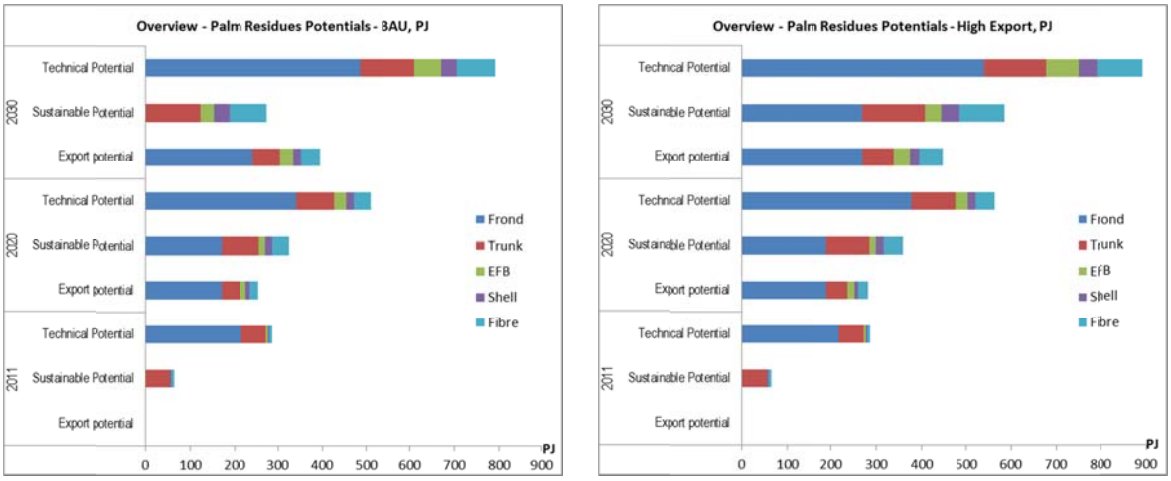

Figure 11: Overview of various palm residue potentials in BAU and HE scenarios over time

Source: Biotradeplus2020plus project

In the BAU scenario, the potentials are increased in 2020 and 2030 due to expansion of palm plantation, higher palm yield and lower local use of palm residues. From a technical potential of 286 PJ in 2011, the palm residues indicate a 497 PJ in 2020 and 751 PJ in 2030. Consequently, the sustainable potential of palm residues taking into consideration sustainability criteria also grows from 65 PJ in 2011 to 318 PJ in 2020 and 491 PJ in 2030. Finally, the potential surplus potential demonstrates an amount of 249 PJ in 2020 and 375 PJ in 2030.

In the High Export scenario, the potential of palm residues shows a higher quantity compared to the BAU scenario. In fact, the palm plantation areas are not changed due to the commitment of not using deforested lands, however, palm yields (and so also amounts of residues produced) progressively increase thanks to better soil management, implementation of best practice in plantation and better planning and cooperation of plantation farmers. The technical potential of palm residues is 521 PJ in 2020 and 803 PJ in 2030. Consequently, the sustainable potential of palm residues taking into consideration sustainability criteria also increases to 333 PJ in 2020 and 527 PJ in 2030. The potential surplus potential is estimated to be 260 PJ in 2020 and 401 PJ in 2030.

More information available in report *3.1 Assessment of sustainable lignocellulosic biomass export potentials from Indonesia to the European Union*. http://www.biotrade2020plus.eu/publications-reports.html

4.5. Colombia

Colombia is a large country with diversified characteristics in terms of climate, soil, geology, topography, vegetation cover and current land use which forms the basis for six regions. It has a total area of 114 million ha, of which approximately 50% is covered with forest. Colombia is one of the most mega-diverse countries worldwide. About 90% of its non-agricultural land is protected area. The main agricultural activities of Colombia are coffee, dairy, sugar, bananas, flowers, cotton and cattle. However, only 9.6% or 4.1 million ha of agricultural land is used for crops. Annual crops represented 33% of the cultivated area, whereas permanent crops and plantations account for 59%, the rest 8% was fallow land. The most extensive land use is cattle grazing which accounts for over 70% of the agricultural land, usually exhibiting low productivity levels.

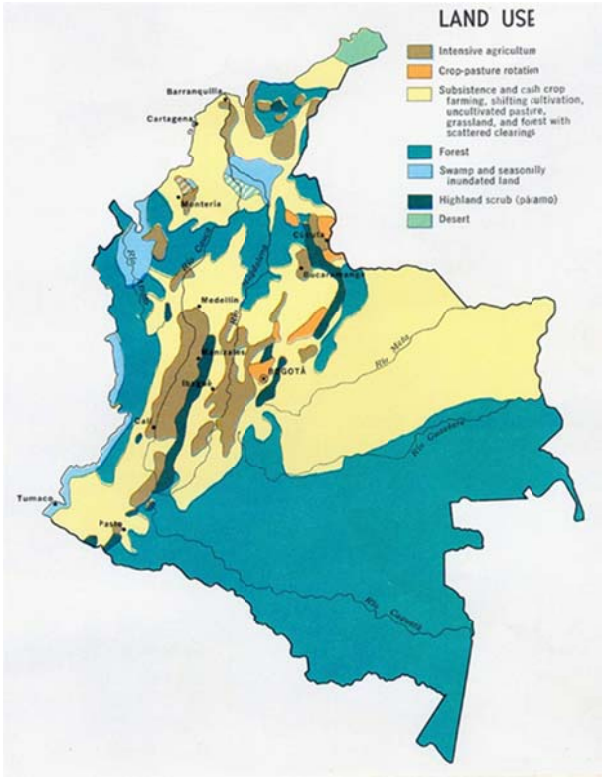

Figure 12: Land use in Colombia Source: Colombia Environmental Ministry

Biomass plays an important role in the energy mix of the country, as it is today the second largest renewable energy source after hydroelectricity. The main biomass potentials in Colombia consist of crop residues. The potential to use these residues at regional or national level is very limited due to the fact that many of the residues are generated in the field and/or have a high moisture content and/or a high mineral content and/or are dispersed and/or cannot be mobilised due to a lack of infrastructure to transport the biomass at a reasonable cost to a sea harbour.

Favourable conditions for export do exist, however the export potentials for residues from the Northern and Central palm oil zones and for the Cauca Valley sugar cane zone range from one million tons DM (pellets) currently to 4 million pellets in 2030 under high export conditions. The cost for export to the EU starts at €118 per ton pellet delivered. The sustainable potential was calculated focusing in the main regions in Colombia that have the sugar cane and palm oil production, that are close enough to a harbour to make export feasible. In the case of Colombia, it shows a high theoretical potential but one of the main impediments is related to the logistics for transport. Nevertheless, as demonstrated in the cost analysis and the current uses, the production of pellets from sugar cane from the Valley of Cauca are a possible source of biomass export to the European Union.

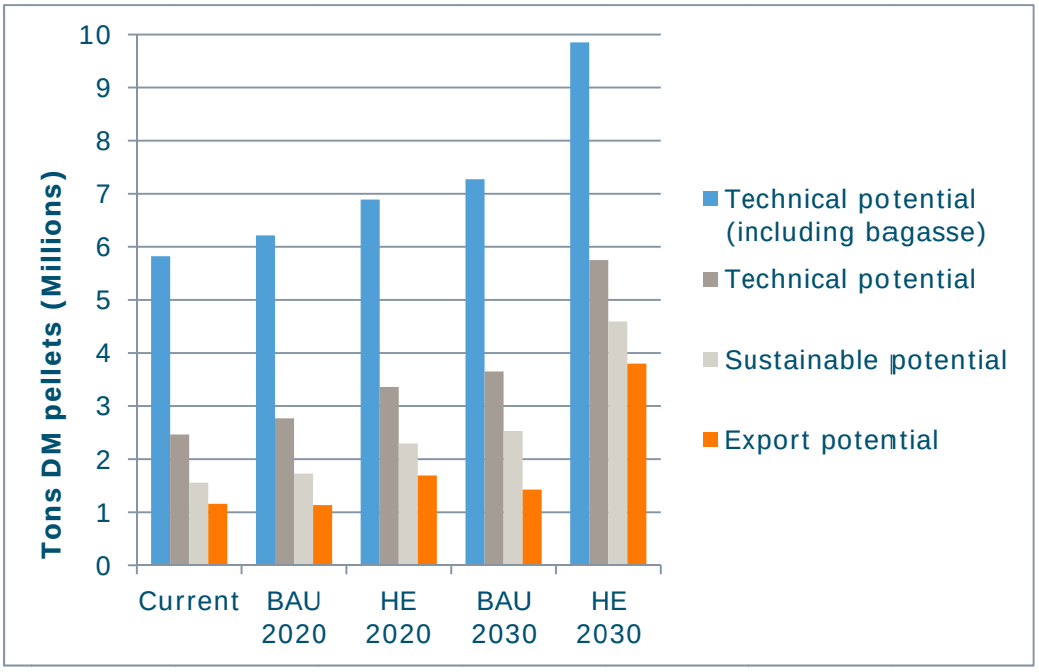

Figure 13: Sugar cane and palm oil sustainable export potential under BAu and HE scenarios

Source: Biotradeplus2020plus project

More information available in report *3.6 Progress report on WP 3 case studies Colombia*. http://www.biotrade2020plus.eu/publications-reports.html

4.6. Kenya

The Kenya Vision 2030 is the national long-term development policy that aims to transform Kenya into a newly industrializing, middle-income country providing a high quality of life to all its citizens by 2030 in a clean and secure environment [18]. It is expected that wood fuel will continue to be the primary source of energy for the majority of the rural population and urban poor for as long as it takes to transform the rural economy from subsistence to a highly productive economy. Wood fuel supply management is crucial to ensure sustainable supply to meet the growing demand. Key issues here include: competing land use activities, the growing imbalance between supply and demand and the attendant adverse environmental as well as related land and tree tenure issues, among others. The Government has promoted agroforestry and social forestry programs to increase the stock of woody biomass on farms to make up for the loss of forest trees as forestland is converted into agricultural and settlement land.

Regarding agricultural feedstock, sugarcane, sisal, coconut, rice and coffee were found to be the most promising crops by indicating the higher amounts of field-based and/or process-based residues possibly available. If good governance and investment implemented in agricultural sector, the total biomass potential will be competitive in terms of quantity, cost and sustainability consideration for export.
The most challenges of agricultural residues considered for export were found to be the internal uses and proximity of production regions to the Mombasa port.

Timber was recognized as the most promising forestry product among poles, firewood and charcoal. Timber residues, sawdust, off-cuts & chips were investigated and although they indicate about 88 per cent of the total technical potential, owing to the intensive and multiple domestic demand applications, such as fencing and firewood, the sustainable feedstock surplus potential is solely formed by sawdust.
On the other hand, through the analysis carried out on assessing land availability for lignocellulosic biomass production, no land was found to be available. The high pressure on land use is indicated by the high woody biomass deficit (10.3 million m^3) and the high demand by livestock and agricultural activities.

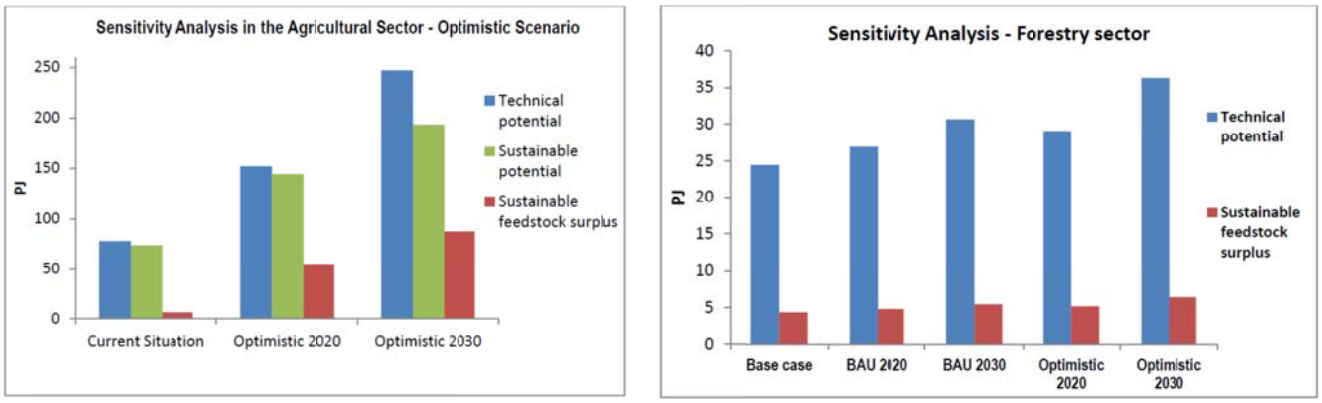

Figure 14: Export potential under Business as Usual and High Export scenario desegregate buy agricultural or forestry sector

Source: Biotradeplus2020plus project

From discussions with local experts and review of the Kenyan Crop Act 2013, interventions from the Ministry of Agriculture and Forestry as well as further investments in the two sectors might soon happen which hopefully firstly will discontinue the decreasing trend of productivity and secondly improve further crop yields which ultimately may lead to higher biomass potentials even in the BAU on the short and medium term. At present, the different aggregate sustainable feedstock surplus potentials were estimated to be approximately 7 PJ and 4 PJ respectively. And as result of the intervention (High Export potential or optimistic scenario), the sensitivity analysis carried out provided the lower limits of 28 and 35 PJ and the higher ones of 55 and 87 PJ of sustainable biomass potential surplus for 2020 and 2030 respectively.

More information available in report 3.5 *Assessment of Sustainable Lignocellulosic Biomass Potentials from Kenya for export to the European Union 2015 to 2030* http://www.biotrade2020plus.eu/publications-reports.html

4.7. Overview and Synthesis

In the next figure the net export sustainable potential for each sourcing region in current, BAU and High Export scenario for 2030[2] is shown.

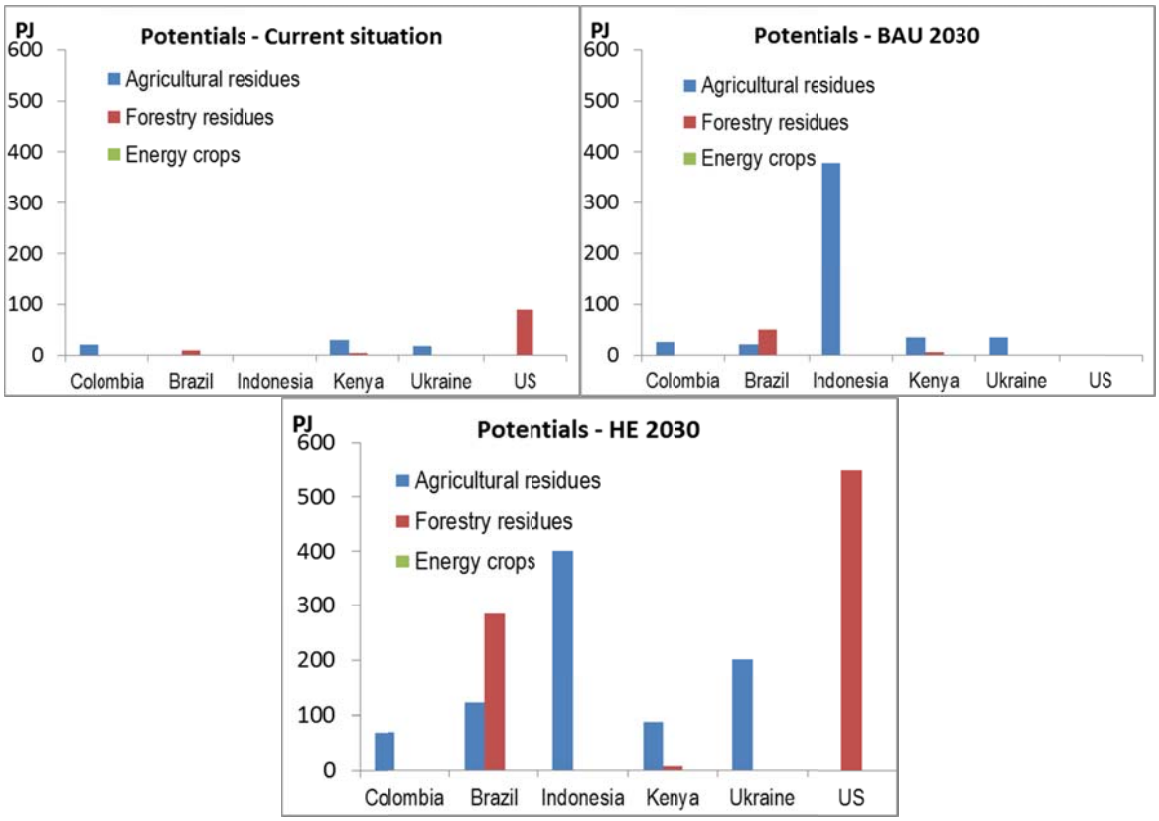

Figure 15: Biomass net sustainable export potentials for the six selected case studies under BUS and HE scenarios; current situation and 2030

Source: BioTrade2020plus project

Currently, forest biomass pellets exported by the US, from the south eastern states, represent the greatest share of lignocellulosic biomass arriving for energy production in Europe. It is mainly sold to the United Kingdom but also to Belgium and the Netherlands. The amount was almost 4 million tonnes in 2014 and it is expected that this will increase. According to the results of the project and focused on the high export scenario, the US still has a great exporting potential, with more than 500 PJ of forest biomass[3]. Indonesia and Brazil also stand out, with potentials of 400 PJ and 300 PJ respectively. Ukraine is another country which is very interesting due to its proximity and its potential to create energy from agricultural waste at 200 PJ. All these levels are to be considered under the premise of a scenario for 2030 where exportation is approved under high export potential premises. At a lower level, but still important, there are other countries such as Colombia and Kenya which need to be considered.

[2] The idea of not including the 2020 based scenarios is that it is little time available and they are more likely not to be reached

[3] The sustainable export potentials presented in US case assume that all biomass harvesting in the US SE is confined to those areas deemed to meet the sustainability criteria considered here. For this reason, these are conservative estimates of availability, and in some cases the sustainable export values are very small or even negative. This is the case in BAU 2030 scenario.

We are always referring to a potential of sustainable biomass, considering firstly that the domestic demand has been met. Nevertheless, it must be noted that although Europe is currently the area with the highest solid biomass demand, other markets are growing, especially in Asia, which could alter the makeup of established markets.
In terms of the cost for delivery to Europe, specifically to the port of Rotterdam, following is shown the cost-supply curves for each case study for both scenarios.

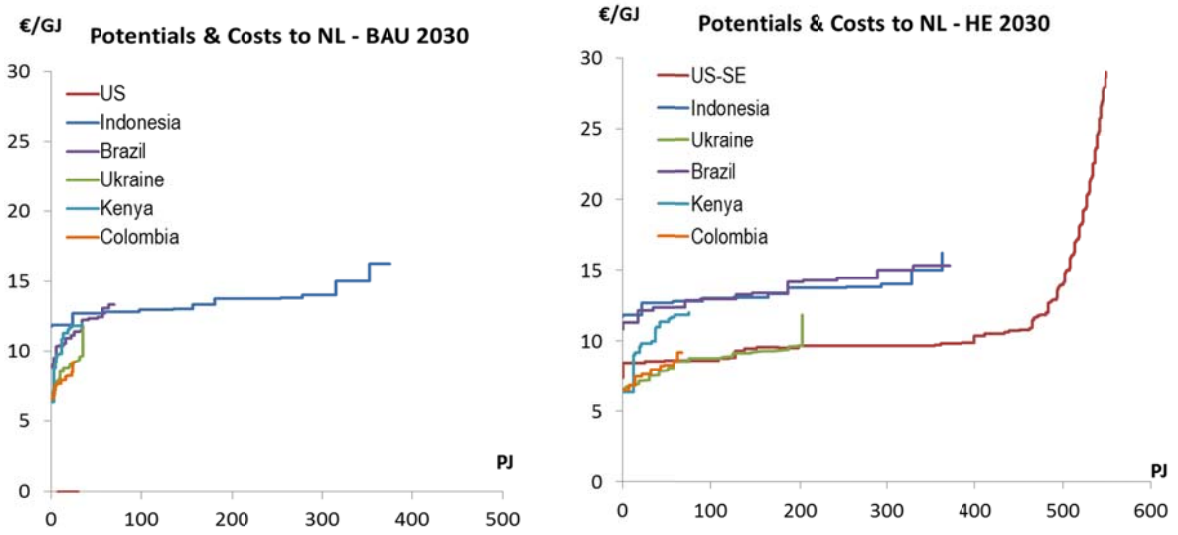

Figure 16: Cost-supply curves for each case study for BAU and HE scenarios
Source: BioTrade2020plus project

On the other hand, as result to combine all cost supply curves in the scenario analyzed for 2030, in case of High expert scenarios a large percentage of the imported biomass, about 600 PJ, would cost 10€ per GJ and another major part would cost less than 15€ per GJ. The costs are higher when we talk about the BAU scenario. At 10 €/GJ less than 100 PJ could be imported to Europe.

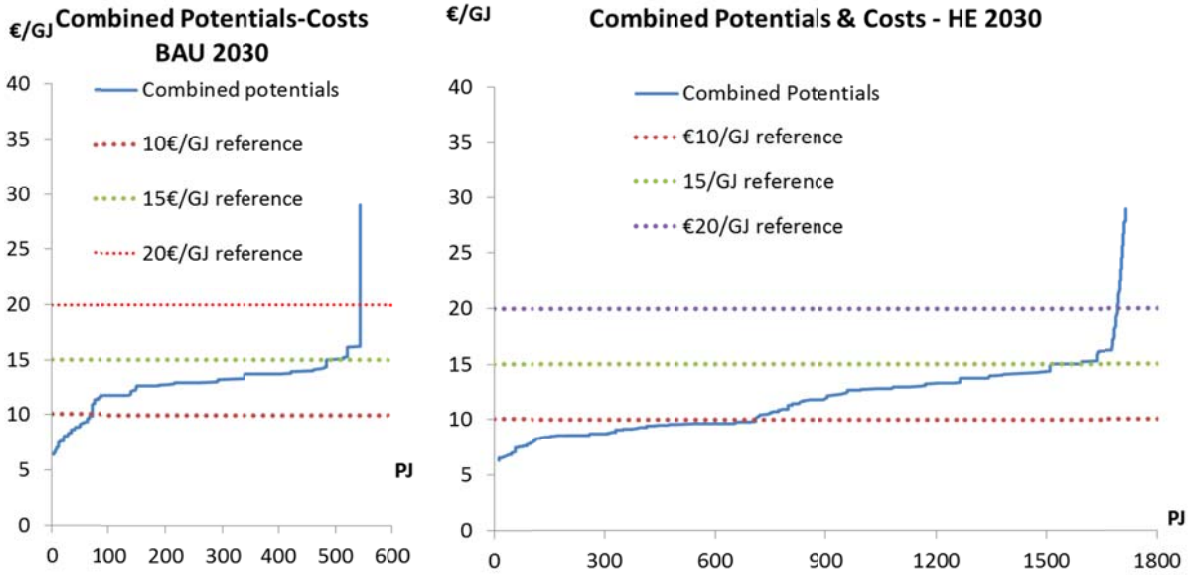

Figure 17: Global export potentials: costs delivered to EU
Source: BioTrade2020plus project

As it was pointed out previously another important issue according the sustainability is the assignment of the corresponding GHG emissions for export this feedstock to Europa form the different sourcing regions. As it shows in the next figure there is important differences between countries, being Ukraine, Colombia and Brazil the countries with lower values, around 10 kg CO_2 per GJ.

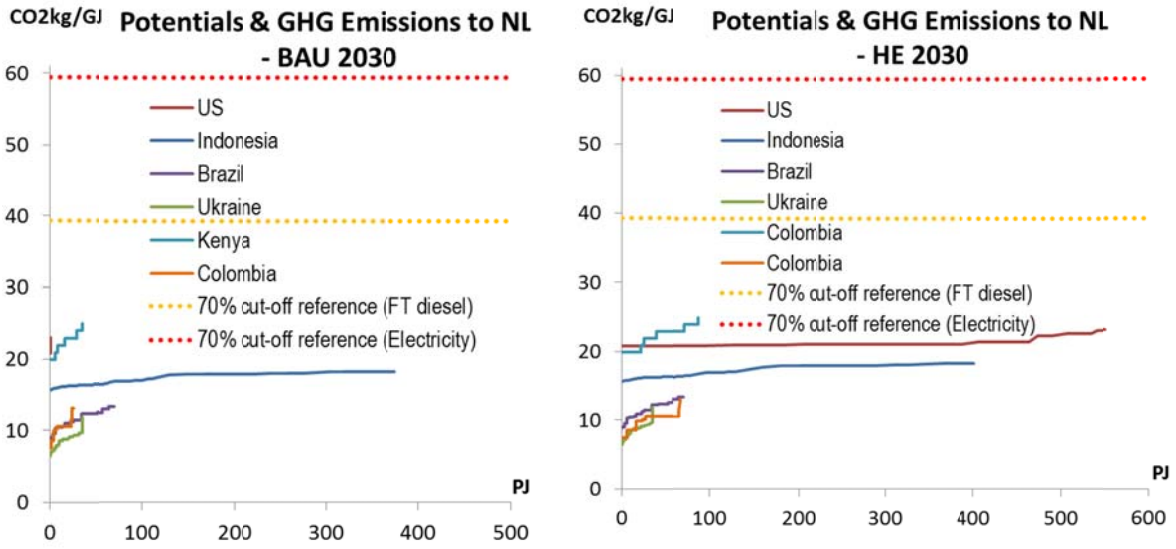

Figure 18: GHG emissions of lignocellulosic biomass delivered to EU
Source: BioTrade2020plus project

From the previous results some conclusions are presented:

- US South East shows highest export potentials however sustainability requirements are the main limit for increasing the net sustainable export potential by 2030.
- US SE, Ukraine and Colombia could make significant contributions (200-600 PJ) to fill the EU supply gap. In other sourcing regions as Kenya, the speed of biomass mobilisation is the main constraint
- Not all the feedstock types have been included for all supply regions. The studies have been focus on the most promising ones in each region.
- GHG emission thresholds are not an issue, but at current price levels, exports would be limited to 200-600 PJ for all regions under study.
- Competing demand from South and East Asia may further limit export to the EU.
- Other promising sourcing countries (e.g. Canada, Mozambique) have not (yet) been included in the analysis. Therefore, it would be useful to expand in the future BioTrade2020plus approach to other areas in the world to analyze that have sustainable biomass potential available for export in order to complete the whole biomass trade world map, considering also new biomass demanding areas as for example Asia.

5. Strategies for securing imports

As it was indicated in section 1, the main aim of BioTrade2020plus is to provide guidelines for the development of a European Bioenergy Trade Strategy for 2020 and beyond. For this purpose, the following issues have been addressed through questionnaires, surveys, workshops and deliverables [19]:

- Opportunities and risks of sustainable biomass trade, perceived by different stakeholders, both for importing and exporting regions.
- The current technical barriers for market parties when they are involved in trade.
- A number of suggested key principles were agreed upon with different stakeholders as a prerequisite to have sustainable biomass trade.
- Suggested policy strategies and guidelines for bioenergy markets and trade.

Most conclusions were drawn from a global survey – 127 stakeholders from 35 countries participated in this survey.

5.1. Opportunities and risks of international biomass trade

In terms of markets and society, there are clear opportunities and risks related to international biomass trade. Distinction can be made between opportunities and risks for the importing regions (in this case EU countries), and on the other side opportunities and risks for sourcing regions (distinction can be made between North America, South America, Africa, Southeast Asia, East Europe & Russia).

The principal opportunities for **European importing regions** can be summarized as follows (*more than 60% agreement, and ranked from highest agreement by respondents of the survey*):

1. Higher cost-efficiency to reach renewable energy targets
2. Beneficial also for regions with limited domestic potential
3. Complementary with other renewable energy
4. Broader feedstock portfolio (more flexibility in sourcing, stabilized prices)
5. Potential to invest in new technologies (substantial biomass volumes needed to reach economy of scale)

The agreed risks for European importing regions are (ranked from highest agreement by stakeholders):

1. Business case uncertainty
2. Impact of subsidies on feedstock prices

When applying the analysis to **sourcing regions**, i.e. countries which produce biomass and could potentially export to the European Union, the most important opportunities are (*more than 60% agreement, and ranked from highest agreement by respondents of the survey*):

1. Contribution to economic development
2. Job creation
3. Improved sustainable management practices

4. Building up supply chains
5. Synergies with local sectors
6. Capacity building

The most important perceived risks strongly depend on the sourcing region in mind.

1. Unstable EU policy (*relevant for all*)
2. Overexploitation (biodiversity loss and carbon loss in forests and soils) (*for Africa, SE Asia, East Europe and South America*)
3. Mainly opportunity for large players, less for smallholders (*for SE Asia, Africa, South America and East Europe*)
4. Displacement of local biomass/land use (*for SE Asia, Africa and East Europe*)
5. Low value-added exports (*for SE Asia and Africa)*
6. Reduced access to land (*for SE Asia, South America and Africa)*
7. Lower local renewable energy opportunities (*for Africa and SE Asia)*

5.2. Technical barriers

A number of potential barriers were listed in the on-line survey. These are the ones which were rated as important or very important by over 60% of the respondents:

- The bad public image due to claims of unsustainable practices for biofuels and a lack of knowledge of public, media and policy makers are seen as the most important barriers for trade.
- In terms of sustainability criteria and certification systems, respondents indicated the difference in sustainability requirements in EU Member States for solid biomass and the differences in sustainability governance of agriculture and forestry policies by country/region as some of the main barriers. Also people indicated that the lack of sustainability criteria for fossil fuels creates an unlevel playing field, that changing sustainability requirements create uncertainty for stakeholders, and that sustainability criteria only required for energy and not for other applications of biomass. Proliferation of certification systems is also considered a barrier for trade.
- The lack of roads and port infrastructure in some sourcing regions were also seen as relevant trade barriers.

5.3. Key principles

As a basis for a long term trade strategy, a number of key principles were suggested as a prerequisite to have sustainable biomass trade. These principles were also discussed in the various stakeholder consultations.

The following principles reached an agreement of more than 75% in the survey (ranked from highest agreement):

- Trade should be based on sustainable and legally acquired biomass sourcing (traceable and verifiable).
- Markets should be transparent, with clear reporting and monitoring systems.

- The full value chain (from feedstock production up to end conversion) should be the basis for performance assessments (e.g. energy, GHG).
- Trade should follow the principles of fair trade, i.e. all actors in the value chain receive a fair share of the benefits.
- Markets should be open (WTO compliant), and there should be no discrimination in market access.
- Local use of biomass should have priority over trade. Displacement as a result of trade demand should be avoided.
- Displacement/indirect effects in the sourcing regions should be taken into account in support mechanisms for biomass/bioenergy.

5.4. Long term strategies and guidelines on European bioenergy markets and trade

A number of long term strategies and guidelines were proposed in relation to bioenergy trade. In fact, the project does not propose a specific European trade strategy in terms of biomass for energy, but suggests to consider overall bioenergy strategies and the fact that trade will be part of these markets.

The recommendations and guidelines can be summarized as follows:

- Policy needs to be consistent, but also dynamic to be effective (e.g. in case of price fluctuations). It is very important to have a long term policy vision. There should be consistency between different policy fields.
- Risk perception is high in the biobased economy and access to finance is an issue. Governments can provide tools to improve this.
- Market access needs to fulfil WTO rules, there can be no discrimination between imported and domestic biomass. Sustainability requirements can be justified in terms of WTO compliance, if they are not intended as a trade barrier to protect or prioritize domestic resources.
- A sustainability frame is to be applied to the management of forest or agriculture overall, independent of the end use of its products. Transparency and controllability of the chain of custody are key. Consistency in sustainability requirements along Members States and different markets is needed to avoid market distortions. It is important to build on existing systems like EUTR or voluntary schemes.
- A serious and urgent reduction of fossil fuels is needed in the frame of climate change mitigation. Fossil fuels are by definition unsustainable and currently they don‘t have to demonstrate their sustainability performance, e.g. in terms of GHG emissions, land use, … This creates an unlevel playing field with the alternatives on biomass which have to put efforts in chain of custody reporting and certification. Tools for phasing out fossil fuels (like carbon tax) need to be considered, also to remove the unlevel playing field of fossil fuels versus its alternatives.
- Mobilisation of biomass is the key for further deployment of the biobased economy. Cooperation/good practice exchange would help in developing regions to facilitate progress in agricultural productivity, forest management and waste management and develop infrastructure and logistics to mobilize biomass.

- It is important to monitor the impacts related to EU policies on markets, both in the EU and on global markets. These can be co-benefits or trade-offs. In terms of iLUC it is important to demonstrate innovative approaches to avoid or deal with iLUC and identify cases where iLUC is low or even positive.
- When assessing the performance of biomass value chains, the full chain (from production of biomass, over logistics, conversion, up to the end use) needs to be taken into account, with a focus on greenhouse gas emissions and energy use. Improved energy efficiency means that more can be done with the same amount of biomass.
- Bioenergy has a bad public image and the public, media and policy makers are not very well informed about possibilities and opportunities of biomass and bioenergy. Independent answers should be given to some of the concerns to provide clarity for policy makers and the public, but also demonstrate opportunities.
- Variability of biomass quality is an issue, particularly for residues or herbaceous material. A major step to mobilize lignocellulosic materials for international markets (and trade) is to turn them into real commodities. This can also be supported by governments.

6. Interactive On-line tool

A web-based easy to use interactive tool that is based on existing biomass supply tools and fully adapted to the main end-user requirements has been elaborated. The interactive tool's main goal is to provide detailed spatially explicit cost-supply information on biomass sources and to assist in the identification of sustainable origins of imported lignocellulosic biomass from the targeted sourcing regions. Therefore, the information elaborated for each case study region in other project's tasks has been integrated into the tool. For each case study, an overview, including cost supply curves, a supply view and a SWOT matrix is presented.

For the design of the online tool the starting point was:

1) The approaches and specification on presentation of data collected and results elaborated accumulated in the other WPs in Biotrade2020plus, particularly

2) The results of a user requirements analysis based on interviews held with 50 stakeholders at the 2014 Biomass conference in Hamburg (see Deliverable 4.2)

3) An evaluation of existing tools for exploring or assessing issues in bioenergy and biomass. This evaluation identifies useful elements in functionality and data presentation. Moreover, it helps to determine added value and unique qualities of the BioTrade2020plus tool in comparison to the other tools.

Figure 19: Overview of General User Interface (GUI) of Biotrade2020plus tool harvest is confined to sustainable sourcing

Source: Biotradeplus2020plus project

The Biotrade2020plus tool can be accessed from http://biotrade2020.services.geodesk.nl/

On the main page the user sees the home page with a general introduction to the project and the main features of the tool. On the main menu the seven regions are visible. Under every region a tab is available for: overview, supply viewer, cost supply curves, policies and a SWOT matrix.
Further, the main bar shows a tab for methods, policies and a description of partners.

The overview page for each region holds a general description of the region, its biomass sources and sustainability issues. Furthermore, there is a link to the full regional case report.

A main feature of the tool is the supply viewer. The supply viewer gives in quantitative way the sustainably available biomass sources (in this case from only woody origin). Values can be chosen both in dry weight as well as energy content. When clicking on a county, the values for the county appear in the right hand bottom screen.
In the left pane the different scenarios can be chosen (see main bar: methods), the year, as well as category of biomass and if available also subcategory of biomass.

In the left bottom pane, the options of technical, sustainable or exportable potential can be chosen. See for a description other deliverables (Iriarte et al. 2014) and the tab 'methods'. Unique feature of this tool is that available biomass can now be assessed in a consistent and transparent manner between regions. Each background report per region gives the criteria according to which sustainable is defined and implemented.

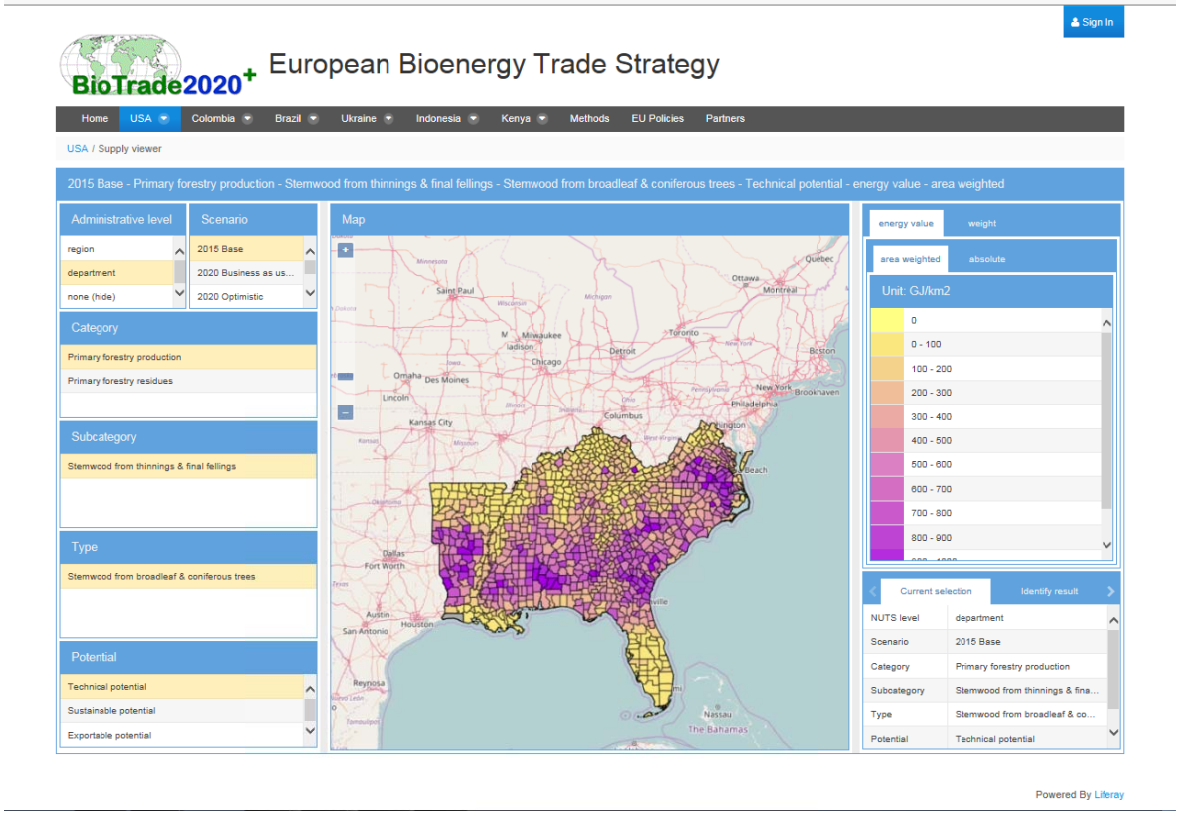

Figure 20: Supply viewer for the case of Southeast USA

Source: Biotradeplus2020plus project

7. Stakeholder engagement

BioTrade2020plus also aimed at strengthening links and information exchange between stakeholders involved in international sustainable biomass trade. For this reason among the several dissemination activities scheduled during the course of the project, three stakeholder **working groups** have been established:

- WG1: Biomass importers and end-users (e.g. industries, representatives of competing markets, biomass traders, NGOs, policymakers)
- WG2; Biomass producers and exporters (e.g. agricultural, forestry and industrial sector in biomass producing countries, NGOs, policy makers in sourcing countries)
- WG3: Long-term strategies and support frameworks

For each working group a series of telephone conferences were periodically organized. All these conferences are aimed to collecting user requirements, provide feedbacks on initial inputs and assumptions and provide feedback and validate draft deliverables. Previously to the conference calls a background paper was sent to all participants in order to boost the contribution during the meetings. After these teleconferences brief minutes are prepared and circulated to all the participants in order to compile all the information gathered and discussed.
The stakeholder working groups were involved in 12 telephone conferences, bi-lateral communications, and workshops. Strong focus was placed on the input from stakeholders from non-European sourcing regions of solid biomass.
Furthermore, several **surveys** with stakeholders were implemented. On the basis of the collected background data a number of SWOT statements were produced for the different sourcing regions (6 to 10 statements per region) divided in general conditions, export conditions for biomass from forestry and export conditions for agricultural biomass. The statements were discussed in an Advisory Board meeting, in two webinars and through an on-line survey. The draft statements were entered into an on-line SurveyGizmo survey (http://www.surveygizmo.com/s3/2807987/67e19fea8229). The survey was distributed to several stakeholders on 3 June 2016 and it was kept open until 8 July 2016. 46 valid responses were received.
Most of the respondents classified themselves as ‘expert’, but different sectors were also represented (people could indicate multiple selections).The following figure shows how many of the responses were received for each sourcing region. Responses related to Kenya, Colombia and Indonesia are limited, indicating a relatively low interest from these regions in trade of lignocellulosic biomass with Europe.

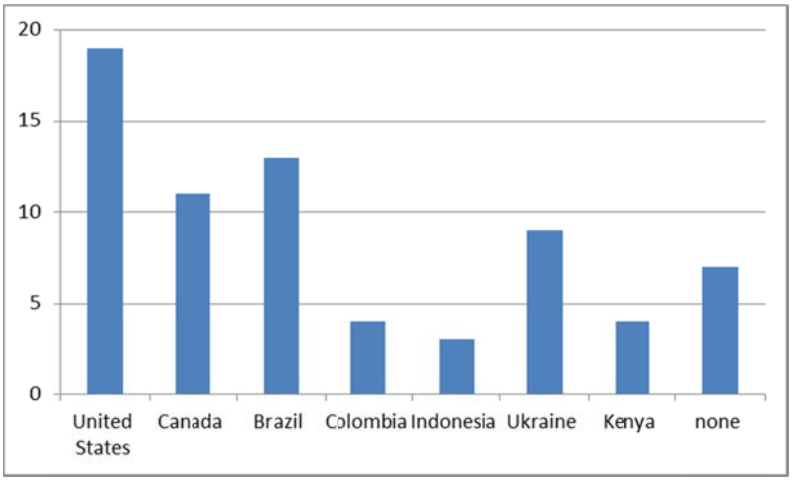

Figure 21: Origin of survey participant

Source: Biotradeplus2020plus project

The concrete results per sourcing region and the reactions to the SWOT statements (also from the advisory board meeting and the webinars) have been integrated in the final version of report 5.2 *Strategies for bioenergy in potential supply regions and regulatory SWOT analysis as trade partner to the EU* available in project website.

Finally, the BioTrade2020plus project organized a series of **workshop**, either as stand-alone events or in co-location with other events. The following events were executed:

- Targeted interviews for the collection of end-user requirements on the occasion of the 22nd European Biomass Conference & Exhibition (EUBCE 2014) in Hamburg, 23-26 June 2014
- Mid-term and IEA cooperation workshop on 24 October 2014 in Brussels on the occasion of the IEA Bioenergy ExCo Meeting.
- Workshop on “Policy options for sustainable biomass trade” on the occasion of the 23rd European Biomass Conference & Exhibition (EUBCE 2015) on 3 June 2015 in Vienna, Austria.
- Final BioTrade2020plus Workshop on 14 June 2016, Brussels, Belgium

Figure 22: Interactive session during BioTrade2020 workshop held in Brussels, October 2014

Source: Biotradeplus2020plus project

8. Conclusions and recommendations

Today in the European Union, the achievement of existing and future bioenergy targets implies that in addition to using domestic biomass, European markets will also rely on imports of biomass. Some well-positioned regions of the world are already playing a role in supplying biomass to the European markets and could become increasingly relevant in the near future. Trade can be a logical result of a supply-demand balance: some regions can mobilize much more biomass than needed in domestic markets, while others have shortages, which can balance out through trade. Another argument is that export regions potentially have more cost-efficient production systems - reasons can be higher productivity (because of favorable climate and oils) or also inexpensive labor - so they can compete with EU. If the resource base described in this report were mobilized from the case study regions and were available for export, the EU would be competing economically for this material. It is possible that EU member states would be the primary importers of this biomass, but the potentials reported here should be considered as export potentials from the sourcing regions and not necessarily as import potentials for the EU. However, given that the only other major market for imported wood pellets is in East Asia (Korea and Japan, which are supplied by exports from other countries in the region and Western Canada), it is likely that EU member states will remain the largest import market for biomass in the coming years.

The following table summarizes the global biomass export potential estimated from the six case studies for the different scenarios:

Scenarios	BAU2015	BAU2020	BAU2030	HE2020	HE2030
Export potential (PJ)	168.41	354.02	545.71	727.80	1,725.88

Table II: Summary of global export potential for the different scenarios

Source: Biotradeplus2020plus project

The models estimate an increase of sustainable lignocellulosic biomass potential over time, however these figures must be considered as an approximation, which point out a ranges. On the other hand, it has to be considered price limitations. In that sense, at current price levels, exports would be limited to 200-600 PJ for all regions under study. On the contrary, GHG emission thresholds are not an issue.

On the other hand, a number of long term strategies and guidelines have been proposed in relation to bioenergy trade. In fact, the project does not propose a specific European trade strategy in terms of biomass for energy, but suggests to consider overall bioenergy strategies and the fact that trade will be part of these markets. The main suggestions include: create policy consistency (in a long term policy vision), provide access to finance, support biomass mobilization and exchange good practices, focus on commoditization to feed in variable biomass quality, monitor impacts on markets, do not discriminate market access (however sustainability requirements need to be fulfilled), be consistency in sustainability requirements along Member States and different markets, keep sufficient focus on reducing fossil fuels, consider full biomass value chains in assessing their performance and provide more information to the public, media and policy makers on possibilities and opportunities of biomass and bioenergy.

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