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on Socio-economics and Sustainability

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Global-Bio-Pact

Impacts of biofuels/bioproducts trade and certification schemes on economies in Africa, LA and Asia

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Abbreviations

Bio-SG – Bio-synthetic gas

BL – Billion litres

BtL – Biomass-to-liquids

CHP - Combined Heat and Power Plants

CPO – Crude Palm Oil

GDP – Gross Domestic Product

GHG – Greenhouse Gases

Gt – Giga tonnes

CARB - California Air Resources Board

CEN – European Committee for Standardisation

EPA - Environmental Protection Agency

EU – European Union

FP7 – Seventh Framework Programme for Research

HCV – High Conservation Values

HVO - Hydrotreated Vegetable Oil

iLUC – indirect (impacts of) land use change

ISCC – International Sustainability and Carbon Certification

ISO – International Organisation for Standardization

IWPB - Initiative of Wood Pellet Buyers

LA – Latin America

LCA – Life Cycle Assessment

LCFS - Low Carbon Fuel Standard

Lge – Litres of gasoline equivalent

MB/d – Millions of barrels per day

OECD – Organization

p.a. – per annum

ppm – parts per million

RED – Renewable Energy Directive

R&D - Research and Development

RSB – Roundtable on Sustainable Biofuels

RSPO – Roundtable on Sustainable Palm Oil

TPES – Total Primary Energy Supply

Unicamp – University of Campinas

US – United States

Preface

This report was elaborated in the framework of the Global-Bio-Pact project (Global Assessment of Biomass and Bioproduct Impacts on Socio-economics and Sustainability) which is supported by the European Commission in the Seventh Framework Programme for Research (FP7). Global-Bio-Pact is coordinated by WIP Renewable Energies and runs from February 2010 to January 2013.

The main aim of Global-Bio-Pact is the improvement and harmonisation of global sustainability certification systems for biomass production, conversion systems and trade in order to prevent negative socio-economic impacts. Thereby, emphasis is placed on a detailed assessment of the socio-economic impacts of raw material production and a variety of biomass conversion chains. The impact of biomass production on global and local food security and the links between environmental and socio-economic impacts are analysed. Furthermore, the Global-Bio-Pact project investigates the impact of biomass production on food security and the interrelationship of global sustainability certification systems with international trade of biomass and bioproducts, as well as with public perception of biomass production for industrial uses. Finally, Global-Bio-Pact focuses on socio-economic sustainability criteria and indicators for inclusion into certification schemes, and the project elaborates recommendations on how to best integrate socio-economic sustainability criteria in European legislation and policies on biomass and bioproducts.

A core activity of Global-Bio-Pact is the description of socio-economic impacts in different countries and continents in order to collect practical experience about socio-economic impacts of bioproducts and biofuels under different environmental, legal, social, and economical framework conditions.

This report “**Impacts of biofuels/bioproducts trade and certification schemes on economies in Africa, LA and Asia**” was elaborated by Unicamp’s research team (University of Campinas, Brazil) that is engaged in the project.

1 Introduction

A strong public debate on sustainability aspects for biomass use for energy and products emerged in the last few years. This debate focused mainly on negative social and environmental impacts. In consequence, several initiatives were set-up, which are engaged in developing tools to ensure sustainability of biofuels. One option to promote the sustainability of biofuels is the application of certification systems.

The main aim of the Global-Bio-Pact project is the improvement of global sustainability certification systems for biomass production, conversion systems and trade in order to prevent negative and to promote positive socio-economic impacts. Thereby, emphasis is placed on a detailed assessment of the socio-economic impacts of feedstock production and a variety of biomass conversion chains.

The report "**Impacts of biofuels/bioproducts trade and certification schemes on economies in Africa, LA and Asia**" aims at providing an assessment of the opportunities of the production and commercialization of biofuels and bioproducts in specific countries of Africa, Asia and Latin America, taking 2020 as time horizon. More specifically, the aim is assessing the impacts of certification schemes on the potential production as such schemes can either foster the production and trade or, on the other hand, can impose barriers for trading. The six countries analyzed are partners of the project, and data gathering was one the reasons for the choice. In addition, some of these countries are currently important suppliers of biofuels and all of them are good case studies as long as biofuels production is concerned. The potential of biofuels/bioproducts production vary from country to country, and this is also the reason for the choices. The analyzed countries are Argentina and Brazil, in South America, Costa Rica, in Central America, Indonesia in Asia, and Mali and Tanzania, in Africa.

This report is organized in six chapters, including the Introduction (Chapter 1). Chapter 2 is based on the report of Deliverable 6.1 and presents an overview of current trading regimes for liquid biofuels and wood pellets. Chapter 3 is an assessment of potential markets of the main bio-products considered in this report (liquid biofuels, wood pellets and new bio-products) taking 2020 as the time horizon. Chapter 4 is devoted to present parameters of the six countries specifically considered in this report (as mentioned, Argentina, Brazil, Costa Rica, Indonesia, Mali and Tanzania) and a brief assessment of the potential for producing bio-products for exporting. Chapter 5 presents an analysis of the potential impacts of certification schemes on trading of bio-products. Finally, concluding remarks are presented in Chapter 6.

2 Overview of current trading regimes for bioproducts

This section summarises the main conclusions of a previous report, in which an overview of the current trading regimes for biomass products, and mainly liquid biofuels and pellets, was presented. The production of non-conventional bioproducts, such chemicals, is still very small and detailed information is not available for the time being; obviously, in this case trading experience is tiny and information is even scarcer. The focus of the previous report was on liquid biofuels (ethanol and biodiesel) and wood pellets.

Trade of ethanol, biodiesel and wood pellets is growing, but the volumes traded are still low regarding other energy and agriculture commodities. International biofuel trade is both supply and demand driven, despite the fact that the demand has been induced by national policies, as mandates. As mentioned by Lamers et al., (2011) (as quoted in the Deliverable 6.3) import duties largely influenced trade volumes, and tariff preferences are the main drivers of trade routes.

Up to 2011, the international trade of liquid biofuels was strongly influenced by regimes imposed by US and EU. In US, in early 2012 there was an important change on trade regimes for biofuels but, so far the information available is not enough for an analysis of the ongoing impacts. In the case of pellets, the main consumer market has been EU and the main exporters have been US and Canada. In comparison to liquid biofuels, trade regimes have been much less restricted for pellets.

Wood pellets are the main feedstock of solid biofuel trade. The main consumer market of wood pellets is Europe, and it is growing fast partly due to the existing renewable energy policy targets. Other growing markets, but to a smaller extent, are US, Japan and South Korea. The main importer region is EU (mainly for large-scale district heating and co-firing plants), and the main exporter countries are Canada and US.

Regarding fuel ethanol, the main consumer markets are US and Brazil, followed by EU. The production is highly concentrated in the US and Brazil, and Brazil used to be the main world exporter; recently, the drawbacks of ethanol production in Brazil and the surplus of US production let space to changes on trade flows. Historically, the main importer of fuel ethanol has been US, but the imported volume is relatively small regarding their consumption. In relative terms imports are more important for EU.

Concerned to biodiesel, the main market is EU and the region has also been the main importer. The largest suppliers have been Argentina and Indonesia, despite the fact that recently, in some years, US took opportunity of exporting subsidized biodiesel. This is also an emblematic example of the dynamics of trading rules, as EU promptly reacted to eliminate what was identified as regulatory fails.

It is predicted that sustainability requirements and certification schemes will have a strong influence on trade regimes both for liquid biofuels and pellets. In case of liquid biofuels, sustainability requirements have already been imposed by EU and US. In the case of pellets, is the consumer market that has imposed (for different reasons) sustainability requirements.

As long as liquid biofuels are concerned, in US, due to the initiatives in California[1] and at the Federal level[2], the focus has been only on avoided GHG emissions regarding fossil fuels. On the other hand, the EU Renewable Energy Directive (RED) also addresses potential impacts on biodiversity, on water resources and on food supply, besides main social aspects (e.g. the respect of human, labour and land use rights). These sustainability initiatives, and mainly the European one, have motivated the proposition and the development of certification schemes

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[1] The regulation was defined by the California Air Resources Board – CARB, in the context of the Low Carbon Fuel Standard (LCFS) program.

[2] Regulation defined by the Environmental Protection Agency – EPA, under the revised Renewable Fuel Standard (RFS2) program.

since the accomplishment of sustainability principles and criteria shall be certified by independent auditors. As these initiatives are very recent, it’s not possible to evaluate their impacts over trade.

At the EU, eight certification schemes have been recognised and can be used by the producers and/or traders to show conformance to the current requirements.

In what concerns the production of other bio-products (e.g. chemical and materials) this industry is yet in its infancy and no example of large-scale production can be presented. One of the most important appeals for such products is its potential benefits to the environment and to the society; thus, sustainable production will be an essential condition for reaching the most important markets. It seems that a strategy under development is the location of the conversion units close to the consumer markets, and the diversification of the biomass supply sources. In this sense, developing countries would be mainly suppliers of raw biomass and not producers of the new bio-products.

3 Potential markets in 2020

In this section the potential markets of biofuels and bioproducts (mainly chemicals and plastics) is presented. The text is based on information available at the literature.

3.1 Liquid biofuels

Liquid biofuels provided about 3% of the global road transport fuels in 2011 and, for the time being, ethanol and biodiesel are the most important biofuels. Compared to 2010, biodiesel production expanded in 2011 while ethanol production stabilised (for the first time in more than one decade) (REN21, 2012). Production figures in 2011 are presented in Table 1. The world production and consumption of fuel ethanol is dominated by the US and Brazil, which are responsible for about 87% of the world production, being US by far the main producer. Regarding biodiesel, EU is currently responsible for 43% of the world production and about 60% of the world consumption.

Table 1: Production of liquid biofuels in 2011, in billion litres (BL)

Country/region	Fuel ethanol	Biodiesel
USA	54.2	3.2
Brazil	21.0	2.7
EU	4.3[a]	9.2[b]
China	2.1	0.2
Argentina	0.2	2.8
Others	4.3[c]	3.3[d]
Total	86.1	21.4

Sources: REN21, 2012

[a] Main European producers: France, 1.1 BL, Germany, 0.8 BL, Spain, 0.5 BL;
[b] Main European producers: Germany, 3.2 BL, France, 1.6 BL, Spain, 0.7 BL, Italy, 0.6 BL;
[c] Other relevant producers: Canada, 1.8 BL, Thailand, 0.5 BL and Colombia, 0.3 BL;
[d] Other relevant producers: Indonesia, 1.4 BL, Thailand, 0.6 BL and Colombia, 0.3 BL.

Figure 1 shows the shares of biofuels production (ethanol and biodiesel) in 2011. It can be seen that almost 80% of the production of biofuels was in the Americas, mostly due to the contribution of US (North America), Brazil and Argentina (South America). In 2011, the production of biofuels in Asia-Pacific was 3.65 Mtoe (equivalent to 0.26% of the annual consumption of oil products in the region).

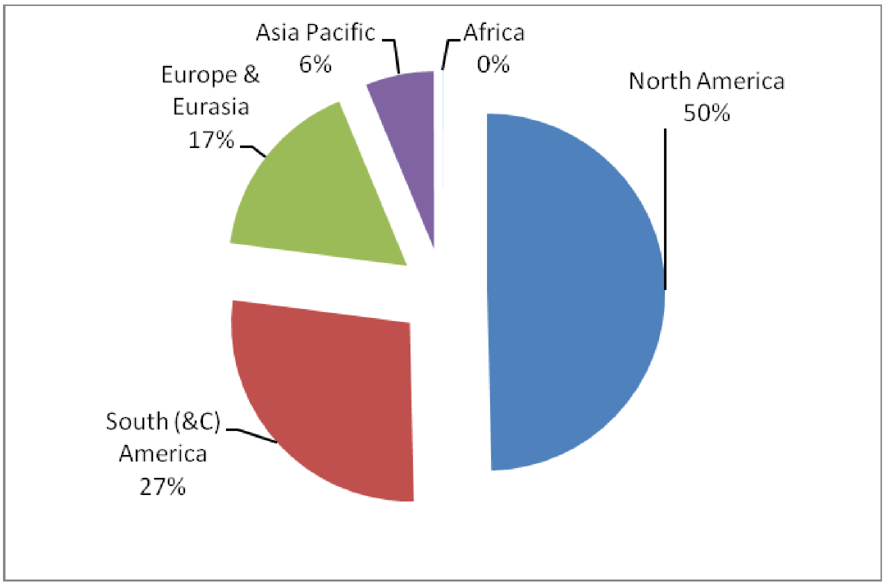

Figure 1: Production of biofuels in different regions, in 2011
Source: BP (2012)

According to REN21 (2012), the mandates in place around the world in mid-2011 called for a biofuels market of at least 220 BL by 2022 (about twice the consumption in 2011). The expected demand of biofuels would be driven primarily by US, the EU, Brazil and China. Also according REN21 (2012), the majority of mandates are in EU countries, as part of the 10% target for renewable energy in transport by 2020[3], and a significant number in Asia.

An important point is the estimate of the potential market of liquid biofuels by 2020 (the time horizon previous defined for this Work Package), i.e. the amount required, the main consumer countries and the prevalence of ethanol or biodiesel in the market.

There are good prospective studies assessing the world energy matrix in scenarios which time horizon vary from 10 to 50 years. Among the reports available, here a study by the International Energy Agency (**Technology Roadmap – biofuels for transport**, published in 2011) and the **BP Energy Outlook 2030** (also published in 2011) are highlighted.

3.1.1 International Energy Agency

The publication **Technology Roadmap – biofuels for transport**, published by International Energy Agency in 2011 (IEA, 2011), addresses the potential and required actions for fostering the use of biofuels in the transport sector. The study takes 2050 as the time horizon and considers an important condition for defining the scenarios the necessity of drastic reduction of greenhouse gas (GHG) emissions. The results are coherent with a study by IEA (**Energy Technology Perspectives 2010**) taking into account that the concentration of carbon dioxide must be stabilized as 450 ppm (parts per million) by 2050 (IEA, 2010) (that implies a target of 50% reduction in energy-related CO_2 emissions by 2050, regarding 2005 levels).

According to the IEA study (IEA, 2011), while improving vehicle efficiency is by far the most important low-cost way of reducing CO_2 emissions in the transport sector, biofuels will play a significant role in replacing liquid fossil fuels suitable for planes, marine vessels and other heavy transport modes that cannot be electrified. The roadmap by IEA considers

[3] This text was written previous of the Draft Law proposed in Europe in September 2012.

conventional[4] and advanced biofuels[5] and for road transport the contribution of hydrogen and electricity in 2050 would be remarkable (20%) (see Figure 2).

The roadmap by IEA envisions that, by 2050, 32 EJ of biofuels will be used globally, providing 27% of world transport fuel (to be compared with less than 2% in 2010). The study indicates that biofuels could contribute in particular to the replacement of diesel, kerosene and jet fuel. Potentially (if produced sustainably), the projected use of biofuels could avoid around 2.1 giga tonnes (Gt) of CO_2 emissions per year (out of a total reduction of about 43 $GtCO_2$ to be reached in the energy supply chains in 2050 (IEA, 2010)). According to IEA, to meet this vision, advanced biofuels need to be commercially deployed, which requires substantial investment and specific support.

Figure 2 shows the predicted global energy use in the transport sector by 2050 (left side) and the predicted use of biofuels in different transport modes (right side). Due to the improvements in energy efficiency, the energy use in the transport sector in 2050 would be even lower than in 2010 (about 125 EJ); oil derivatives would contribute to about 51% of the energy matrix (gasoline, diesel, jet fuel and heavy fuel oil, in Figure 2). The use of biofuels in transport modes like aviation and shipping is almost nil by the time being and would represent about 12 EJ in 2050 (six times the current combined production of ethanol and biodiesel).

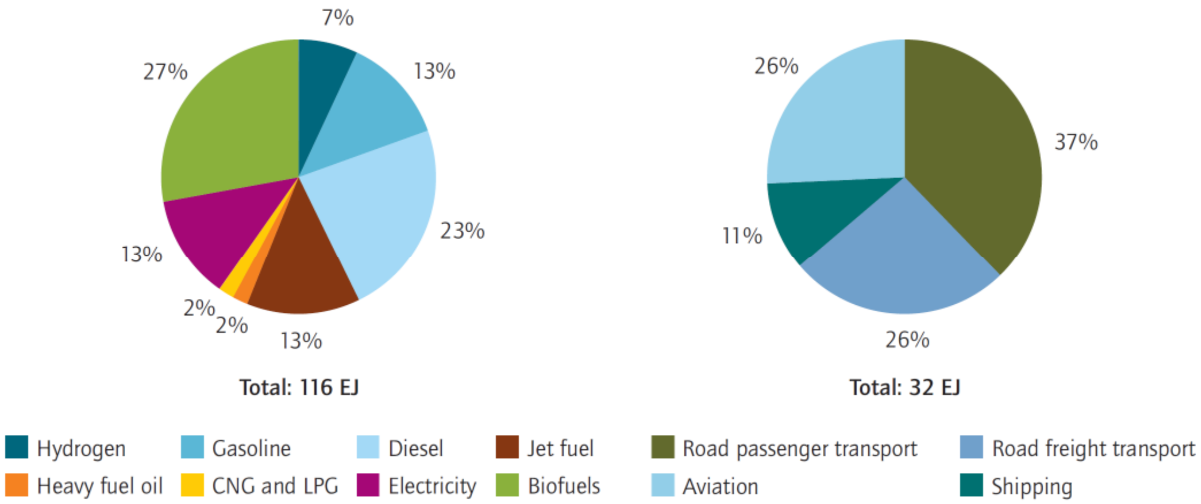

Figure 2: Predicted world energy matrix of the transport sector by 2050 (left) and biofuels use in different transport modes in the same year (right)
Source: IEA (2011)

[4] Technologies include well-established processes that are already producing biofuels on a commercial scale. These biofuels, commonly referred to as first-generation, include sugar- and starch-based ethanol, oil-crop based biodiesel and straight vegetable oil, as well as biogas derived through anaerobic digestion. Typical feedstocks used in these processes include sugarcane and sugar beet, starch-bearing grains, like corn and wheat, oil crops, like rape (canola), soybean and oil palm, and in some cases animal fats and used cooking oils (IEA, 2011).

[5] Conversion technologies are still in the research and development (R&D) stage, pilot or demonstration phase, and are commonly referred to as second- or third-generation. This category includes hydrotreated vegetable oil (HVO), which is based on animal fat and plant oil, as well as biofuels based on lignocellulosic biomass, such as cellulosic-ethanol, biomass-to-liquids (BtL)-diesel and bio-synthetic gas (bio-SG). The category also includes novel technologies that are mainly in the R&D and pilot stage, such as algae-based biofuels and the conversion of sugar into diesel-type biofuels using biological or chemical catalysts (IEA, 2011).

According to the hypothesis considered, the production of 32 EJ of biofuels would require around 100 million hectares (Mha) in 2050 (and the production of 65 EJ as biomass). This poses a considerable challenge given competition for land and feedstocks from rapidly growing demand for food and fibre, besides the additional 80 EJ of biomass for generating heat and power. It is assumed that 50% of the feedstock for advanced biofuels and biomethane will be obtained from wastes and residues, corresponding to 20 EJ.

Figure 3 shows results of the study (IEA, 2011) that correspond to the predicted production of biofuels up to 2050 and the required land. According to IEA's view, the production of conventional ethanol (except ethanol from sugarcane) and conventional biodiesel would be completely phased-out between 2040-2045, due to the low overall efficiency (i.e., energy production per area) and to the expected deployment of advanced biofuels.

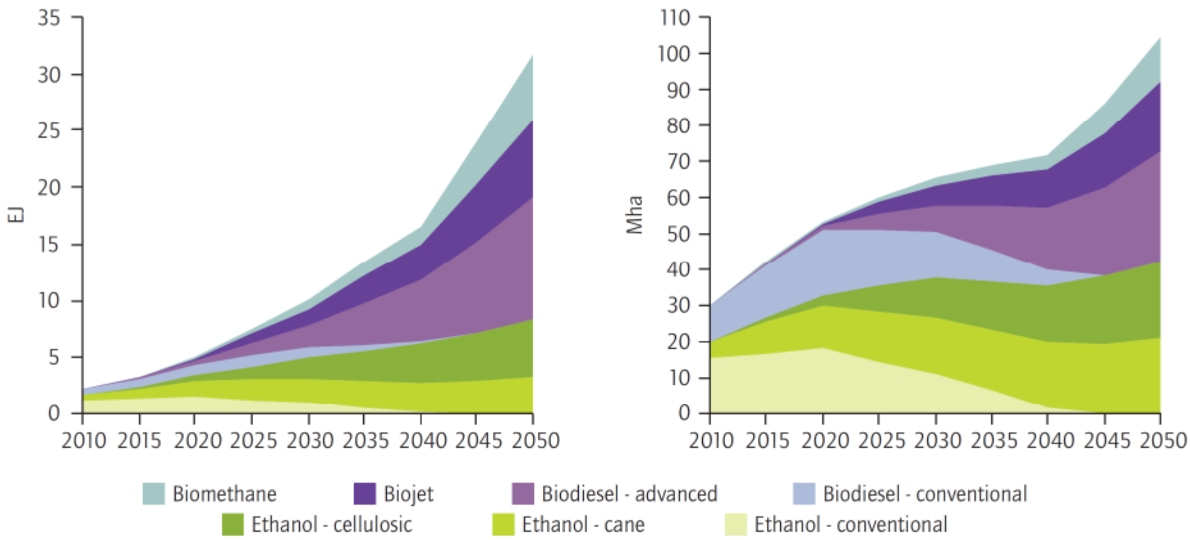

Figure 3: Predicted production of different biofuels from 2010 to 2050 (left) and required land (right)
Source: IEA (2011)

Table 2 presents the predicted production of liquid biofuels (ethanol and biodiesel) in 2020 and 2030, according to the estimates done by IEA (2011) (which results are showed in Figure 3). Compared with the production results for 2010, the prediction is that the production of ethanol could enlarge 2.3 times in 2020 and 3.3 times in 2030; regarding biodiesel, the production could be twice larger in 2020 and 5.5 times larger in 2030. The estimate production in 2022 would be 175-180 BL, i.e. about 20% lower than the estimate done by REN21 (2012) based on the existing mandates.

Table 2: Predicted production of liquid biofuels in 2010 and 2020 (EJ/year) (MB/d in parenthesis)

Year	Liquid biofuels	Ethanol	Biodiesel
2020	5.0 (2.6)	3.4 (1.8)	1.6 (0.8)
2030	9.2 (4.8)	5.0 (2.6)	4.2 (2.2)

Source: IEA (2011)

The scenarios defined by IEA (IEA, 2011) concerning the different technologies for biofuels production indicate that in 2020 advanced biofuels would have a marginal share but, potentially, a significant contribution from 2025 onwards. The installed capacity of advanced biofuels production in 2010 was estimated as 175 million litres of gasoline equivalent (Lge) per year, but with most plants operating below nameplate capacity. At the same time, the production capacity of 1.9 billion Lge/yr was evaluate based on the units under construction and would be sufficient to meet the targets for advanced biofuel production until 2013. Proposals for an additional 6 billion Lge/yr capacity have been announced until 2015. However, after 2015 advanced biofuel production will need to ramp up rapidly: a 30 fold increase over currently announced advanced biofuel capacity will be required to reach 250 billion Lge/yr operating capacity in 2030 and, beyond 2030, a further quadrupling of advanced biofuel capacity will be required until 2050 to reach this roadmap's targets. Figure 4 shows the required production of advanced biofuels from 2010 onwards in order to fulfil the hypothesis presented by IEA; it can be seen that the current installed capacity is tiny regarding the future targets.

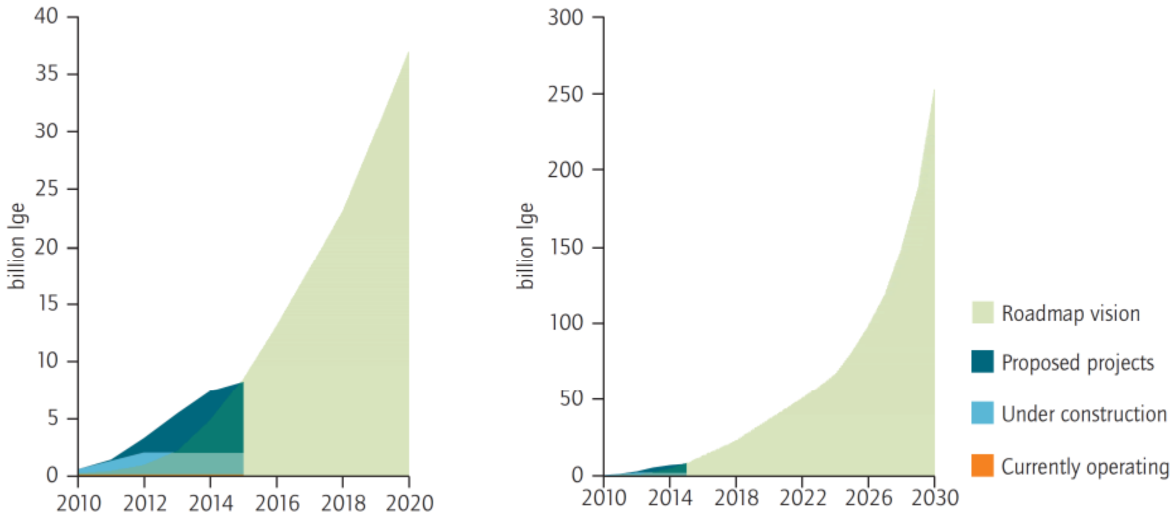

Figure 4: Required production of advanced biofuels up to 2050
Source: IEA (2011)

Conventional biofuels are expected to play a role in ramping up production in many developing countries because the technology is less costly and less complex than for advanced biofuels. It is expected that the first commercial advanced biofuel projects will be set up in the USA and Europe, as well as in Brazil and China, where several pilot and demonstration plants are already operating[6].

In the roadmap by IEA (2011), biofuel demand over the next decade is expected to be highest in OECD countries (about 50% in 2020), but non-OECD countries would account for 60% of global biofuel demand by 2030 and roughly 70% by 2050, with strongest demand projected in China, India and Latin America. In 2020, almost 50% of the biofuels demand (2.3 EJ/year out of 5.0 EJ/year) would be in EU and North America (mostly US) and almost 30% (1.4 EJ/year) in Latin America (mostly Brazil). The balance of the demand would be in China and other Asian countries.

In this sense, biofuels trade will become increasingly important and can help trigger investments and mobilise biomass potentials in certain regions. In regions with limited land and feedstock resources, such as certain Asian countries, feedstock and biofuel trade will play an increasing role. In accordance with the current tendency, IEA (2011) states that important issues for settling biofuels trade are: (a) reduction and/or abolishment of tariffs and other trade barriers, mainly aiming at enhancing sustainable biomass and biofuel trade; and

[6] This is the information provided by IEA (2011). However, the effective operational stage is not known and some plants – or even most of them – are operating with constrains.

(b) the development of internationally agreed sustainability criteria as the basis for implementing sound certification schemes for biofuels (but not creating trade barriers).

As long as the technologies of second generation biofuels develop, the production of liquid biofuels would be more concentrate in countries that dominate such technologies and/or the consumption is higher. Raw biomass could be supplied by the regions with higher potential for the production and, in principle, certain biofuel trade routes could only exist for a limited period.

3.1.2 BP Energy Outlook

The second prospective study to be highlighted is the BP Energy Outlook 2030 (BP, 2012). The company used to develop Energy Outlooks for internal purposes, but has decided to make the report publically available from 2011 on. The company states the Outlook is not a “business as usual” extrapolation and reflects the company’s judgement of the likely path of global energy markets to 2030. The main conclusions regarding energy consumption in the transport sector and liquid biofuels are presented below.

Global liquids demand (oil, biofuels, and other liquids) is likely to rise by 16 Mb/d, exceeding 103 Mb/d by 2030 (in 2011 the consumption of oil products was 88 Mb/d, being 60 Mb/d as middle and light distillates – i.e. mostly diesel oil and gasoline). The growth would come exclusively from rapidly-growing non-OECD economies and Asian countries would account for more than three-quarters of the net global increase (rising by nearly 13 Mb/d). By sector, the demand growth of liquids should come from non-OECD transport (nearly 14 Mb/d), with non-OECD industry also contributing (nearly 6.5 Mb/d, largely for petrochemicals). Post-2015, OECD transport demand is expected to fall as technology and policy lead to improved engine efficiency.

Up to 2030, energy used for transport will continue to be dominated by oil, but its share would decline. Growth is expected to slow over the next twenty years to average 1.1% p.a. versus 1.8% p.a. during 1990-2010, with OECD demand slowing and then declining post-2015. The slowing of growth in total energy in transport is related to (a) higher oil prices and (b) improving fuel economy, (c) vehicle saturation in mature economies, and (d) expected increases in taxation and subsidy reduction in developing economies.

Transport fuel in 2030 remains dominated by oil (87%) and biofuels (7%). Other fuels gain share, such as natural gas and electricity (4% and 1%, respectively, in 2030); the use of such fuels would be constrained by limited policy support combined with a general lack of infrastructure in all but a handful of markets. According to BP (2012), Brazil would have the highest penetration of biofuels (21% in 2010, rising to 39% by 2030), while the US would lead the OECD in incentivizing biofuels (4% in 2010 to 15% by 2030). Figure 5 shows the predicted growth of the world transport fuel demand from 2010 to 2030.

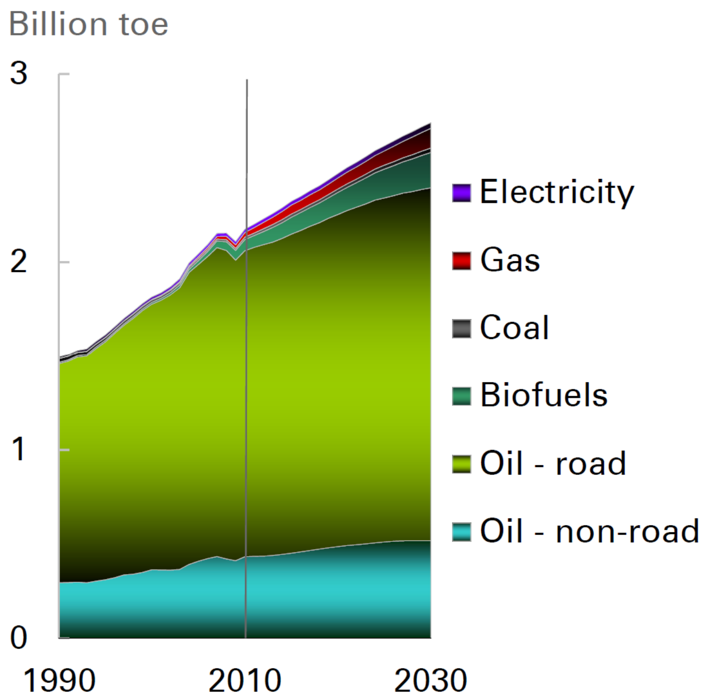

Figure 5: Predicted transport energy demand up to 2030
Source: BP (2012)

Biofuels production (largely ethanol, from the point of view of BP) is expected to exceed 5 Mb/d by 2030 – contributing 30% of global supply growth over the period 2010-2030. The results presented by BP (2012) are slightly more optimistic than those presented by IEA (2011) (see Table 2 for comparison) regarding the growth of biofuels production.

The US and Brazil would continue to dominate production; together they would account for 68% of total output in 2030. First- generation biofuels are expected to account for most of the growth. After 2020, roughly 40% of global liquids demand growth will be met by biofuels with the US and Europe leading the consumption growth. By 2030, this figure approaches 60%.

The results presented by BP (2012) are that the growth rate of energy used for transport declines due to accelerating improvements in fuel economy and the impact of high oil prices. Vehicle saturation in the OECD and likely increases in taxation (or subsidy reduction) and development of mass transportation in the non-OECD are other factors. The global vehicle fleet (commercial vehicles and passenger cars) would grow from around 1 billion in 2011 to 1.6 billion by 2030. Most of the growth would be in the developing world with some mature markets at saturation levels.

3.1.3 Main conclusions

The three estimates previously presented indicate some convergence on the predictions of liquid biofuel markets by 2020-2022: (a) based on mandates, REN21 (2012) estimates the consumption of 220 BL of biofuels by 2022; (b) IEA (2011) estimates a production of about 240 BL in 2020, being about 80% fuel ethanol; and (c) BP (2012) estimates the production of about 210-220 BL of biofuels by 2020, being the majority fuel ethanol. The production in 2011 (see Table 1) was 107.5 BL, being 80% ethanol.

All three studies coincide that the main markets for biofuels in 2020 will be US, Brazil and EU, while some Asian countries, like China, could also have a special importance. In addition, all studies agree that the first generation biofuels will be by far the most important alternative and that a tiny share of the demand could be matched by the second generation biofuels.

In this sense, the main producer players will be basically the same as in 2011, i.e., US and Brazil, for ethanol, EU, Argentina and Indonesia (and possibly Malaysia), for biodiesel. The production of conventional ethanol in US is already close to the maximum predicted from corn and, in case of delays on developing the second generation technology, the targets of RFS2 won't be matched or imports will rise. The issue is that few countries are in condition to go for large-scale production in short-term and even Brazil, a country with more than 35 years of experience and large production potential is facing drawbacks.

Without changes on the current EU mandate, the way the potential European market will be matched depends on the decisions regarding trade policy. Laborde (2011) stated that it seems Member States intend to implement the EU mandate in such way that would result an increase in the relative consumption of ethanol to biodiesel. According to the author, in a scenario under the trade policy status quo the local production of ethanol would be reinforced. However, under trade liberalization the EU ethanol production would decline, with sugar beet- and wheat-based ethanol most affected. In both scenarios, biodiesel will be the predominant biofuel in Europe and EU will be worldwide the main consumer market. Laborde (2011) concludes that the imports of biodiesel shall increase to the EU, despite sustainability criteria, largely due to price competitiveness. In this sense, the EU is very unlikely to fully use its existing biodiesel capacity.

However, a very recent proposal at the European Union would completely change the current picture. In September 2012 it was announced that EU can impose a limit on the use of crop-based biofuels and also an end (after 2020) to the subsidies applied to them. Under the proposal, the use of first-generation biofuels would be limited to 5% of total energy consumption in the EU transport sector in 2020, while crop-based fuel consumption currently accounts for about 4.5% of total EU transport fuel demand.

The European Commission wants to increase the share of advanced biofuels made from household waste and algae in the EU's 10%. The Commission has proposed that the use of such advanced fuels should be quadruple-counted within the EU's 10%, in an attempt to at least meet it on paper.

The very short-notice of this proposal makes impossible a deep analysis of the impacts of this possible new regulation on biofuels market in Europe, as well on trade. In a first moment, it seems that the biofuels market would be reduced, with a deep impact on the domestic production of biodiesel[7]. The direct impacts on ethanol production and on ethanol imports could be smaller, but indirectly the impacts will come from the adverse environment for first-generation biofuels.

3.2 Wood pellets

Global production of wood pellets grew almost tenfold, from 1.6 to over 15 Mt in ten years (up to 2010). Currently, the largest producers are the USA, Canada, Germany, Sweden, and Russia. Over the past decade, the leading consumer and importer of wood pellets has been the EU27, with more than two thirds of global production annually (Lamers et al., 2012).

In 2015, the consumption of pellets for power generation can surpass 8 Mt, being about 4.5 Mt only in UK; other large consumer countries for such purpose should be the Netherlands, Denmark, Belgium and Poland. According to the European Biomass Association, quoted by Pirraglia et al. (2011), it is expected that Europe will reach a total consumption of 50 Mt per year by 2020. Regardless of increased production, European countries will have a lack of

[7] At the same moment, the tendency is the imposition of default factors for taking into account the impacts of indirect land use change (iLUC) on GHG emissions. The proposed default factors are much higher for biodiesel than for ethanol, mainly ethanol from sugars.

production capacity to satisfy the internal demand, mainly due to the scarce availability of sustainable sources of raw material in the EU. East Asia (Japan and South Korea, mainly) is predicted to become the second largest consumer after the EU in the near future.

The predictions presented by Sikkema et al. (2011) are even higher: in 2020 the demand for woody biomass would vary from 105 Mt, based on market forecasts for pellets in the energy sector and a reference growth of the forest sector, to 305 Mt, based on maximum demand in energy and transport sectors and a rapid growth of the forest sector.

While most markets of non-industrial pellets are largely self-sufficient, markets of industrial pellets depend on the import from outside the EU. Industrial pellet markets are relatively mature, compared to non-industrial ones, because of their advanced storage facilities and long-term price-setting, but depend on the establishment of public support schemes (Sikkema et al., 2011).

According to (Goh et al., 2012) the two most important factors that determine the demand for wood pellets, besides support policies, is the existence of coal power plants and the development of residential heating systems based on biomass. On the wood pellet supply side, the three main interrelated factors are: resource availability, interactions with the wood industry and logistics issues.

Regarding sustainability requirements, a decision by EC is that specific criteria are not necessary for solid biomass (EC, 2010), but the main consumers have decided to adopt their own criteria. Pushed by the main consumers, EC launched a consultation on sustainability criteria for solid biomass and it seems possible, in the near future, the adoption of uniform sustainability criteria for wood pellets consumed by power plants above 20 MW of net capacity (Ryckmans, 2011).

So far, the trade of wood pellets between Belgium, the Netherlands and UK is only possible if evidence of sustainability can be presented to the buyer (the final consumer, i.e., the power plant operator). Belgium has a system in place related to grant of green certificates that only covers raw material by country report and GHG balance through audit of processor, while UK and the Netherlands are developing mandatory systems for biomass co-firing that include a verification scheme for the whole supply chain (Ryckmans, 2011).

An important action from the consumer’s side is the Europe's Initiative of Wood Pellet Buyers (IWPB) that has worked on standards for sustainability criteria; the organization includes all major European power companies that fire biomass – and mainly wood pellets – in power plants (Ryckmans, 2011).

Currently, each firm has its own sustainability criteria for the procurement of biomass for power production, with image playing a major role. The firms would also, however, like to sell wood pellets to each other, and doing so would then require standardised sustainability criteria (Koop and Morris, 2011).

In summary, the market is growing rapidly mainly in Europe and in a smaller extent in North America and in Asia. The European market will require a significant share of imports, mainly of industrial pellets; so far the main suppliers are Canada and US, but there are good opportunities for new players. Sustainability requirements have been demanded by the main consumers and the tendency in short-term is the harmonization of certification schemes. The main consumers are not just concerned about the risks and their public image, but also want to transform pellets into a real commodity.

3.3 Bio-products

The so-called bio-based economy is related to the production of different materials from biomass feedstock, including (a) energy vectors such as liquid biofuels, pellets, chips and biogas, (b) classical products such as food ingredients, pulp and paper, and pharmaceuticals, and (c) innovative products like bio-plastics, fine and specials bio-chemicals. The integrated production of diverse products using biomass as source of carbon has been called biorefinery and the effective development of feasible, efficient and sustainable production processes is worldwide the current challenge of many research and development projects.

The European Commission, in a 2007 report called “A Lead Market Initiative for Europe”, prepared by the Taskforce on Bio-Based Products, Composed in the preparation of the Communication, defined bio-based products as such (CSES, 2011):

“*Bio-based products refer to non-food products derived from biomass (plants, algae, crops, trees, marine organisms and biological waste from households, animals and food production). Biobased products may range from high-value added fine chemicals such as pharmaceuticals, cosmetics, food additives, etc., to high volume materials such as general bio-polymers or chemical feedstocks. The concept excludes traditional bio-based products, such as pulp and paper, and wood products, and biomass as an energy source”.*

Globally, the total market for bio-based products is difficult to estimate. Generally there is a strong tendency to focus on markets where bio-based products can substitute for products based on other raw materials (European Commission, 2009).

A common approach in the literature is to assess the market size and the number of employees in the sector by estimations and underlying assumptions. Two studies are mentioned by CSES (2011):

- A McKinsey study estimated that biotechnology accounted for 7% of global sales in the chemical industries in 2005 and predicted that by 2010 biotechnology would account for 10% of sales within the global chemical industry. The estimate is that biotechnology would account for 20% of the global chemical sector by 2020;
- Another study estimated total global sales of products made by biotechnological processes at 3.5%; the study projected that sales of products made by biotechnological processes in 2017 should reach 15.4% of total chemical sales.

There are already several bio-based products on the market in Europe; for instance, the chemical industry is estimated to use 8-10% renewable raw materials to produce various chemical substances. In other market segments, the market shares for bio-based products are still very low (European Commission, 2009).

An illustration of the growing market of bio-plastics is presented by van der Pol (2011), who estimated that the installed production capacity grew from 190 thousand tonnes (kt) in 2006 to more than 960 kt in 2011, and could surpass 1,400 kt in 2012 (see Figure 6). Bio-based chemicals would represent about 8% of the total production in 2012 and could represent 15% in 2017.

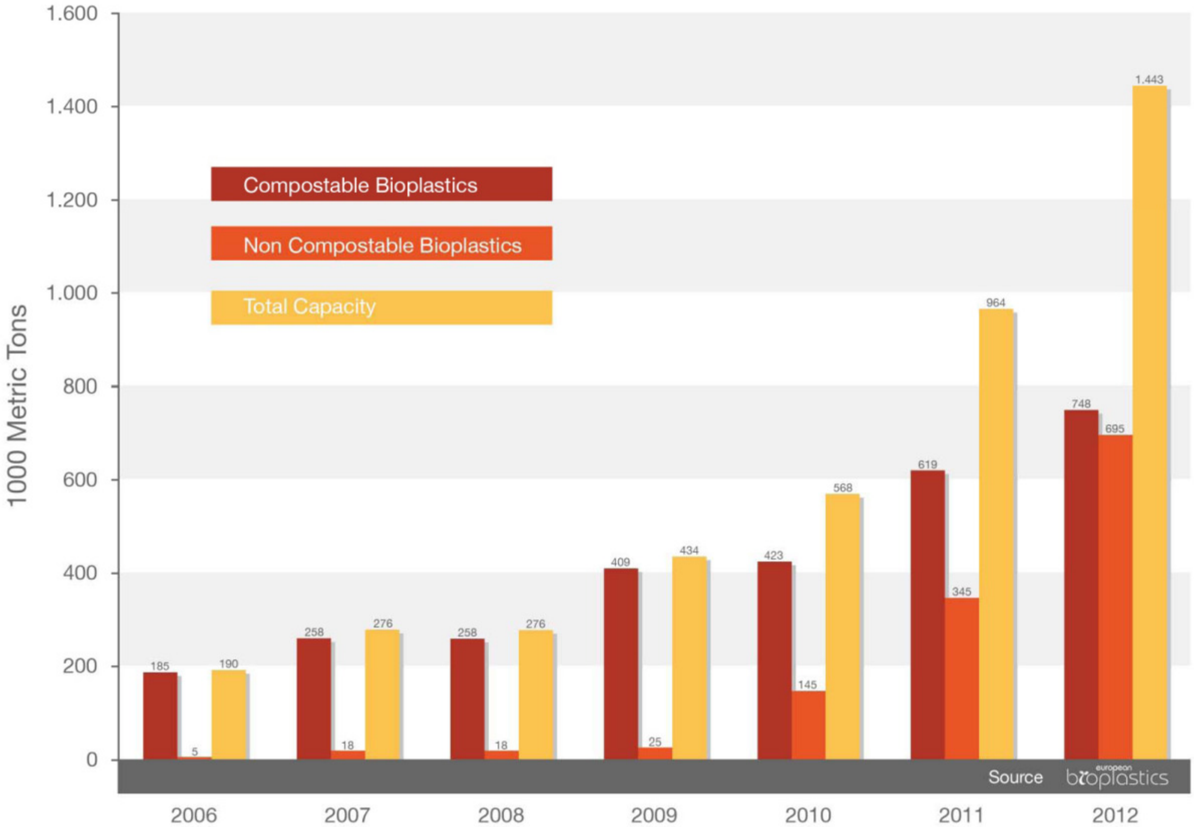

Figure 6: Installed capacity for production of bio-plastics
Source: van der Pol (2011)

Also regarding bio-plastics, a study from the University of Utrecht[8] (see Figure 7) suggests that over 90% of the global annual production of plastics is technically feasible for substitution by bio-plastics. However, it will not be possible to exploit this technical substitution potential in the short to medium term due to (a) economic barriers (especially production costs and capital availability), (b) technical challenges in scale-up, (c) the short-term availability of bio-based feedstocks and (d) the need for the plastics conversion sector to adapt to the new plastics (Vijayendran, 2010). Another common constrain for bio-based products is the lack of technical standards. As can be seen in Figure 7, the world bio-based plastic capacity in 2007 was estimated at 360 kt (about 280 kt in Figure 6) and could reach 3,450 kt in 2020.

[8] By Li Shen, Juliane Haufe and Martin K. Patel. Quoted by Vijayendran (2010).

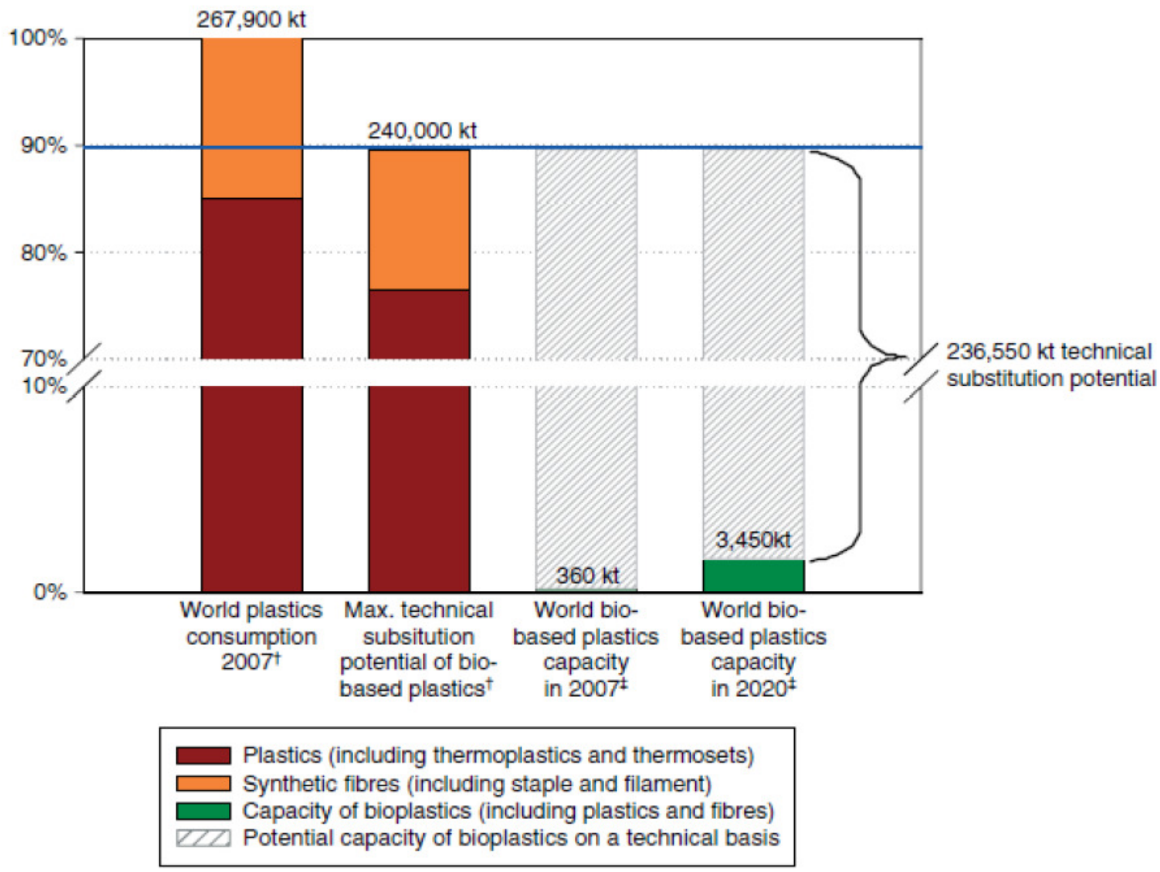

Figure 7: Predicted and potential world production of bio-plastics
Source: Vijayendran (2010)

In theory, bio-based products are of high societal and economic interest due to several positive factors, such as:

- Use of renewable and expandable resources;
- Less dependency on limited and increasingly expensive fossil resources;
- The potential to reduce GHG emissions (carbon neutral / low carbon impact) [9];
- The potential for sustainable industrial production;
- Potentially better recovery and recycling options;
- Often low toxicity;
- Often high bio-degradability or compostability;
- Less resource-intensive production (potentially) (water, energy, waste);
- Potentially improved population health;
- Support to rural development;
- Increased industrial competitiveness through innovative eco-efficient bio-based products.

[9] Bio-based products can be carbon negative on a lifecycle basis by sequestering atmospheric carbon within the product itself.

An important aspect to be highlighted in this report is regarding the sustainability of these bio-products, aspect that is close related to the sustainability of the feedstocks. In principle, feedstocks could be produced elsewhere, but the industrial conversion units most probably will be close to the main consumer markets due to particularities of the production processes and also due to proprietary aspects. In this sense, some countries have defined a strategy of installing bio-refineries close to the harbors, aiming at receiving imported biomass and reducing logistics costs; examples are two largest ports in Europe, the Rotterdam port, in The Netherlands, and Antwerp, in Belgium (Hennissen, 2011; Accenture, 2012).

The Netherlands intends to be the main bio-hub in Europe given its geography, strong agro, chemical and logistics sectors (Roland Berger, 2012) and, in this sense, the strategy of Rotterdam port is clear[10]. Some of the main ports in Europe intend to be "bio-hubs", importing final products but also importing bioenergy feedstocks to transform them into biofuels and bio-products. Figure 8 shows the predicted development of Rotterdam port regarding biofuels and bioproducts.

A prevalent vision is that ports should increase their involvement and evolve to a logistical hub for biofuels flows and bio-based industrial cluster. Basically, this has happened regarding the petrochemical industry.

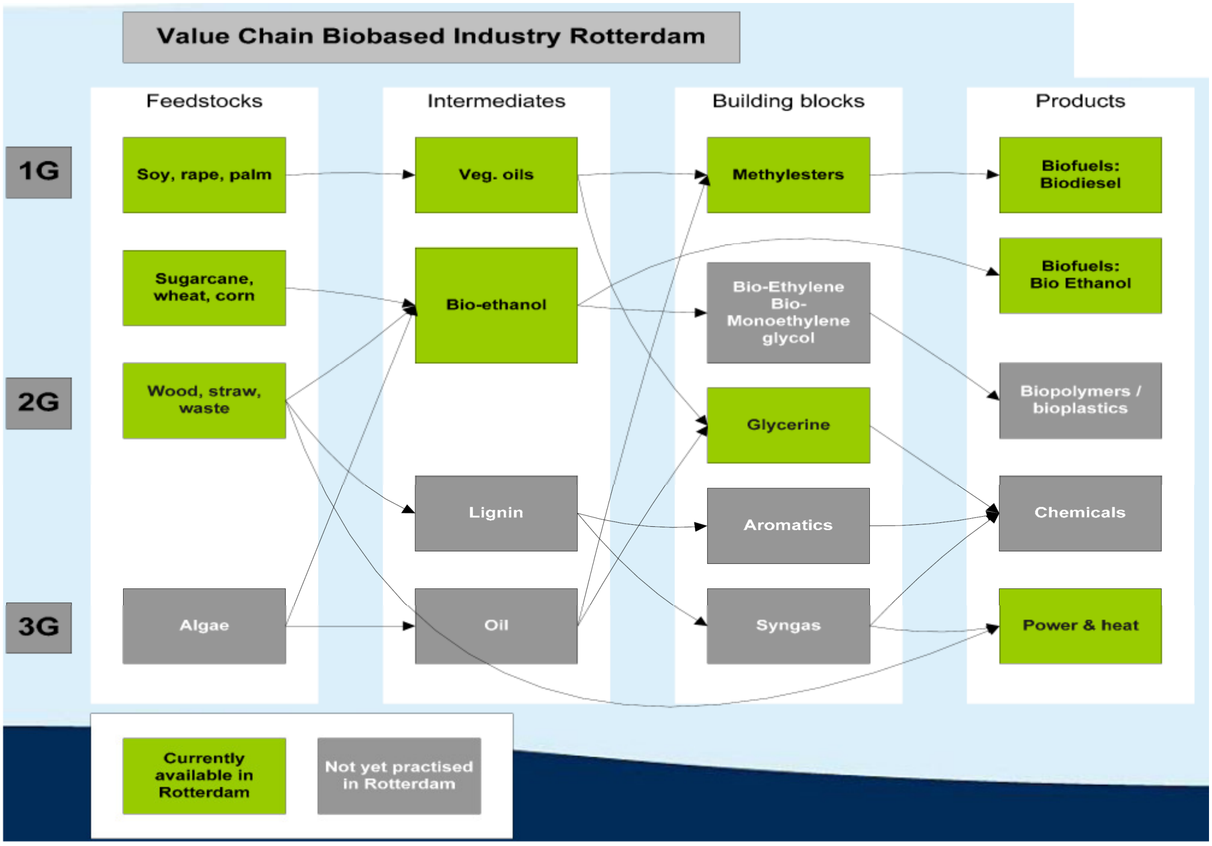

Figure 8: Predicted development of Rotterdam bio port
Source: Hennissen (2011)

[10] For details, see Rotterdam Climate Initiative at www.rotterdamclimate.initiative.nl

4 Country cases

4.1 General information

This section presents main figures about the six countries that were addressed in this report as representative cases for evaluating the impacts of certification schemes on biofuels/bioproducts production and trade. They are Argentina and Brazil (South America), Costa Rica (Central America), Mali and Tanzania (Africa) and Indonesia (Asia).

The information provided is regarding general economic figures, their energy matrix and degree of foreign dependence, the importance of renewables, in general, and biomass, in particular, general figures about the agriculture in each country, and information about the potential for large-scale biomass production.

Table 3 presents information for the above mentioned countries (except Mali – as no information is available at the IEA data basis), regarding total population, the Gross Domestic Product (GDP) (both in absolute terms and expressed according to the Power Purchase Power of each country), the total energy production, the share of net imports (as an indicator of the energy dependence) and indicators of specific energy consumption (per GDP and per capita), and carbon dioxide emissions. The information presented is for 2009, and is based on the Statistics of IEA (2012).

Among the five countries listed, only Indonesia is a net exporter of energy (mainly coal and natural gas – see Table 4) while Costa Rica is a large importer of energy sources (mainly oil products and crude oil – also, see Table 4). Tanzania has low indicators of energy consumption and carbon dioxide emissions per habitant, but the highest indicator of energy supply per GDP (indicating the low efficiency of energy use in the whole economy).

Table 3: General figures of five out of the six countries considered in case studies – data for 2009

Indicator	Argentina	Brazil	Costa Rica	Indonesia	Tanzania
Population (million)	40.28	193.73	4.58	229.97	43.74
GDP (billion 2000 US$)	397.95	856.02	23.09	258.49	16.24
GDP (PPP) (billion 2000 US$)	624.85	1,652.10	46.48	938.71	31.54
Energy production (Mtoe)	80.82	230.31	2.71	351.84	18.05
Share of net imports (%)	6.1	6.8	85.2	-43.7	9.5
TPES/population (toe/capita)	1.84	1.24	1.07	0.88	0.45
TPES/GDP (PPP) (toe/thousand 2000 US$)	0.12	0.15	0.11	0.22	0.62
Electricity consumption/ population (kWh/capita)	2,744	2,201	1,817	609	85
CO_2 emissions/population (tCO_2/capita)	4.14	1.74	1.37	1.64	0.14

Source: IEA (2012)

Argentina and Brazil have the best economic figures among the five countries, relatively low energy dependence and highest figures of energy consumption per habitant.

Also based on the statistics of the International Energy Agency (2012) for 2009, Table 4 presents details about the share of renewable (in general) and of biomass (in particular) in the energy matrix of each country, the dependence of energy carriers, the production and exports of biofuels and the importance of solid biomass in the residential sector.

Except Argentina, in all countries renewable energy sources have a large importance, but only Tanzania has a large dependence of conventional biomass. The importance of solid biomass (conventional) in the residential consumption is high in Costa Rica and very large in Indonesia and Tanzania; this could indicate that energy services are not adequate in these countries. In these three countries the highest share of the residential electricity consumption indicates low diversification level of the economy. Tanzania and Costa Rica are dependent on imported oil products and this could indicate the opportunity of biofuels production (that in both countries was nil in 2009).

In 2009 the production of liquid biofuels was relevant in Brazil (mainly ethanol, but also a reasonable amount of biodiesel regarding the world production) and almost 15% of the ethanol production was exported. Argentina produced biodiesel from soy and in 2009 the production was almost totally exported, while the production of biodiesel in Indonesia was small, taking into account the size of palm oil production there[11].

Table 4: Some figures of energy supply and energy demand for five out of the six countries considered in case studies – data for 2009

Parameter/Indicator	Argentina	Brazil	Costa Rica	Indonesia	Tanzania
Share of renewables[1] (%)	7.0	45.8	55.3	34.4	88.9
Share of biomass[1] (%)	3.1	31.6	15.8	26.0	87.7
Net exporter of	Crude oil, oil products and biofuels	Crude oil and ethanol		Coal, natural gas and biofuels	
Net importer of	Coal, natural gas and electricity	Coal, natural gas, oil products and electricity	Coal, crude oil and oil products	Crude oil and oil products	Oil products
Liquid biofuels production (1,000 tonnes)	1,168	20,987	---	355	---
Share of liquid biofuels exported[2] (%)	98.5	12.6	---	56.3	---
Residential consumption of solid primary biofuels[3] (%)	2.3	19.7	35.5	87.0	77.8
Residential consumption of electricity[3] (%)	30.6	25.0	40.0	40.8	45.5

Source: IEA (2012)

Notes: [1] Regarding the TPES; [2] Regarding the production; [3] Regarding the total final consumption.

[11] For making possible the comparison, figures of 2009 are presented. In the following years, the production of biodiesel in Argentina grew, and the production of ethanol in Brazil reduced.

As can be seen in Table 5, Argentina and Brazil are worldwide important agricultural producers, covering a reasonable share of the world production and both are among the top ten producers for most of the products listed. Both countries are important exporters of many agricultural products (or derivatives) listed in Table 5. Conversely, the relative importance of Indonesia is regarding palm oil and rice paddy, besides maize in a smaller extent. On the contrary, in relative terms the agricultural production in Costa Rica, Mali and Tanzania is small; for the products listed in Table 5, only the production of dry beans in Tanzania is significant.

Table 5: Figures of agricultural production in the six countries considered in case studies – data for 2011

Parameter/ Indicator	Argentina	Brazil	Costa Rica	Indonesia	Mali	Tanzania
Main agricultural commodities (top five – production basis)	Soybeans, sugarcane, maize, wheat and milk	Sugarcane, soybeans, maize, corn and cassava	Sugarcane, pineapples, bananas, milk and orange	Rice, sugarcane, cassava, palm oil and maize	Rice, maize, millet, sorghum, milk	Maize, cassava, bananas, sugarcane, Milk
Also important production of (based on production value)	Meat, sunflower and fruits	Meat, oranges and coffee	Meat, coffee and fruits	Rubber, meat and coconuts	Meat and groundnuts	Meat, beans and rice
Share of the world production and rank position						
Dry beans	1.5%/10th	13.8%/2nd		1.3%/12nd		3.2%/7th
Maize	2.7%/5th	6.6%/3rd		2.2%/6th	0.2%	0.6%18th
Palm oil		0.6%/10th	0.5%	45.3%/1st		
Rice paddy		1.6%/9th		9.5%/3rd	0.3%	0.7%
Soybeans	19.9%/3rd	25.9%/2nd		12nd		
Sugarcane	1.5%/10th	41.9%/1st	0.2%/12nd	1.4%		
Wheat	2.3%/13rd	0.9%/20th				

Source: FAO (2012)

Among the six countries considered, Brazil has the larger potential for agriculture: is the larger country, has more than 30% of its total area available for agriculture and livestock, and a small share (7%) already occupied. The potential for agriculture is also large in Brazil due to the average annual precipitation. Costa Rica is in the opposite site, with the smallest area and a large fraction of its territory occupied with forests; on the other hand, water availability doesn't seem to be a constrain.

Taking into account land availability, Argentina also has large potential for agriculture (a large agricultural area and a small share (~10%) already occupied with crops). In contrast, the average annual precipitation is low and the potential for irrigation is limited.

Indonesia doesn't have a large agricultural area, and a reasonable amount of the land available is already occupied with crops. The country also has a large share of its territory covered with forests.

Table 6: Data about land use and conditions for agriculture in the six countries considered in case studies

Parameter/Indicator	Argentina	Brazil	Costa Rica	Indonesia	Mali	Tanzania
Country area (1,000 ha)	278,040	851,488	5,110	190,457	124,019	94,730
Agricultural area[1] (%)	50.5	31.1	35.2	28.1	33.1	37.5
Arable land[1] (%)	11.1	7.2	3.9	12.4	5.1	10.6
Forest area[1] (%)	10.7	61.3	50.5	49.9	10.1	35.7
Irrigation potential[2] (%)	4.4	11.2	23.9	20.3	1.4	6.0
Precipitation (mm/year)	591	1,782	2,926	2,702	282	1,071
Dependency ratio[3] (%)	66.1	34.2	0.0	0.0	40.0	12.8

Source: FAO (2012)

Notes: [1] Regarding the total country area; [2] Regarding the agricultural area; based on the area of land which is potentially irrigable and that is calculated by different criteria; [3] Ratio between the external renewable water resource and the total renewable water resource;

Mali has significant constrains related to water availability, despite a considerable land extension. Conversely, land suitability for agriculture in Tanzania is lower, but water availability is less critical than in Mali. Thus, none of these countries have high potential for large-scale agriculture.

The information presented in Table 7 aims at indicating the potential for the production of forest products; the data are regarding wood production in 2011 (round wood and sawn wood) and the share of net imports vis-à-vis the total production. Among the six countries considered, Brazil is the one with the largest production and has been among the top five producers worldwide.

Table 7: Production of forest products in the six countries considered in case studies – data for 2011

Parameter/Indicator	Argentina	Brazil	Costa Rica	Indonesia	Mali	Tanzania
Industrial round wood production (Mm^3)	9.84	128,4	1.33	54.1	0.42	2.31
Round wood – net imports regarding production (%)	-0.5	0.0	-14.6	0.0	-0.2	-0.4
Industrial sawn wood production (Mm^3)	2.15	25.1	0.54	4.17	0.01	0.02
Sawn wood – net imports regarding production (%)	-8.5	-4.9	4.4	-13.9		

Source: FAO (2012)

Considering land availability, the large forested area, the know-how regarding planted forests and the tradition on wood production, Brazil is the country with the highest potential for supplying raw wood and bio-products. The drawbacks for Brazil are the illegal deforestation (mainly in the North region)[12], the lack of adequate infra structure and the relatively small investments on planted forests.

In the opposite side, Mali and Tanzania have the smallest potential among the six countries due to the low land availability and the lack of tradition on the production of forest products. The lack of infra structure is also a big constrain.

The production of forest products in Indonesia is also important in relative terms (among the top-ten producers) but the drawbacks regarding environmental sustainability for being a large supplier seems to be even larger than for Brazil.

Finally, Argentina has possibilities of being a supplier of wood products (in short-term) and bio-products (in medium term) due to land availability, existence of infra structure and certain tradition on the forest activity.

4.2 Additional information from country studies

Additional information from the country studies[13] and the main conclusions of this section are presented below.

Argentina

Data presented in the previous sub-section show that Argentina has tradition and also adequate conditions for enlarging the production of agricultural goods. The country is worldwide the third largest producer of biodiesel (from soy) and is the main exporter. The country has infra structure for enlarge its production and the exports, and public policies are targeted on supporting such actions. The country is one of the main producers of agricultural commodities. A large share of the biodiesel production could be certified for reaching the European market. Argentina tends to keep its position as one of the main exporters of biodiesel in the years to come.

Some of the main topics addressed in the Argentina's case study are presented below:

- Argentina's agricultural production is leaded by wheat, sorghum, maize, sunflower and soy;
- Soy production has been steadily growing over the last few years thanks to high international prices and a state of the art technology over the core sector in Argentina;
- The evolution of the agricultural system with soybean production is characterized by a continuous technological improvement;
- Argentina exports more than 80 million tonnes of the main commodities mentioned earlier and this accounts more than 40% of the primary goods exported;
- Regarding the leading agricultural products, Argentina doesn't import them;
- Over the last five years soy biodiesel has gained importance in Argentina's agro production; The installed capacity reached 3 million tonnes per year in 2011;
- The forest area has decreased since 1990 basically because of the frontier expansion due to the advance of agriculture;
- Planted forests are mainly based on pines and eucalyptus, with smaller areas with other species;

[12] Wood production from illegal deforested tropical forests certainly won't be considered sustainable.

[13] The reports of the six country studies are available at www.globalbiopact.eu

- The imports of forest products are larger than exports, and the county faces a trade deficit.

Brazil

Similarly, data presented in the previous sub-section show that Brazil is one the largest producers and has potential for enlarging the production of agricultural and forest goods. Brazil is worldwide the second largest producer of fuel ethanol (from sugarcane) and the fourth largest producer of biodiesel (mainly from soy). The country had been the main exporter of ethanol but has faced difficulties and its production even declined in 2011; as consequence, Brazil has lost room in the international market. Biodiesel has been produced only for the domestic market. In some years Brazil can overcome the current drawbacks and enlarge its production of ethanol that is, potentially, the cheapest in the world. A large share of the ethanol production could be certified for reaching the European market. Concerned to forest products and (potentially) to bio-products, Brazil has adequate conditions for being a supplier of raw material and even a producer of more elaborate products, but the forest industry is in some sense not well organised.

Some issues presented in the Brazilian case study are transcript below:

- In 2008, the main crops were soybeans (with a total area of 23.3 Mha and total weight of 68.5 Mt), maize (totalizing 12.9 Mha, resulting in 56.1 Mt) and sugarcane (9.2 Mha, with a total production of 730 Mt).
- The production of soybeans in Brazil has been blamed for deforestation.
- The top agricultural products imported are wheat and maize, followed by malt. Brazil is the top importer of wheat in the world.
- In case of dedicated forests of eucalyptus, it is believed that Brazil has worldwide the best technology for implementing them.
- Brazilian forests are among the richest in the world. However, only a limited percentage of forest land is being exploited, in part because of a lack of adequate transportation.

Indonesia

Indonesia has a relative large area suitable for agriculture and a large area occupied with forests. The country has reasonable to large potential of being an exporter of biofuels (mainly biodiesel), but so far the bulk of the production of palm oil is as raw and refined vegetable oil. An important issue to be addressed in Indonesia is the sustainability of its production as deforestation has been blamed for severe impacts on biodiversity and on ecosystem services.

Some issues presented in Indonesia's case study are transcript below:

- Agricultural land accounts for around 27% of Indonesia's land area (about 50 Mha), being the largest proportion of land (18.5 million ha) occupied with palm oil plantations (that also is the biggest and fastest expanding land user).

- The agricultural sector makes a significant contribution to Indonesia's GDP (14.5% in 2008). Agriculture is the largest sector of the economy in terms of employment (41% in 2009).

- Food crops make the most significant contribution to GDP within the agricultural sector (7.5% share of overall GDP). Crops that include oil palm, cocoa and rubber, constituted 2.1% share of overall GDP.

- Palm oil and derived products contributed 6% of export earnings in the period 2003 to 2007, with crude palm oil as the leading commodity export.

- The principal end use of CPO (crude palm oil) is in the production of cooking oil, with significant quantities also used in the production of margarine. The use of CPO for the production of biodiesel is a relatively new development in Indonesia.
- Two thirds of Indonesia's land area is designated as "forest zone", although it is estimated that up to 30% of this land has no forest cover.
- 55 Mha is designated as protection and conservation forest, but with a varying degree of protection. Indonesia is experiencing a net loss of forest cover, and degradation of its remaining forests.
- Forestry contributes directly to Indonesia's GDP through the production of tropical hardwood logs. It also contributes indirectly, through processed forest products. Forest harvesting only contributes with 0.8% of the overall GDP.
- The forestry sector has shown negative growth rates in recent years, a trend attributed to forest fires, income losses from illegal logging and a slowdown in the rate of production of wood products.
- The majority of Indonesia's wood production is used by the domestic wood processing industries.
- Estimates suggest that up to 2/3 of Indonesia's forest sector production is based on non-legal sources.
- The forestry sector has seen important structural changes in recent decades, largely as a result of government policies. The pulp sub-sector accounts for half of Indonesia's log consumption.
- Access to the land is regulated by customary law and few local farmers have titles to land.

Costa Rica

Based on data previously presented it can be concluded that the potential for large-scale biofuels/bioproducts production in Costa Rica is constrained. The country has small area available for agriculture. In proportion, the area covered with forests is large but the production of wood products is small. The country has large dependence on imported energy sources and, due to some experience with sugarcane production, it could be possible to produce ethanol for partially displace gasoline consumption.

Some issues presented in Costa Rica's case study are transcript below:

- In Costa Rica climate conditions are favorable to high yielding biomass feedstock (such as sugarcane and African palm). However, geographical characteristics (central volcanic mountain range, coastal areas, etc.) and active forest and biodiversity conservation policies make it impossible to think of large-scale production schemes of biofuels.
- Costa Rica has actively developed its agro-export sector, with quite high value-added products. Coffee, bananas, pineapple, sugar, lumber, wood products and beef are still important exports. Diversification efforts have led to develop economic activities of suppliers to processing industries (e.g., concentrates, juice, vegetable oils);
- Main agricultural land uses include (in decreasing order): coffee (99 thousand hectares in 2009), rice (63), palm oil (55), sugarcane (53), bananas (43), pineapples (39), cassava (30, starting to rise in 1989)), oranges (25, starting in 1984 and rising in 2004), beans (16), and maize (11);
- Therefore the land where sugarcane is cropped cannot increase much unless entering in competition with other land uses. Ethanol fuel can be produced out of locally grown sugarcane in two plants in the country, but has not started yet on an

important and regular basis, because relative prices of sugar and ethanol do not provide adequate incentives;

- The importance of the forestry sector in Costa Rica is not completely evidenced by macroeconomic data;
- Registered forest plantations represent slightly more than 100,000 hectares, belonging to the administration, NGOs or private business;
- Wood deficit is increasing, especially for products such as sawn wood, carpentry, wood fibre boards, furniture and plywood.

Mali

The country has many constrains for being an exporter of bioenergy and bio-products. Land availability, water availability and lack of adequate infra structure are the main constrains. The country in land locked and the risks and costs for displacing the production up to harbours are additional constrains. In Mali it seems more adequate the production of biofuels for matching local or regional markets.

Some issues presented in Mali's case study are transcript below:

- The country is characterized by an inter-tropical climate that can be divided in three main climatic zones: arid Saharan in the North, semi-arid Sahelian in the central belt and cultivated Sudanese in the South;
- Mali's total arable land is 5% of the total area, and 10% is covered by forests. The remaining 85% is desert and semi-desert land, primarily in the north;
- More than 80% of the country's workforce is involved in the primary sector. This consists mostly of farming (mainly subsistence) and livestock (respectively 20.6% and 8.1% of GDP); The major part of the population still remain rural (75% of total);
- Agricultural development has been focused on rice and cotton. Cotton is the main cash crop and is the country second export (behind gold);
- Cereals are the main food crops in Mali;
- The wood produced does not meet the demand for construction and furniture making causing a significant amount of imported wood;
- Although forests have been protected due to its sacred status in certain regions of the country, its progressive conversion to agricultural land coupled with overexploitation for wood fuels have been the major contributors to forest decline and desertification.

Tanzania

The constraints are less severe than in Mali, but the main conclusion is the same, i.e., it seems more adequate the production of biofuels for matching local or regional markets than for exporting. Anyhow, in some regions the production aiming at the international market would be possible, despite the fact drawbacks related to land tenure and infra structure should be properly addressed.

Some of the main issues presented in Tanzania's case study are transcript below:

- Nearly half of Tanzania's land area is considered suitable for biofuel production. Less than 6% of this land has been utilized;
- The area of the land suitable for biofuel production in Tanzania is estimated to be between 30 million and 55 million ha. To date, approximately four million ha have been requested from the government for biofuels investment. About 640,000 ha in

total, have been allocated for biofuel investments and around 100,000 ha have been fully secured by biofuel investors following the procedures for land acquisition;

- About 75% of the land area is either uninhabited or too difficult to manage due to existence of national parks and forest reserves, unreliable rainfall, etc.;
- It is considered that biofuels have recently been a fast growing industry in Tanzania. Local and multilateral companies have been acquiring big portions of land for biofuel feedstock production;
- Smallholder farmers have developed interest in taking advantage of this opportunity;
- Agriculture in Tanzania is dominated by smallholder farmers cultivating an average farm sizes of between 0.9 ha and 3.0 ha each. Only 10% of Tanzania's crop area is cultivated by tractor. 80% of the working population is engaged in agriculture;
- Jatropha has been considered one of the main crops for producing biofuels in Tanzania and has been promoted throughout Tanzania for small and large scale biofuel production;
- Agriculture is the major economic sector in Tanzania. It accounts for about half of the national income and three quarters of merchandise exports;
- The bulk of the country's export crops are coffee, cotton, cashew nut, tobacco, sisal, tea, horticultural crops, oil seeds, spices and flowers;
- Both crops and livestock are adversely affected by periodical droughts;
- Tanzania has about 33.5 million ha of forests and woodlands. Out of this total area, almost two thirds consists of woodlands on public lands which lack proper management;
- It is estimated that the contribution of the forest sector to the GDP is between 2.3% and 10% of the country's registered exports. This contribution is underestimated.

5 Impacts of certification schemes on biofuels/bioproducts trade

5.1 Biofuels

Regarding biofuels, both in the US and the EU sustainability criteria have been imposed. In theory these initiatives aim at assure that the production of biofuels would occur according to certain principles, reducing the negative impacts to the environment and to the society.

Sustainability has been recognized as an essential aspect for the consolidation of biofuels in the international markets. The discussion about sustainability has become even more important as long as biofuels production have grown and, in particular, gained momentum with the food crisis in 2007-2008.

So far, the main driving forces come from specific actions at the EU and in US. In the US (due to the initiatives in California – California Air Resources Board – CARB, in the context of the Low Carbon Fuel Standard – and at the Federal level – EPA, under the revised Renewable Fuel Standard Program) the focus has been only on avoided GHG emissions regarding fossil fuels, while the EU Renewable Energy Directive (RED) also addresses potential impacts on biodiversity, on water resources and on food supply, besides the respect of human, labour and land use rights. These two sustainability initiatives, and mainly the initiative in Europe, have motivated the proposition and the creation of certification schemes, as the accomplishment of sustainability principles and criteria shall be certified by independent auditors.

In this sense, some of the certification schemes have been proposed exactly aiming at fulfilling EU-RED criteria, such is the case of the ISCC scheme – International Sustainability and Carbon Certification –, existing since 2010. Conversely, other certification schemes were defined in a wider and more stringent way, such is the case of RSB – Roundtable on Sustainable Biofuels; in this case it seems that the focus has been on fulfilling the expectations of the consumer market that is more conscious about sustainability of biofuels (Scarlat and Dallemand, 2011).

There are also certification schemes developed by producers and the by main consumers of agricultural commodities, as it is the case of the Roundtable on Sustainable Palm Oil – RSPO (established in 2004) – and the Bonsucro (former Better Sugarcane Initiative, which standard was published in 2010), regarding sugarcane products (Scarlat and Dallemand, 2011).

In addition, other certification schemes have been developed and these could (potentially) have much more impact on the international trade due to the tradition or the organizations that are promoting these initiatives. These are the cases of the ongoing initiatives by CEN (European Committee for Standardisation) and ISO (International Organisation for Standardization). The CEN/TC 383 Committee for Sustainable Produced Biomass for Energy Applications was established in 2008 and aims specifically on standards that assist the economic operators in implementing the EU-RED. The public inquiry stage was predicted to finish mid-2011 and in this case the standard could be published in 2012 (CEN, 2011). The focus has been on liquid biofuels as EU has decided that in short-term won't prioritize the certification of solid biomass, such as pellets.

The ISO initiative aims at creating a global standard able to deal with the sustainability of all bioenergy sources and uses (ISO 13065 – Sustainability Criteria for Bioenergy). The standard was proposed in 2009 by the German and the Brazilian normatization bodies and currently 30 countries are participant members. The target is the release of the standard in April 2014.

The existing/proposed certification schemes include different aspects (environmental, economic and social) depending on their main goals. Table 8 summarizes information about certification schemes and the EU-RED sustainability initiative.

Table 8: Synthesis of some sustainability initiatives and certification schemes

Scheme/Initiative	EU-RED	RSB	ISCC	Bonsucro	RSPO
Aim	Sustainability initiative that requires certification	Certification scheme that mainly targets the consumer market	Certification scheme with focus on the EU-RED	Certification scheme for sugarcane products	Certification scheme for palm oil products
Product	Biofuels	Bioenergy	Biofuels	Sugarcane products	Palm oil products
# of principles and criteria		12 / 37	6 / 45	5 / 20[a]	8 / 38
GHG	Yes	Yes	Yes	Yes	Yes
Thresholds on GHG	35%-60%	50%	35% (currently)	No	No
LUC – direct effects	Yes	Yes	Yes	Yes	Yes
LUC – indirect effects	Possibly	Possibly – importance recognized	Possibly	No	No
Biodiversity – restrictions applied to HCV	Yes	Yes	Yes	Yes	Yes
Addressing GMO	No	Yes	No	Yes	Yes
Addressing food security	Issue to be reported	Yes, as a principle	Yes, as a principle	No	Issue mentioned
Scope of economic aspects considered	Not considered	Includes impacts over the community	Only energy efficiency	Only focused on the operator viewpoint	Includes impacts over the community
Scope of social aspects considered	No specific criteria but to be considered	Detailed criteria	Moderated detailed	Less detailed	Less detailed
How labour conditions are addressed	No specific criteria but to be considered	Addressed in details	Addressed in details	Addressed in details	Addressed, but with less details

Source: based on (Scarlat and Dallemand, 2011)

Notes: EU-RED – European Union – Renewable Energy Directive; RSB – Roundtable on Sustainable Biofuels; ISCC - International Sustainability and Carbon Certification.
HCV – high conservation values;
[a] plus two criteria in the additional section “Additional mandatory requirements under EU-RED” and six criteria in the section “Chain of custody requirements”

5.2 Bioproducts

The text below is based on European Commission (2009) and reflects the main concerns regarding sustainability assessment of bio-products. Essentially, recommendations for actions and for defining sustainability schemes are presented. The main recommendation of the report are:

- The sustainability assessment should be based on all three pillars of sustainability: environmental, social and economic. While we need (to develop) tools to assess sustainability of products, we need to ensure the tools used will stimulate and not limit the development and implementation of bio-based products.

- The scope of an assessment methodology should be all products including bio-based products.
- For bio-based products it is important to take into account the fact that this is an emerging sector using yet maturing technologies that will develop and improve. Comparing bio-based products and non- bio-based alternatives should ensure a level playing field for all products in the market place.
- Life Cycle Assessments (LCA) should be clear, objective, science-based and easy to handle and implement. Key factors to be taken into account (or not) in an LCA should be defined. The product life cycle can be divided into clearly defined stages (e.g. cradle to gate, gate to grave, and gate to cradle) to improve the comparability of products.
- The gathering of LCA data represents an important cost to industry which could be prohibitive for innovative products and/or SMEs. It can also be impossible to provide data for an emerging market. A research effort should be made to cover these gaps and make sensible analysis possible.
- Sustainability criteria for biofuels have been developed and included in the Renewable Energy Directive. For bio-based products it has to be verified whether these criteria are also applicable. To ensure coherence between biofuels and other bio-based products, two aspects should be considered for cross-sector harmonization: (i) the methodology to calculate GHG emissions, and (ii) the criteria for sustainable biomass production.

The currently existing European Eco-label covers bio-based products in various product groups (e.g. lubricants, detergents, plastics). The label sets environmental requirements for products on the basis of the net environmental balance between the environmental benefits and burdens, including health and safety aspects, at the various life stages of the product. Two important issues are (i) to stimulate the use of the European Eco-label for products made from renewable raw material, and (ii) to inform consumers about the meaning of the label.

The standards will help to verify claims about bio-based products in the future (e.g. biodegradability, bio-based content, renewable carbon, recyclability, and sustainability).

5.3 Impacts on trade

Initiatives aiming at sustainability requirements can impose barriers for the production in new producer countries due to the limited human skills, lack of appropriate data, less competitiveness of small scale production and to the extra costs. Obviously, developing countries would face more difficulties to fulfil required criteria. A consequence would be a higher risk perception of investors, constraining investments in these countries.

On the other hand, it's clear that currently the public perception in developed countries is such that biofuels would be an acceptable option just if the main concerns about the sustainability of their production are well addressed. And there is no reason to suppose that this behaviour will change considerably in short- to mid-term.

For developing countries, with no tradition on large-scale production of biofuels, with lack of accurate data and with weaker institutions and poor governance, the compliance of sustainability criteria won't be an easy task. First, capacity building is an issue to be addressed in short-term. Second, planning and coordinated actions are required, as the production of biofuels aiming at exports will require, besides the accomplishment of sustainability criteria, fulfilment of technical standards and reliable supply. For instance, a good result regarding avoided GHG emissions requires high yields (and, in this sense, site-specific development of species are necessary), coordinated actions, good logistics, etc.

In this sense, it seems that the only way for moving forward in concrete basis is with a strong participation of developing countries along the whole process. This should give them the opportunity to understand the reasons of such initiatives, for evaluating what is possible to do in short-term and also give them the opportunity of defining priorities by themselves.

It is not possible to foster a larger consumption of biofuels without a real international trade and, in addition, large-scale production will require a strong participation of developing countries. Moreover, it is fundamental to understand that sustainability is all about continuous improvement. The sustainability of biofuels shall be induced along the years and principles and criteria should be defined not aiming at an ultimate short-term standard, but rather rational and feasible mid to large-term solutions.

6 Concluding remarks

Trade of ethanol, biodiesel and wood pellets is growing, but the volumes traded are still low. The international bioenergy trade is both supply and demand driven, despite the fact that the demand has been induced by national policies, as mandates. Up to now, import duties have largely influenced trade volumes, and tariff preferences are the main driver of trade routes.

Up recently (end of 2011), the international trade of liquid biofuels was strongly influenced by regimes imposed by US and EU. In early 2012, in US, there was an important change on trade regimes for biofuels but, the information available so far is not enough for an analysis of the ongoing impacts.

In the case of pellets, the main consumer market has been EU and the main exporters have been US and Canada. In comparison to liquid biofuels, trade regimes have been much less restricted for pellets.

Conversely, the production of other bio-products (e.g. chemical and materials) has been small. One of the most important appeals for such products is their potential benefits to the environment and to the society and, consequently, sustainable production will be an essential condition for reaching the most important markets.

According to one the studies quoted in this report, in 2020 almost 50% of the biofuels demand would be in EU and North America (mostly US) and almost 30% in Latin America (mostly Brazil). The balance of the demand would be in China and other Asian countries. In this sense, biofuels trade will become increasingly important and can help trigger investments and mobilise biomass potentials in certain regions.

As long as the technologies of second generation biofuels develop, the production of liquid biofuels would be more concentrate in countries that dominate such technologies and/or the consumption is higher. Raw biomass could be supplied by the regions with higher potential for the production and, in principle, certain biofuel trade routes could only exist for a limited period.

A very recent proposal at the European Union can completely change the current picture. In September 2012 it was announced that EU can impose a limit on the use of crop-based biofuels and also an end (after 2020) to the subsidies applied to them. Under the proposal, the use of first-generation biofuels would be limited to 5% of total energy consumption in the EU transport sector in 2020, while crop-based fuel consumption currently accounts for about 4.5% of total EU transport fuel demand.

While most markets of non-industrial pellets are largely self-sufficient, markets of industrial pellets depend on the import from outside the EU. Industrial pellet markets are relatively mature, compared to non-industrial ones, because of their advanced storage facilities and long-term price-setting, but depend on the establishment of public support schemes.

The market for pellets is growing rapidly mainly in Europe and in a smaller extent in North America and in Asia. The European market will require a significant share of imports, mainly of industrial pellets; so far the main suppliers are Canada and US, but there are good opportunities for new players.

Regarding sustainability requirements, a decision by EC is that specific criteria are not necessary for solid biomass (EC, 2010), but the main consumers have decided to adopt their own criteria. As sustainability requirements have been demanded by the main consumers, the tendency in short-term is the harmonization of certification schemes.

There is a growing interest regarding bio-products despite the fact the market is more characterised by niches. The main appeal is the sustainability of such products and certainly certification will be required in short-term. The first initiatives regarding certification are based on the existing schemes for biofuels. A clear tendency seems to be the production of advanced bio-products (and also advanced biofuels) in the developed countries, in the so-called hub-harbours, using feedstock imported from developing countries.

Considering the six countries specifically addressed in the Global Bio-Pact project, those with large potential for the production of biofuels (and in some sense also with potential for bio-products production) are Argentina and Brazil. This statement is due to land availability, the existing infra-structure, the tradition on the production of agricultural goods, and the production stage regarding sustainability. Indonesia has also reasonable potential, but at this moment sustainability has been a constraint for a reasonable share of the production (e.g., of palm oil). Costa Rica and Tanzania have constrains due to small land availability and the lack of infra-structure, respectively. And, finally, Mali, is the country with lower possibilities of becoming an exporter of biofuels/bio-products.

Considering the time horizon of 8-10 years, sustainability requirements and certification schemes won’t be a severe barrier for exporting biofuels/bio-products, at least for the countries with potential of producing reasonable volumes in such period. This is the case of Argentina and Brazil, but Indonesia can face difficulties. A country like Tanzania has a limited potential of being an exporter of biofuels/biomass and it’ll be a challenge starting the production fulfilling the requirements imposed by Europe and in US.

References

Accenture (2012). Round Table 2012 – From Harbor to Hub: Port integration in the Biofuel Supply. Information available at http://www.accenture-blogpodium.nl/latest-post/rt2012-harbortohub-biofuels/.

Berger. R. (2012). Bio-Based Economy in the EU vis-à-vis Malaysia's Model for Bio-Economy Development. Presentation at EU-Asia Biomass Best Practices and Business Partnering Conference 2012.

BP (2012) Statistical Review of World Energy. Avalianle at bp.com/statisticalreview. 2012.

CEN – European Committee for Standardization (2011). Information available at www.cen.eu/cen.

CSES – Centre for Strategy & Evaluation Services (2011). Final Evaluation of the Lead Market Initiative. Final Report.

European Commission (2009). Taking Bio-based from Promise to Market. Measures to promote the market introduction of innovative bio-based products.

FAO (2012) Food and Agricultural Organization of the United Nations. Data available at www.faostat.org

Goh, C., M. Cocchi, et al. (submitted 2012). "Wood pellet market and trade: A global perspective." Biofuels, Bioproducts and Biorefining.

Hennissen, B. (2011). Bio port Rotterdam – Gateway to Europe.

IEA – International Energy Agency (2010). Energy Technology Perspectives 2010. Paris.

IEA – International Energy Agency (2011). Technology Roadmap – biofuels for transport. Paris.

IEA – International Energy Agency (2012). Statistics database. Available at www.iea.org

Koop, D, Morris, C. (2011). Global sustainability criteria for wood pellets. Available at http://www.renewablesinternational.net/global-sustainability-criteria-for-wood-pellets/150/515/32395/.

Laborde, D. (2011). Assessing the Land Use Change Consequences of European Biofuel Policies. Final Report, IFPRI.

Lamers, P., C. Hamelinck, et al. (2011). "International bioenergy trade-A review of past developments in the liquid biofuel market." Renewable and Sustainable Energy Reviews **15**(6): 2655-2676.

Lamers, P., M. Junginger, et al. (2012). "Developments in international solid biofuel tradeâ€"An analysis of volumes, policies, and market factors." Renewable and Sustainable Energy Reviews **16**(5): 3176-3199.

Pirraglia, A, Gonzalez, R, Saloni, D. 2011. Wood Pellets: An Expanding Market Opportunity. Biomass Magazine. Available at http://biomassmagazine.com/articles/3853/wood-pellets-an-expanding-market-opportunity/.

REN21 (2012) Renewable Energy Policy Network for the 21st Century. Renewable 2012 – Global Status Report.

Ryckmans, Y. (2011). Initiative Wood Pellets Buyers Sustainability criteria for solid biomass in large scale power plants. Presentation at the IWPB Meeting, Rotterdam.

Scarlat, N, Dallemand, JF. (2011). Recent developments of biofuels/bioenergy sustainability certification: A global overview. Energy Policy, 39, 1630–1646.

Sikkema, R, Steiner, M, Junginger, M, Hiegl, W, Hansen, MT, Faaij, A. (2011) The European wood pellet markets: current status and prospects for 2020. Biofuels, Bioproducts & Biorefining. 250–278.

van der Pol, H. (2011). Bioplastics - Market Pull for Bio-based Chemicals in Europe. European BioPlastics.

Vijayendran. B. (2010). Biobased Chemicals: Technology, Economics and Markets.
Biobased Chem Asia. April.